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### Title

Governing international freshwater resources: an analysis of treaty design

### Permalink

<https://escholarship.org/uc/item/20c8c87s>

### Journal

International Environmental Agreements: Politics, Law and Economics, 16(2)

### ISSN

1567-9764

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### Publication Date

2016-04-01

### DOI

10.1007/s10784-014-9259-0

Peer reviewed

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**International Environmental  
Agreements: Politics, Law and  
Economics**

ISSN 1567-9764

Int Environ Agreements  
DOI 10.1007/s10784-014-9259-0



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# Governing international freshwater resources: an analysis of treaty design

Neda A. Zawahri · Ariel Dinar · Getachew Nigatu

Accepted: 7 July 2014

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**Abstract** International rivers create complex relationships between their riparian states, which can contribute to economic, political, and social losses. Treaties provide a means for states to coordinate their actions in managing international river disputes to minimize these losses. However, there is little knowledge about treaty content and the factors influencing treaty design. We test whether a relationship exists between the challenges of negotiating, complying, and distributing the gains in bilateral, multilateral, and basin-wide negotiation contexts and the depth of cooperation along with the degree of institutionalization. While the great challenges confronting multilateral or basin-wide negotiations can produce treaties that focus on joint gains and shallow cooperation to secure the signature of riparians, we find that they can also provide opportunities for deeper, more behavior-altering, cooperation. To manage the difficulties of maintaining multilateral cooperation, we find a higher degree of institutionalization. We also find that bilateral negotiations provide states with opportunities for deeper cooperation, but a lower degree of institutionalization.

**Keywords** International rivers · Treaty design · Negotiation context · Bilateral treaties · Multilateral and basin-wide treaties

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The views expressed are those of the authors and do not necessarily reflect the views of the Economic Research Service or the U.S. Department of Agriculture.

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## 1 Introduction

Climate change, population growth, and industrialization are challenging the ability of many states to meet their freshwater needs. As states look to their international rivers<sup>1</sup> to meet ever-increasing demands for freshwater, the potential for regional conflict or tension is likely to increase. In fact, the United Nations has issued warnings about the increasing potential for conflict over scarce freshwater (United Nations 2006). Due to these warnings, experts are analyzing attempts at cooperation through treaty<sup>2</sup> formation to govern international rivers (Song and Whittington 2004; Tir and Ackerman 2009). Although treaties do not guarantee a future of stable cooperation, they nevertheless provide states with structured means to organize and manage disputes (Barrett 1994; Jacobson and Weiss 1998; Wangler et al. 2013). Treaties have the potential to minimize disputes by allowing states to coordinate their actions in managing water quality and quantity issues or guiding states in the economic development of the river. In fact, empirical analysis revealed that riparians<sup>3</sup> with treaties are more likely to manage their water crises through negotiations than riparians without these contracts (Hensel et al. 2006).

Some understanding exists about the factors contributing to the formation of treaties to govern international rivers (Tir and Ackerman 2009; Zawahri and Mitchell 2011), but there is less knowledge about the design of treaties (Conca et al. 2006). Consequently, there is little knowledge as to why some riparians manage water quality or quantity issues in treaties that include all the riparians of a river (basin-wide treaties), while other riparians rely on bilateral (two states) or multilateral (three or more states) treaties to govern multilateral rivers.<sup>4</sup> In designing treaties, riparians tend to also include institutions<sup>5</sup> to implement treaty commitments and maintain future cooperation by identifying and punishing free-riders (Barrett 1994; Conca et al. 2006). These institutions can have varying capacity, such as conflict resolution mechanisms, monitoring capability, and information exchange. We are uncertain whether the amount of institutional capabilities contained in a treaty, or the degree of institutionalization, is higher for basin-wide, multilateral, or bilateral treaties governing international rivers, such as the Ganges, Colorado, and Mekong. Thus, there is little knowledge about the factors influencing investment in treaty design. It is essential to gain this understanding because divided governance of an international river through the use of several bilateral or multilateral treaties contradicts the integrated development approach that is recommended by experts for the river's sustainable development. That is, to sustainably develop an international river, it is generally advised by experts to include all states sharing the resource in a basin-wide treaty (Barrett 1994). Moreover, divided governance may contribute to tension or conflict as states struggle to comply with several bilateral or multilateral treaties governing a single river.

Treaties governing international rivers can cover various issue areas. They can allocate the river's waters, regulate environmental issues, commit to economic development, and establish an institution to implement the treaty and manage the river system. Some of these issue areas require strong behavior-altering commitments from riparians (water allocation

<sup>1</sup> An international river is a river shared between two or more states.

<sup>2</sup> A treaty is a formal agreement or contract between states.

<sup>3</sup> Riparians are states that share an international river.

<sup>4</sup> A basin-wide treaty is a treaty reached by all riparians sharing an international river, while a multilateral treaty does not include all riparians.

<sup>5</sup> Institutions are "persistent and connected sets of rules (formal and informal) that prescribe behavioral rules, constrain activity, and shape expectations" Keohane (1989:3).

or environmental quality), while other issues (economic development) may require less commitment or simply confirm the status quo (Barrett 1994). We propose that the challenges of negotiating, distributing the gains, and enforcing commitments in bilateral, multilateral, or basin-wide setting—or the negotiation context—is likely to influence treaty design. More specifically, the negotiation context is likely to influence the depth of cooperation—or the extent to which a treaty contains commitments that require states to depart from what they would have done in the treaty's absence (Downs et al. 1996:383; also see Barrett 1994). The negotiation context can also influence the degree of institutionalization, or it can impact how much states will invest in designing treaties that include institutional features like monitoring, conflict resolution, or river basin organizations. The degree of institutionalization can be high with great investment in institutional design or low with little investment in design (Tir and Stinnett 2011).

In the bilateral negotiation context, for instance, the two negotiating states can focus on individual needs and improve the prospect of dealing with incentives to cheat, which often plagues attempts at cooperation. This context is more likely to contribute to treaties designed to collaborate over issues that require “deeper,” more behavior-altering cooperation, such as managing environmental issues and allocating the river's water (Zartman 1994; Barrett 1994; Koremenos et al. 2001). The bilateral context is easier than the multilateral and basin-wide contexts at identifying cheating because of the small number of states attempting to cooperate (Finus 2008). It is also easier to enforce compliance between two states because of the improved ability to directly target and punish defection from cooperation (Barrett 1994). Consequently, the bilateral context is likely to contribute to treaties with a lower degree of institutionalization, or result in less investment in institutional design.

Because of the need to accommodate three or more states with varying interests in cooperation and the improved ability to manage distributional problems, multilateral and basin-wide negotiations are more likely to lead to accords that focus on joint gains than the bilateral negotiation context (Zartman 1994). The issue area most likely to focus on joint gains is economic development, which can secure the interests of states by promising future gains. Given the various interests within multilateral and basin-wide negotiation contexts, they are likely to produce “shallow” accords, with minimal behavior-altering cooperation (Sebenius 1983; Barrett 1994; Downs et al. 1996). In other words, “adding a particular state to an agreement necessitates reducing the level of cooperation of the other members” (Gilligan 2004:459). The Aral Sea multilateral accord was reached in the hope of contributing to economic development (Weinthal 2002). Due to the larger number of states participating in this context, it becomes difficult to identify and punish defections from multilateral and basin-wide treaties, which increases the potential gains from free-riding (Barrett 1994; Finus 2008). Therefore, multilateral negotiations are more likely to have a higher degree of institutionalization, or greater institutional features included in a treaty than the bilateral context (Martin 1992; Drezner 2000).

To test these expectations, we use an updated database of treaties from 1945 until 2007. Given our interest in testing whether the negotiation context alters the expected behavior of states in designing treaties, the database contains only international rivers with a treaty and excludes rivers that are not governed by a treaty.<sup>6</sup> There are 261 international rivers in the world, 226 of which are bilateral and the rest are multilateral (Wolf et al. 1999; Dinar et al. 2007). Of the 226 bilateral rivers, 149 are governed by a treaty (Dinar et al. 2007). Almost

<sup>6</sup> Conca et al. (2006) analyze treaty design features using only existing treaties.

all of the multilateral rivers are governed by some form of treaty—whether bilateral, multilateral, or basin-wide.

We consider bilateral treaties covering bilateral basins (BTBB), bilateral treaties covering multilateral basins (BTMB), multilateral treaties covering multilateral basins (MTMB), and basin-wide treaties covering multilateral basins (BWTMB).<sup>7</sup> We differentiate between BTBB and BTMB because they may represent different opportunities for negotiations. Although we test the expectation that the bilateral negotiation contexts can be similar in bilateral and multilateral rivers, we are cognizant of findings in the behavioral and economics literature on coalition formation suggest that “...coordination among players becomes an issue... when there are greater opportunities for coalition formations” (Kahan and Rapoport 1984:306; also see Finus 2008), which exists in BTMB context. In the case of sub-basin treaties, non-signatory states may have an impact on the negotiation context (Barrett 1994). Moreover, in BTMB, “State contingent agreements lose their usefulness when countries face states which are not specified in the agreement” (Just and Netanyahu 1998:12). Therefore, we separated the two formats to examine whether they may differ. We also differentiate between BWTMB and MTMB. Although BWTMBs and MTMBs are both multilateral contracts, MTMBs do not include all riparians. The Mekong Basin is managed by a MTMB but not a BWTMB because China and Burma are not part of the 1995 accord. These distinctions allow an examination of the negotiation context, divided governance, and integrated development of international rivers.

While our findings confirm that the negotiation context influences treaty content and the degree of institutionalization, we discover mixed results for the impact of the negotiation context on the depth of cooperation. Contrary to expectations that multilateral negotiations tend to produce shallow cooperation, they can also provide opportunities for deeper cooperation. We also find that the negotiation context has a different influence on the design of MTMB and BWTMB.

The following section examines the existing knowledge about the design of treaties governing international rivers, discusses the impact of the negotiation context on treaty design, and generates hypotheses about treaty content. Sections three and four present the research design and results from the empirical analysis. The paper concludes with implications from the findings.

## 2 Determinants of treaty design

Treaties governing international rivers vary widely in their design. Existing empirical studies of these design variations are either limited to analyzing individual issues or they neglect to examine the negotiation contexts' potential influence. Focusing on environmental issues and multilateral basins, Giordano (2003) finds a prevalence of bilateral but not basin-wide treaties to govern these issues. Considering treaty commitments to exchange information, Gerlak et al. (2011) discover that they are more likely in multilateral as opposed to bilateral accords. Although their work considers the negotiation context, it does not differentiate between MTMB and BWTMB. In an examination of the degree of institutionalization, Stinnett and Tir (2009) consider the extent to which treaties include monitoring, conflict resolution, commissions, and enforcement. Although one of

<sup>7</sup> In a bilateral river, the only available negotiation context is a bilateral one and of course the bilateral treaty produced is basin-wide. But in this study, a basin-wide treaty is used only in reference to multilateral rivers.

their control variables is the number of signatory states, their research design is unable to explain whether the degree of institutionalization is higher in BTBB, BTMB, MTMB, or BWTMB. Examining the diffusion of norms from the 1997 Convention on the Law of the Non-navigational Uses of International Watercourses (henceforth Watercourse Convention) through an analysis of treaty content, Conca et al. (2006) discover an increase in the number of treaties covering environmental issues, information exchange, and consultation. While their study finds no significant difference in norm diffusion in multilateral or bilateral basins, they do find a prevalence of fragmented governance of multilateral basins (Ibid). Thus, we remain uncertain as to whether the challenges or opportunities of bilateral, multilateral, and basin-wide negotiations influence treaty design.

We argue that the negotiation context, or the format that presided over the creation of the regime (Thompson and Verdier 2010:1), influences treaty design, more specifically it impacts the depth of cooperation and degree of institutionalizations of BTBB, BTMB, MTMB, and BWTMB. To demonstrate this argument, we draw on theories of international relations about the prospects for international cooperation. We also consider the literature on theoretical politics and economics that focuses on the stability of cooperative agreements in light of the mechanisms and incentives in the treaty that seek to address issues such as climate change, ozone layer depletion, and forest exploitation.

The problems confronting states attempting to collaborate can be divided into two phases—bargaining and enforcement (Fearon 1998). Due to the collective action problem confronting states as they attempt to cooperate, the number of negotiating states is likely to complicate both phases (Olson 1965; Oye 1985; Barrett 1994). During the bargaining phase, states must distribute the gains and losses from collaboration.

The total number of states that can theoretically participate in the negotiations refers to the actors that are potentially relevant to the joint welfare because their actions affect others or others' actions affect them (Koremenos et al. 2001:777). Along international rivers, the total number of riparians sharing a river that can potentially participate in the negotiations is an exogenous geographic feature (Snidal 1994). For example, the total number of states that can negotiate over the Tigris and Indus rivers is four.

We argue that riparians' decision to proceed with bilateral, multilateral, or basin-wide negotiations is a byproduct of exogenous factors, such as international or regional politics. The decision to initiate negotiations between Israel and Jordan or Turkey and Syria over international rivers resulted from changes in regional and domestic politics. But, once negotiations begin, we propose that the negotiation context influences treaty design. That is, while the choice to proceed with the various negotiation formats is exogenous, the content and design outcomes of treaties made subsequently are a result of the opportunities and challenges of bargaining, distributing the gains, and enforcing commitments in bilateral, multilateral, and basin-wide contexts.

## 2.1 Number of negotiating states

Due to the diversity of interests among states in multilateral and basin-wide negotiations, these interactions are likely to be more protracted and complex than bilateral negotiations over bilateral and multilateral basins (Oye 1985; Zartman 1994). Multilateral negotiations are likely to be plagued by communication difficulties and complexities in attempting to accommodate each state's needs and solicit concessions (Olson 1965; Oye 1985). As the number of negotiating states increases, those with less interest in the negotiations can hold the process hostage as they attempt to increase their gains (Waterbury 2002). Prior to 2010, bilateral negotiations were more successful than multilateral and basin-wide contexts along the Nile because some—



Uganda, Egypt, Sudan, and Ethiopia—had interest in an accord, while others—Kenya, Tanzania, Burundi, and Rwanda—were less interested (Ibid). This complexity of interests and associated transaction costs can influence treaty content (Koremenos et al. 2001). The need to solicit concessions from multiple states can contribute to diluted, shallow, treaties that confirm the status quo, or demand little change in behavior, and focus on joint gains (Barrett 1994; Downs et al. 1996; Gilligan and Johns 2012). The outcome of multilateral negotiations can be the lowest-common-denominator agreements with little substantive content or it may not differ from the non-cooperative outcome (Barrett 1994; Hopmann 1996: 270).

The lower transaction costs of bilateral negotiations are expected to provide states with opportunities to focus on and achieve their interests (Hopmann 1996; Gilligan and Johns 2012). It also provides states with the ability to consider issues that require intense cooperation and design bilateral treaties that can achieve deeper cooperation (Barrett 1994; Zartman 1994; Downs et al. 1996).

## 2.2 Distribution of gains

States might agree to cooperate; that is, move from a sub-optimal outcome to a more efficient outcome along the Pareto Frontier. Once on the frontier, states must still resolve distributional conflicts (Krasner 1991), because movement along the frontier can be a zero-sum game whereby one state's gains is another state's loss. The concern of states with distributional issues is important because the very existence of a treaty requires that there are at a minimum some gains for each signatory state (Barrett 1994). Distributional conflicts vary from strong to weak, and their magnitude depends on how each actor compares its preferred alternative to other actors' preferred alternative (Koremenos et al. 2001:775). The magnitude can also depend on the size of the pie that states are attempting to share. Small pies denote strong distributional conflicts, while large pies that can meet the interests of states denote weaker conflict. To manage a strong distributional conflict, states can expand from bilateral to multilateral negotiations that enlarge the opportunity for linking issues (Sebenius 1983). A weak distributional conflict can be managed in bilateral negotiations.

## 2.3 The enforcement problem

In bilateral interactions, states can identify, monitor, and manage cheating by directly threatening to punish defection in bilateral and multilateral basins (Axelrod and Keohane 1985; Finus 2008). Bilateral agreements are better able to manage the moral hazard problem (Verdier 2008). As the number of collaborating states increases, it becomes more difficult to identify, monitor, and punish defectors, raising the potential for free-riding and the desire for rent-seeking, which could lead to the collapse of cooperation (Ibid; Finus 2008). Sustaining future cooperation with multilateral treaties is complicated by the enforcement problem (Just and Netanyahu 1998). Confronted with an issue area with strong incentives to free-ride, or cheat, states are likely to select bilateral coalitions because large coalitions—such as occurs in multilateral or basin-wide treaties—tend to confront strong incentives to free-ride (Finus 2008; Nagashima et al. 2009). Thus:

“the format of negotiations had important effects on institutional outcomes insofar as it shapes some of the variables commonly used to explain them, such as uncertainty about other actors' preferences and behavior (which is reduced in bilateral settings) and the presence of monitoring and enforcement problems (which are most pronounced in multilateral settings)” (Thompson and Verdier 2010:3).

## 2.4 Negotiation context and treaty design

To secure the signature of states with different interests, multilateral and basin-wide negotiations are likely to focus on issues that involve joint economic gains for states (Zartman 1994; Downs et al. 1996; Koremenos et al. 2001).<sup>8</sup> Should a strong distributional problem arise, then the multilateral and basin-wide contexts can resolve them through issue linkages (Snidal 1991; Sebenius 1983). The issue area most likely to meet these expectations is economic development, which can involve commitments to develop the river through construction of infrastructure—dams, barrages, and irrigation—all of which can generate gains. The multilateral Aral Sea, La Plata, and Mekong rivers all have economic development multilateral accords focusing on gains for riparians (Weinthal 2002; Gilman et al. 2008). An analysis of treaties governing international rivers revealed that multilateral agreements are more likely to involve hydropower production (Hamner and Wolf 1998).

Treaties focusing on construction of hydrological infrastructure, such as dams, can contribute to economic development through job creation, hydropower generation, flood control, and regulation of water (Sadoff and Grey 2002). Irrigation systems also contribute to economic development through food production (Ibid). Multilateral economic development treaties can also focus on navigation, fisheries, and groundwater. River navigation provides a cheap form of transportation to facilitate commerce and regional trade, such as along the Rhine (McCaffrey 2007). Joint gains can come in the form of protection of fisheries, a critical source of nutrition and protein (Sadoff and Grey 2002). As with managing international rivers, treaties governing groundwater need to include all riparians in order to avoid the tragedy of the commons (Ibid). Treaties focusing on water development enable riparians with a variety of interests, such as the Mekong and La Plata, to draw on the international community for financial assistance to help finance the river's economic development (Weinthal 2002).

**Hypothesis 1** Multilateral and basin-wide negotiation contexts are more likely to contribute to treaties that focus on economic development than the bilateral contexts.

Due to the lower transaction costs of negotiating bilateral agreements, this format enables states to negotiate over issues that require deeper cooperation, such as managing environmental issues (Zartman 1994; Waterbury 2002). An analysis of existing treaties revealed that the bilateral negotiation context is more likely to contribute to the formation of agreements governing environmental issues (Mitchell 2003).

In the case of international rivers, the bilateral negotiation context is more likely to lead to accords that manage the environment in multilateral and bilateral rivers because of this negotiation format's capacity to permit for behavior-altering cooperation and address enforcement problems (Barrett 1994; Nagashima et al. 2009; Gengenbach et al. 2010). Improving the river's environment requires changes in the behavior of many domestic actors and hence deep cooperation because of the sunk costs involved in modifying behavior. Due to the diversity of domestic actors involved in polluting rivers and the various sources of pollution, managing environmental issues entails enforcement problems to ascertain compliance (Mitchell and Keilbach 2001; Tir and Stinnett 2011; Giordano 2003; Gengenbach et al. 2010).

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<sup>8</sup> In the multilateral context, the focus is likely to be on joint economic gains in attempt to secure the signature of negotiating states with varying interests in cooperation. In the bilateral context, however, there can be both economic gains and losses exchanged between states to address an issue that requires deep cooperation.

A distributional problem arises because some states confront higher costs in altering their behavior to clean the river, while others gain from receiving clean water (Gengenbach et al. 2010).<sup>9</sup> Although the multilateral and basin-wide negotiation contexts can manage strong distributional conflicts by expanding the use of issue linkages, the stronger enforcement problem minimizes the effectiveness of these contexts (Barrett 1994; Nagashima et al. 2009). Therefore, bilateral negotiation is more likely to lead to treaties that focus on environmental issues (Giordano 2003) in multilateral and bilateral rivers. The larger the coalition the less stable and ineffective it is at managing environmental pollution of an international river (Gengenbach et al. 2010). The bilateral Indus Waters Treaty and the Israeli-Jordanian Peace Treaty discuss environmental issues on these multilateral rivers.<sup>10</sup>

**Hypothesis 2** The multilateral and basin-wide negotiation contexts are less likely to produce treaties that focus on environmental issues than the bilateral contexts.

The bilateral negotiation context is also likely to lead to bilateral treaties in both multilateral and bilateral rivers to allocate the river's waters because of its ability to allow for deeper cooperation and address enforcement problems (Barrett 1994; Nagashima et al. 2009; Delli Priscoli and Wolf 2009). Allocating the river's waters requires deep cooperation because states must adjust their behavior to comply with quantitative commitments to share the river's waters (Anisink and Weikard 2009). In periods of consecutive droughts, states may need to cut water from powerful domestic users to comply with treaty commitments in allocating the waters.

Complying with allocation commitments can present an enforcement problem because of opportunities for cheating (Tir and Stinnett 2011). Although riparians can find means to verify potential cheating by using satellite imaging (Delli Priscoli and Wolf 2009), implementing water allocation agreements still provides opportunities for cheating. An upstream state can manipulate hydrological data to argue insufficient rain to the downstream state as it attempts to justify inadequate discharge of water downstream. This strategy has occurred along the Indus and Ganges rivers (Zawahri 2008). In a multilateral river, such as the Euphrates, a midstream state can always blame its upstream neighbor for its inability to discharge sufficient waters to meet with treaty commitments with its downstream neighbor. Syria tends to blame upstream Turkey for its inability to meet its commitments to discharge water in the Euphrates River to downstream Iraq. The bilateral negotiation context is better capable of managing incentives to free-ride, while the multilateral and basin-wide contexts are plagued by incentives to cheat (Barrett 1994; Finus 2008; Nagashima et al. 2009).

Riparians seeking to allocate the quantity of water within an international river also confront a distributional problem (Ansink and Weikard 2009). The distributional problem arises because some riparians might depend more on the river's waters than other states, or the river might fail to carry sufficient water to meet riparian needs. Ansink and Weikard (2009) consider the scope for the settlement of such distributional conflict over bilateral rivers and demonstrate that states can opt to fight over water allocation hoping for improved allocation in the future. While the multilateral negotiation context can increase

<sup>9</sup> Regardless of the river's shape, states still confront enforcement and distributional conflicts.

<sup>10</sup> These treaties also discuss water allocation and agricultural development. In the Indus case, the treaty specifies limits on the development of Indus tributaries in upstream India. In the other case, the treaty identifies the construction of a small dam and storage facilities along the Yarmouk River and lower Jordan River.

opportunities for issue linkages to assist in the negotiations over allocating the river's waters, the strong enforcement problem minimizes this negotiation context's effectiveness and increases the likelihood that riparians select the bilateral context.

**Hypothesis 3** The multilateral and basin-wide negotiation contexts are less likely to produce treaties that focus on quantitative allocation than the bilateral contexts.

While cooperation is likely to be shallow in the multilateral context, states must still deal with the challenges of maintaining cooperation with the treaty commitments they achieved. Cooperation in the presence of large numbers of states requires centralization, leading to expectations of relatively strong formal organization (Martin 1992: 770). As the number of collaborating states increases, there should be greater investment in institutional capabilities because the higher degree of institutionalization reduces transaction costs and enforcement problems associated with multilateral interactions (Martin 1992; Verdier 2008). Given the ease of identifying and punishing defections, bilateral agreements are better able to manage the moral hazard and free-riding problems (Just and Netanyahu 1998). The weaker sanctioning problem is expected to decrease the degree of institutionalization in bilateral treaties (Drezner 2000) in both bilateral and multilateral rivers.

In examining the degree of institutionalization, we consider the following institutional attributes because of their importance to maintaining cooperation with treaty commitments according to international relations theories: river basin organization (RBO), exchange of data, joint management, monitoring, conflict resolution, and enforcement. The more of these institutional attributes a treaty contains, the higher its degree of institutionalization. RBOs enable contracting states to delegate treaty implementation to a specialized institution that can facilitate collective decision making (Hawkins et al. 2006). RBOs also facilitate cooperation over the river's development, coordinate states' activities, collect along with disseminate information, or execute integrated water resources development (Conca et al. 2006). States also have an interest to delegate to an institution if there are gains from specialization and expert knowledge possessed by individuals operating the organization (Hawkins et al. 2006). In the case of managing international rivers, states can gain from specialization because RBOs allow engineers to exchange hydrological data, which is essential to enabling riparians to allocate domestic water, anticipate floods and droughts, and minimize the potential for disputes (Gerlak et al. 2011). Joint development through RBOs can help states develop the river in an efficient manner (Lautze and Giordano 2005). Although RBOs differ in their objectives, complexity, and reach (Tir and Stinnett 2011, 2012), their degree of independence and ability to perform assigned functions varies based on the degree of institutionalization (Haftel and Thompson 2006; Bernauer 1995).

States can delegate the function of conflict resolution to address disputes that may arise from their interactions or interpretation of treaty commitments, which can increase the institution's degree of legalization and hence independence (Hawkins et al. 2006; Haftel and Thompson 2006). Since riparians are likely to confront continuous disagreements over the river, conflict resolution mechanisms provide means to address these disputes to minimize defection from cooperation. Without procedures or steps to be taken to address disputes, states might opt to cheat, which could lead to defection from cooperation. Conflict resolution mechanisms can guide states through periods of tension and enhance compliance (Tir and Stinnett 2011; Chayes and Chayes 1993).

Monitoring the river's development by traveling throughout the river permits states to confirm the accuracy of exchanged data and overcome fear of cheating by having mechanisms to detect it (Dai 2007). This capacity also permits states to receive assurances that

the necessary maintenance work is completed. Inspection permits members to collect information on the intentions, preferences, and actions of other riparians.

Given states' incentive to defect from cooperation, then sanctioning mechanisms can be an effective means to maintain cooperation between states by threatening to punish defection. As the number of cooperating states increases, the sanctioning problem becomes more complex due to the difficulties of identifying and punishing defectors. The stronger the enforcement problem, the more likely states will invest in designing centralized institutions (Lake 1996). Sanctioning mechanisms can also help prevent opportunistic behavior and decrease opportunities for renegeing on treaty commitments (Abbott and Snidal 2000).

**Hypothesis 4** Multilateral and basin-wide negotiation contexts are more likely to produce treaties with a higher degree of institutionalization than the bilateral contexts.

### 3 Research design

The unit of analysis is the dyad-river treaty. The dataset includes information on treaty content, river, and states. The treaty data comes from an updated version of the Transboundary Freshwater Dispute Database (TFDD) that includes treaties from 1945 until 2007 (Wolf 1998).<sup>11</sup> We did not construct our dataset around dyad-year form because such a structure cannot capture the relationship between treaty content and negotiation format.<sup>12</sup> Since we are interested in negotiations between sovereign riparians over transboundary water resources, treaties between states and colonial powers negotiated on behalf of colonies are excluded.<sup>13</sup> We excluded conventions because of their global nature and lack of focus on an individual river.<sup>14</sup> We retained treaties between states and political entities in transition because the political entities negotiated as autonomous actors, and they were signatories to the accord (i.e., Palestinian Authority, Eritrea).<sup>15</sup> The dataset consists of 392 treaties and 1333 dyads—149 are BTBB, 257 are BTMB, 732 are MTMB, and 195 are BWTMB.<sup>16</sup>

We constructed a treaty/basin dummy consisting of BTBB, BTMB, MTMB, and BWTMB. BTMB is used as the benchmark because its share in the population (20 %) is the closest to the mean (25 %). A marginal (BTBB 11 %) or influential (MTMB 55 %) category used as benchmark could lead to estimates of reference negotiation contexts that are meaningless.<sup>17</sup> Each dyad coded its sign date, states in the dyad, number of basin riparians, and number of treaty signatories.

<sup>11</sup> <http://www.transboundarywaters.orst.edu/database/interfreshwaterdata.html>.

<sup>12</sup> A temporal aspect is embedded in some variables (e.g., water scarcity).

<sup>13</sup> This resulted in the exclusion of 79 treaties.

<sup>14</sup> Seven conventions were excluded.

<sup>15</sup> A reviewer questioned whether the 2000 European Water Framework Directive on international basins means that the European Union cases may behave differently. The existing literature indicates that this framework is actually not effective in this respect, especially during the period covering the treaties in this analysis (see for example Nilsson and Langaas 2006).

<sup>16</sup> In the case of international rivers with three riparians, there is only the possibility of bilateral and basin-wide treaties. This is part of the design of our negotiation context variable. The possibility that states reach MTMB does not exist in basins with three riparians. This affects 45 cases in our analysis. But we believe this does not influence the analysis since the benchmark is BTMB and there are sufficient examples of MTMB. In fact, the dyadic cases are largest for MTMB.

<sup>17</sup> The selection of the benchmark negotiation context would not affect the coefficients of any variable other than that of the negotiation context variables in the regression.

In this analysis, the negotiation context is the independent variable, or the explanatory variable (right-hand-side variable) predicting the outcome. The dependent variables (left-hand-side variables) are the issue areas covered in the treaty and the degree of institutionalization. Four groups of models corresponding to the four hypotheses and using the same set of dependent variables for each model are devised. We estimated our models using several procedures, dictated by the nature of the dependent variable. The variable economic development (Model 1) is based on the TFDD categorization of treaty. Because it comprises six topics (infrastructure development, hydropower, fishing, groundwater, irrigation, and navigation), we measure it as the sum of all economic issues in the treaty (Stinnett and Tir 2009). Each economic issue gets 1 if mentioned and 0 otherwise. The sum of economic development gets values that range between 0 and 6. GLM and Poisson procedures are used for estimation.

Environmental issue (Model 2) is captured using the TFDD for categorization of treaties covering environmental issues. It takes 0 if no environmental issue is mentioned and 1 otherwise. Logit estimation procedure is used.

Quantitative allocation (Model 3) is captured using the TFDD for the categorization of treaties allocating the basin's waters. It takes 0 if no quantitative allocation exists and 1 otherwise. Logit estimation procedure is used. Several proxies are used to uncover riparians' dependence on the river and the basin's aridity.<sup>18</sup> From the International River Basin Registry (Wolf et al. 1999), we imported Percentage of a state's area that resides in the river basin. We employ the weakest link principle by recording the lowest value of the dyad. The higher the percentage of the basin residing inside a state, the more control it has over the water and the less interest it has in allocating the water. We also use the normal mean precipitation for the period 1970–2001 in a state, calculated using the weakest link principle, as a proxy of the basin's aridity. Mean precipitation is taken from the Food and Agriculture Organization of the United Nations AQUASTAT Database, which records the average precipitation (mm/year).<sup>19</sup> The Needs Variability, imported from TFDD, indicates whether or not the variability of the parties' needs for water and/or hydropower is mentioned in the treaty and/or accounted for. The more a state is in need of the basin's waters, the more interest it has in reaching an allocation agreement and the stronger the distributional conflict.

To capture the degree of institutionalization (Model 4), we draw on the TFDD. Because institutionalization is comprised of six topics observed in our dataset (Exchange of Data, Monitoring, Conflict Resolution, Enforcement, RBO, and Joint Management), several measures are used. The degree of institutionalization is measured as the sum of the institutional topics in the treaty—the greater the sum, the higher the institutionalization. Each topic gets 1 if mentioned and 0 otherwise, institutionalization takes values that range between 0 and 6 (Stinnett and Tir 2009). We also estimate separate equations for each of the institutional features (Models 4a–4f). GLM and Poisson are the estimation procedures.

### 3.1 Control variables

While Zawahri and Mitchell (2011) argue that the more democratic the dyads, the lower the transaction cost of treaty negotiation, we remain uncertain about its impact due to the higher transaction cost in open-democratic societies where executives rely on secondary ratification processes (Milner 1997). To capture regime type, we use Polity IV

<sup>18</sup> Several variables are imported from Zawahri and Mitchell (2011).

<sup>19</sup> <<http://www.fao.org/nr/water/aquastat/dbase/index.stm>>.

(Politylow)<sup>20</sup> and draw on the weakest link logic to calculate each dyad score by using the lowest democracy minus autocracy.

To test the distribution of power's influence on treaty design, we draw on the CINC capabilities ratio, which measures six areas of a state's capabilities (Singer et al. 1972).<sup>21</sup> Values are derived from the Correlates of War (COW) Project.<sup>22</sup> We separate the power of the upstream and downstream states, given that upstream riparians have bargaining leverages in negotiations. We record the CINC capabilities ratio for the upstream (CINC1) and downstream (CINC2) state in each dyad (Zawahri and Mitchell 2011). Using the weakest link logic, we assess the influence of a greater concentration of power upstream or downstream on treaty design. To complement this metric of power, we include a variable that measures the upstream and downstream "welfare power" using GDP per capita. Following Dinar et al. (2011:815), we expect that "cooperation in asymmetric contexts will be facilitated by the wealthier state's ability to provide incentives and inclination to create "good will" with the less developed riparian."

As states negotiate over treaty issues, they tend to draw on domestic legal traditions (civil, common, religion, or mixed law) (Mitchell and Powell 2009). States with similar legal traditions are expected to save on transaction costs in negotiating and designing treaties (Mitchell and Powell 2009). To measure Samelegal, we draw on Mitchell and Powell's (2009) database of legal traditions, expressed as 1 if both states have the same legal tradition and 0 otherwise.

International environmental non-governmental organizations (IENGOS) can also influence treaty content by lowering transaction costs of negotiation, implementation, and compliance (Princen et al. 1994). Our measurement of IENGOS consists of a random sample of 25 IENGOS drawn from the Union of International Association Yearbook for 1987–88 and 2007–08. Constructing membership data at the state level, the database includes every fifth IENGO<sup>23</sup> and uses the weakest link measure to capture the smallest number of memberships for both states in the dyad.

The models' equations are:

Model 1: Economic Development = f(BTBB, MTMB, BWTMB, CINC1, CINC2, Upstream Power, Downstream Power, Politylow, IENGO Low, Samelegal);

Model 2: Environmental Issues = g(BTBB, MTMB, BWTMB, CINC1, CINC2, Upstream Power, Downstream Power, Politylow, IENGO Low, Samelegal);

Model 3: Quantitative Allocation = h(BTBB, MTMB, BWTMB, Rainfall, Percentage in Basin, Needs Variability, CINC1, CINC2, Upstream Power, Downstream Power, Politylow, IENGO Low, Samelegal);

Model 4: Level of Institutionalization = k(BTBB, MTMB, BWTMB, CINC1, CINC2, Upstream Power, Downstream Power, Politylow, IENGO Low, Samelegal);

Model 4a-4f: Specific Institutions = d(BTBB, MTMB, BWTMB, Upstream Power, Downstream Power, Politylow, IENGO Low, Samelegal); where specific Institutions include: information exchange, monitoring, conflict resolution, enforcement, joint management, and RBO.

<sup>20</sup> <<http://www.systemicpeace.org/polity/polity4.htm>>.

<sup>21</sup> Iron/steel production, urban population, total population, energy production, military personnel, and expenditures.

<sup>22</sup> <[http://www.correlatesofwar.org/COW2%20Data/Capabilities/NMC\\_3.02.csv](http://www.correlatesofwar.org/COW2%20Data/Capabilities/NMC_3.02.csv)>.

<sup>23</sup> <<https://webfiles.uci.edu/frankd/index.html>>.

**Table 1** Summary statistics

	Mean	Maximum	Minimum	Std. Dev.	Observations
Economic development	1.014	5	0	1.3	1,333
Quantitative allocation	0.17	1	0	0.376	1,333
Environmental issue	0.377	1	0	0.485	1,333
Institutional design	2.10	6	0	1.596	1,333
Intensity of institutions	0.350	1	0	0.266	1,333
BTBB	0.112	1	0	0.315	1,333
BTMB	0.193	1	0	0.395	1,333
MTMB	0.549	1	0	0.498	1,333
BWTMB	0.146	1	0	0.354	1,333
Average rainfall low	647	2,702	51	426	1,333
Needs variability	0.022	1	0	0.146	1,333
Percentage of area in basin low	10.487	87.45	0.01	12.645	1,306
Politylow	-2.668	10	-10	7.109	1,333
Samelegal	0.602	1	0	0.490	1,321
CINC1	0.02	0.31	0	0.048	1,325
CINC2	0.009	0.17	0	0.025	1,323
Upstream power	0.015	0.27	0	0.039	1,166
Downstream power	0.014	0.31	0	0.039	1,154
IENGO state 1	1.571	16	0	2.901	1,333
IENGO state 2	1.626	44	0	3.085	1,333
IENGO low	0.986	14	0	2.175	1,333

#### 4 Results and discussion

Table 1 presents summary statistics of the variables. Most variables used in our models appear in all 1,333 observations. Only six variables range in their number of observations and appear in less number of observations (1306–1321). All model regressions are associated with high and significant fit tests, indicating an overall plausible explanation of variation in the dependent variable that is explained by the variation of the independent variables, confirming that the negotiation context influences treaty design.

Table 2 reports results of hypothesis 1 (Model 1) that economic development provisions are more likely in MTMB and BWTMB. The findings reveal that the multilateral negotiation context is more likely to produce MTMB focusing on economic development. However, basin-wide negotiations are not likely to produce economic development BWTMB. While this finding is against our expectation, BWTMB is characterized by the lowest share of economic development provisions compared with the other subsets. BWTMB's negative sign may be attributed to this observation. Alternatively the complexities of basin-wide negotiations can present hurdles to negotiating economic issues by allocating the gains and losses. This finding confirms Barrett's (1994, 1998) conclusion that as the number of negotiating states increases, the transaction costs increase and hamper treaty formation along with minimizing the stability of the large coalition. Our finding that MTMB are more likely to cover economic development issues is similar to Hamner and Wolf (1998), but the finding that BWTMB are less likely contradicts expectations and highlights the importance of studying negotiation contexts. We also find



**Table 2** Model 1 economic development

Estimation procedure Equation	Poisson 2.1	Poisson 2.2	GLM 2.3	GLM 2.4
BTBB	-0.217 (0.163)	-0.316 (0.182)	-0.186 (0.140)	-0.261 (0.152)
MTMB	0.276 (0.102)**	0.238 (0.113)*	0.292 (0.105)**	0.252 (0.118)*
BWTMB	-0.489 (0.154)**	-0.601 (0.179)**	-0.358 (0.115)**	-0.416 (0.128)**
CINC1	-0.323 (0.916)		-0.285 (0.785)	
CINC2	-3.113 (1.909)		-2.671 (1.460)**	
Upstream power		-0.625 (1.396)		-0.323 (1.143)
Downstream power		0.971 (1.013)		0.757 (0.967)
Politylow	0.021 (0.006)**	0.017 (0.006)**	0.022 (0.007)**	0.018 (0.007)**
IENGO Low	-0.071 (0.019)**	-0.053 (0.019)**	-0.071 (0.018)**	-0.053 (0.018)**
Samelegal	0.117 (0.075)	0.059 (0.081)	0.112 (0.074)	0.058 (0.08)
Constant	0.011 (0.103)	0.001 (0.116)	1.028 (0.104)**	1.012 (0.119)**
Observations	1,311	1,149	1,311	1,149
Log Likelihood	-1,884.16	-1,638.57	-2,174.82	-1,894.51
LR $\chi^2$	64.38**	50.18**		
Pseudo $R^2$	0.0297	0.0274		
$R(\rho)^2$			0.0493	0.0442

Robust standard errors are in parentheses

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

**Table 3** Model 2 environmental issues

Estimation procedure Equation	Logit 3.1	Logit 3.2	Logit 3.3
BTBB	0.081 (0.28)	-0.040 (0.348)	0.136 (0.343)
MTMB	1.068 (0.192)**	1.290 (0.223)**	1.294 (0.223)**
BWTMB	0.284 (0.248)	0.565 (0.288)*	0.583 (0.291)*
CINC1	-4.497 (1.737)**		-4.451 (7.982)
CINC2	2.372 (2.9328)		2.436 (9.108)
Upstream power		1.507 (2.224)	3.794 (8.054)
Downstream power		-6.839 (2.565)**	-3.640 (7.885)
Politylow	0.089 (0.109)**	0.102 (0.012)**	0.100 (0.012)**
IENGO low	0.091 (0.033)	0.072 (0.038)*	0.077 (0.038)*
Samelegal	-0.142 (0.139)	-0.019 (0.150)	-0.057 (0.38)
Constant	-0.853 (0.198)**	-1.067 (0.227)**	-1.090 (0.230)**
Observations	1,311	1,149	1,148
Log likelihood	-773.20	-663.22	-660.88
LR $\chi^2$	162.75**	62.75**	162.33**
Pseudo $R^2$	0.1103	0.1304	0.1324

Robust standard errors are in parentheses

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

that BTBB is not significantly different than the benchmark (BTMB), suggesting that the bilateral negotiation context has similar results regardless of whether riparians reside in bilateral or multilateral rivers.

Table 3 reports results of hypothesis 2 (Model 2) that the bilateral negotiation context is more likely to produce treaties governing environmental issues in multilateral and bilateral basins. Contrary to our expectation, the results indicate that multilateral and the basin-wide negotiation contexts are likely to produce MTMB and BWTMB that govern environmental issues. BTBB is not significantly different than BTMB, indicating a similar impact of the bilateral negotiation context. While Giordano (2003) finds that states are more likely to address environmental issues in bilateral accords, we could not support this conclusion. Our finding indicates that management of environmental issues might not represent a strong enough of an enforcement problem that would push states toward bilateral accords. Development of remote control monitoring and regional environmental frameworks can reduce transaction costs of the multilateral negotiation framework (Bernauer 1995). The weaker sanctioning problem and improved ability to manage strong distributional conflicts suggests why states select to address environmental issues in multilateral and basin-wide contexts. Along the Danube and Rhine rivers, riparians have effectively used multilateral contexts to address water quality. Contrary to expectations that the complexity of multilateral negotiations contribute to shallow cooperation, these finding reveals that they can also provide opportunities for deep cooperation. Moreover, states appear to be conceding to the basin's integrated development, which can better address environmental externalities.

Table 4 reports results of hypothesis 3 (Model 3) that the bilateral negotiation contexts are more likely to contribute to treaties focusing on water allocation in multilateral and bilateral basins. The findings reveal that MTMB and BWTMB are both negative and significantly different from the benchmark. As expected, BTBB is not significantly different from BTMB. States are more likely to select bilateral negotiations along multilateral and bilateral basins to address water quantity issues. This finding confirms our expectation that bilateral negotiation contexts are capable of managing issues with strong sanctioning problems and deep cooperation (Barrett 1994; Nagashima et al. 2009). States appear to shy away from integrated management of international rivers in making water allocation commitments.

As for the distributional conflict's influence, the findings reveal that rainfall is insignificant and percentage in basin is of low significance. A river carrying insufficient water to meet riparian needs does not influence the negotiation process in presenting strong distributional conflicts. However, the more a state needs water, the more interest it has in reaching an allocation agreement, which suggests strong distributional conflicts. The fact that the bilateral negotiation contexts appear to contribute to allocation treaties may indicate that the distributional conflicts in this issue area are not strong enough to encourage states to embrace multilateral negotiations to facilitate issue linkages. As proposed by our hypothesis, the sanctioning problem appears stronger than the distributional conflict.

Table 5 reports results of hypothesis 4 (Model 4) that the multilateral and basin-wide negotiation contexts are more likely to have a higher degree of institutionalization. The findings reveal that the multilateral negotiation context is more likely to result in MTMB with a higher degree of centralization. Against our expectation the basin-wide context is less likely to contribute to a high degree of institutionalization. A scrutiny of our dataset suggests that BWTMB is characterized by the lowest share of institutionalization provisions. The complexities associated with basin-wide negotiations present hurdles to building basin-wide institutions. The difficulties in managing a large organization may increase transaction costs and decrease the success of basin-wide institutions (Just and Netanyahu 1998). The finding that MTMB is likely to have a greater degree of institutionalizations is

**Table 4** Model 3 Quantitative allocation

Estimation procedure	Equation	Logit 4.1	Logit 4.2	Logit 4.3	Logit 4.4	Logit 4.5	Logit 4.6
BTBB		-0.304 (0.269)	-0.349 (0.302)	-0.244 (0.276)	-0.358 (0.284)	-0.356 (0.307)	-0.305 (0.291)
MTMB		-1.268 (0.195)**	-1.205 (0.201)**	-1.227 (0.199)**	-1.105 (0.218)**	-1.057 (0.319)**	-1.069 (0.223)**
BWTMB		-1.292 (0.278)**	-1.173 (0.280)**	-1.155 (0.281)**	-1.210 (0.322)**	-1.181 (0.39)**	-1.069 (0.322)**
Rainfall		7.66e-5 (2.04e-4)			1.15e-4 (0.0002)		
Percentage in basin			0.0121 (0.006)			0.009 (0.007)	
Needs variability				2.703 (0.454)**			2.614 (0.455)**
CINCI		2.744 (1.693)	2.263 (1.750)	2.802 (1.713)			
CINCI2		-1.042 (2.812)	-2.952 (3.130)	-0.995 (2.833)			
Upstream power					2.326 (2.120)	1.537 (2.204)	2.609 (2.134)
Downstream power					3.471 (2.075)	2.080 (2.097)	3.275 (2.081)
Politylow		-0.016 (0.014)	-0.016 (0.014)	-0.018 (0.014)	-0.0120 (0.015)	-0.009 (0.015)	-0.011 (0.015)
IENGO low		-0.027 (0.040)	-0.034 (0.041)	-0.016 (0.041)	-0.039 (0.041)	-0.047 (0.042)	-0.028 (0.042)
Samelegal		0.349 (0.176)*	0.406 (0.176)*	0.342 (0.179)*	0.390 (0.192)*	0.415 (0.191)*	0.381 (0.195)*
Constant		-1.113 (0.258)**	-1.222 (0.230)**	-1.211 (0.224)**	-1.258 (0.289)**	-1.288 (0.259)**	-1.325 (0.256)**
Observations		1,311	1,284	1,311	1,149	1,140	1,149
Log likelihood		-558.35	-548.91	-538.04	-490.02	-486.39	-472.08
LR $\chi^2$		81.60**	92.25**	110.70**	70.62**	78.77**	99.68**
Pseudo $R^2$		0.069	0.074	0.102	0.064	0.064	0.098

Robust standard errors are in parentheses

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

**Table 5** Model 4 Level of institutionalization

Estimation procedure Equation	Poisson 5.1	Poisson 5.2	GLM 5.3	GLM 5.4
BTBB	-0.065 (0.101)	-0.061 (0.107)	-0.111 (0.156)	-0.119 (0.163)
MTMB	0.469 (0.060)**	0.441 (0.068)**	0.990 (0.109)**	0.930 (0.124)**
BWTMB	-0.338 (0.096)**	-0.349 (0.108)**	-0.442 (0.129)**	-0.470 (0.147)**
CINC1	-2.024 (0.651)**		-3.238 (0.918)**	
CINC2	-0.515 (0.651)		-1.039 (1.254)	
Upstream power		-1.528 (0.732)*		-2.430 (1.108)*
Downstream power		-2.679 (0.909)**		-4.043 (1.147)**
Polity low	0.018 (0.003)**	0.019 (0.003)**	0.038 (0.006)**	0.039 (0.007)**
IENGO low	0.003 (0.007)	0.008 (0.008)	0.017 (0.019)	0.028 (0.020)
Samelegal	-0.088 (0.043)*	-0.104 (0.046)*	-0.174 (0.088)*	-0.211 (0.097)*
Constant	0.623 (0.064)**	0.651 (0.072)**	1.898 (0.120)**	1.945 (0.136)**
Observations	1,311	1,149	1,309	1,149
Log likelihood	-2,292.99	-2,030.10	-2,339.17	-2,072.99
LR $\chi^2$	320.30**	160.18**		
Pseudo $R^2$	0.065	0.063		
$R(\rho)^2$			0.191	0.178

Robust standard errors are in parentheses

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

confirmed in the sanctioning literature (Drezner 2000), but the fact that BWTMB is less likely indicates a need to refine the literature to consider the negotiation context's influence. The findings also reveal that BTBB is not significantly different from BTMB, which indicates a lower degree of institutionalization in all bilateral negotiation contexts.

Table 6 reports results of hypothesis 4 (Models 4a–4f) that the multilateral and basin-wide negotiation contexts are more likely to include individual institutional provisions than the bilateral contexts. Unlike BTMB, BTBB is less likely to include conflict resolution mechanisms but more likely to include joint management of the basin. While previous findings confirmed no significantly different outcomes for BBTB and BTMB contexts, the finding for specific institutions reveals a difference and confirms that the coordination costs in BTBB are lower than in BTMB, and thus, the former format is less likely to establish conflict resolution mechanisms. The coefficient of joint management in BBTB is positive and significantly different than that of BTMB. The dividends from joint management are likely to be higher in BTBB than BTMB due to the lack of challenges from riparians excluded from treaty commitments in multilateral basins (Just and Netanyahu 1998). All other institutional arrangements are similar for the two contexts.

The multilateral negotiation context is more likely to lead to MTMB with all institutional provisions, except enforcement, which confirms previous findings about a higher degree of institutionalization for MTMB. Basin-wide negotiations are less likely to produce BWTMB with monitoring, conflict resolution, and enforcement mechanisms. Multilateral negotiation contexts are more likely to result in a higher degree of institutionalization than the other contexts, which confirms the need to consider the impact of the negotiation context in future analysis. Riparians are neglecting the 1997

**Table 6** Model 4a–4f specific institution provision

Estimation procedure	Logit						
	Information exchange 6.a	Monitoring 6.b	Conflict resolution 6.c	Enforcement 6.d	Joint management 6.e	RBO 6.f	
BTBB	-0.260 (0.269)	-0.231 (0.302)	-0.830 (0.315)**	-0.358 (0.494)	0.678 (0.266)**	-0.952 (1.103)	
MTMB	0.444 (0.183)**	0.587 (0.206)**	0.862 (0.189)**	0.597 (0.334)	1.306 (0.187)**	1.110 (0.408)**	
BWTMB	-0.299 (0.243)	-1.157 (0.360)**	-1.128 (0.274)**	-1.106 (0.546)*	-0.060 (0.232)	0.443 (0.468)	
Upstream power	3.206 (1.853)	-1.187 (2.160)	-6.658 (2.423)**	-1.843 (3.510)	-3.009 (1.860)	-101.03 (34.467)**	
Downstream power	-2.949 (1.922)	-3.797 (2.446)	-3.013 (2.479)	-1.718 (5.549)	-7.513 (2.184)**	-50.692 (37.278)	
Polity low	0.062 (0.011)**	0.033 (0.012)**	0.049 (0.012)**	-0.090 (0.023)**	0.049 (0.012)**	0.047 (0.018)**	
IENGO low	-0.024 (0.033)	0.168 (0.036)**	0.065 (0.033)*	0.090 (0.079)	-0.035 (0.033)	-0.027 (0.050)	
Samegal	0.105 (0.133)	0.576 (0.156)**	-0.505 (0.143)**	-0.308 (0.202)	-0.266 (0.141)*	-0.932 (0.197)**	
Constant	-0.129 (0.198)	-1.415 (0.229)**	-0.037 (0.203)	-2.727 (0.378)**	-0.068 (0.195)	-1.429 (0.455)**	
Observations	1,149	1,149	1,149	1,149	1,149	1,149	
Log likelihood	-761.02	-631.22	-685.33	-348.70	-707.18	-407.48	
LR $\chi^2$	65.39**	124.43**	173.74**	44.88**	123.19**	65.77**	
Pseudo $R^2$	0.044	0.114	0.136	0.078	0.090	0.183	

Robust standard errors are in parentheses

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

Watercourses Convention recommendation to build basin-wide institutions. While the results examining individual institutional provisions are less stable than the aggregated institutionalization variable, they nevertheless support hypothesis 4.

#### 4.1 Control variables

The higher the capability of downstream riparian, the less likely that economic development treaty is reached. This could stem from the increase in downstream negative externalities from upstream developments. The denser the concentration of IENGOS in the basin, the less likely that riparians reach economic development treaties. IENGOS can advocate against the construction of hydrological infrastructure because of the negative impact on society. This finding confirms the need to consider the influence of non-state stakeholders on treaty design. It also supports the qualitative literature on the role of IENGOS in treaty design (Princen et al. 1994; Frank 1999). The more democratic the riparians, the more likely they are to negotiate economic development treaties, which could result from lower transaction costs.

The higher the capability of the upstream riparian, the less likely that states will reach an environmental treaty. Upstream states have an interest to develop the river without downstream restrain and export externalities downstream without incurring any cost. The presence of a downstream powerful riparian is negative and significant in one equation, which indicates that a powerful downstream riparian decreases the likelihood of environmental treaties. Powerful downstream riparians—Egypt along Nile—could use their power to prevent upstream weaker states from degrading the environment, without the need for treaty commitments. Democratic dyads are more likely to reach environmental agreements because the transaction costs of negotiations are lower than other government types (Lipson 2003). This confirms expectations that democracies tend to cooperate more with one another in different issue areas than with non-democracies (Mansfield et al. 2000). The more involved IENGOS are the more likely that a treaty will cover environmental issues. This finding supports the literature on the role of non-state actors (Princen et al. 1994) and the World Polity framework, which argues that the more pervasive IENGOS are the more likely that states reach environmental agreements (Frank 1999).

The only relevant control variable for quantitative allocation treaties is Samelegal. States with similar legal systems are more likely to negotiate quantitative allocation treaties. This could be attributed to the lower transaction costs of negotiating and complying with contracts between states with similar legal system (Mitchell and Powell 2009). This finding substantiates previous arguments that states with shared legal systems are likely to confront lower transaction costs that increase the likelihood for treaty formation (Timmerman and Langaas 2005).

Greater power preponderance upstream appears to decrease the degree of institutionalization. If the basin has a powerful upstream or downstream riparian, institutionalization is less likely. This finding confirms Gruber (2000) and Moe's (2005) arguments about the negative impact of power asymmetry on the degree of institutionalization. Powerful states prefer not to limit their negotiating power by investing in centralization.

The more democratic a dyad is, the higher the degree of institutionalization. However, the more similar the domestic legal systems, the lower the degree of institutionalization, which can result from shared legal norms or decreased transaction costs of negotiation.

CINC1 and CINC2 were excluded from the analysis of individual institution features because they were inferior. Upstream Power is not stable across the equations, but it is negative and significant for conflict resolution, joint management, and RBO but positive

and significant for information exchange. Downstream Power is negative and significant for joint management. Together these results confirm the need to examine the influence of power.

The more democratic the dyad, the more likely that the treaty contains monitoring, conflict resolutions, RBO, information exchange, and joint management, but not enforcement provisions. The greater the concentration of IENGO, the more likely that the treaty will include monitoring and conflict resolution, the design features that are needed to maintain cooperation. Shared legal tradition is less likely to contribute to treaties with conflict resolution, joint management, and RBO, but more likely to contribute to treaties with monitoring provisions.

In addition to the foregoing, we tested the possibility that an increase in the number of states participating in the multilateral negotiations that led to a treaty can have an impact on treaty design (Barrett 1994; Finus 2008; Gengenbach et al. 2010). An increase in the number of negotiating states does not seem to have a significant impact on reaching treaties that cover economic development. However, as the number of negotiating states increases, they are less likely to reach a treaty covering environmental issues. This confirms the findings of others that suggest that the larger the number of negotiating states, the less successful they will be in coming to agreement on environmental issues (Barrett 1994; Just and Netanyahu 1998; Gengenbach et al. 2010). As the number of negotiating states increase, they are less likely to reach treaties covering the quantitative allocation of the river's waters. It is possible that distributional and enforcement problems become much more powerful as the number of negotiating states increase. The larger the number of states negotiating and reaching a treaty, the higher the degree of institutionalization. This result confirms that states' concern with cheating and enforcement increase as the number of signatory states increase contributing to the incentive to invest in institutional design.<sup>24</sup>

## 4.2 Robustness test

We conducted a robustness test by eliminating bilateral basins from our dataset and retaining 1,184 observations of multilateral basins. We ran models 1–4 with BTMB, MTMB, and BWTMB, with BTMB as the benchmark. The results suggest that the coefficients of the dummy variables of MTMB and BWTMB negotiation contexts kept their relative order, signs, and significance. Other variables (with significant coefficients) remained with the same sign and almost same values. This robustness test suggests that BTBB and BTMB do not differ significantly from each other in models 1–4, as was observed in the full dataset analysis, where the coefficients of BTBB were not significantly different from the benchmark BTMB in all runs.<sup>25</sup> However, for Models 4a–4f, we obtained inconsistent results that are less satisfactory (compared with the full dataset runs).

## 5 Conclusion

Treaties governing international rivers vary in their design, yet there is little understanding of the factors influencing variation in design. We tested the influence of negotiating,

<sup>24</sup> We thank one of the reviewers for suggesting this analysis. Inclusion of the number of signatories only marginally impacted the level of the coefficients and in two cases (Economic Development and Environment) changed the level of significance. Results are available from the authors upon request.

<sup>25</sup> Results are available upon request.

distributing the gains, and enforcing commitments in bilateral, multilateral, and basin-wide negotiation contexts on the depth of cooperation and degree of institutionalization.

We argued that the multilateral and basin-wide negotiations are likely to result in treaties focusing on joint gains and issues requiring shallow cooperation but a high degree of institutionalizations to overcome the obstacles to cooperation. The easier enforcement and the lower transaction costs of bilateral negotiations along multilateral and bilateral basins are likely to result in treaties with deeper levels of cooperation (focusing on water quality and quantity issues), but it is expected to result in lower institutionalization. This argument and findings present important contributions to the literatures on treaty design and management of international rivers.

Our analysis revealed that the multilateral negotiation context tends to produce treaties that focus on economic development. This confirms expectations that this context is likely to focus on joint gains and result in shallow cooperation because of the various interests that must be accommodated (La Plata 1967 Treaty). The findings also revealed that basin-wide negotiations are not likely to lead to economic development treaties. This difference between multilateral and basin-wide negotiations demonstrates that the literature needs to consider the negotiation context's influence. As the number of states in multilateral negotiations increases, the likelihood that they will reach an economic development treaty decreases. By considering the negotiation contexts, we are able to examine the extent to which states are conceding to the Watercourses Convention to include all riparians in treaty, which can improve the ability to manage the basin in an ecologically sustainable and efficient manner and facilitate stable cooperation. States are not heeding to the norm of integrated river basin management by including all riparians in accords. Third party mediators of riparian cooperation need to take into account this finding. As they attempt to facilitate economic development treaties along the Nile or Mekong basin, it appears that they will confront more obstacles in achieving basin-wide accords.

The analysis revealed that the multilateral and basin-wide negotiation contexts can result in treaties focusing on environmental issues. These findings contradict the expectation that multilateral negotiations produce shallow accords that require minimal behavior-altering cooperation. Rather it suggests that the multilateral and basin-wide contexts can provide opportunities for deeper cooperation, such as managing environmental issues (e.g., Danube Program). As noted by Conca et al. (2006), our analysis finds that states are heeding to the Watercourses Convention as they attempt to regulate the basin's environment.

One of the most contentious issues is the allocation of the river's waters. The bilateral negotiation context is more likely to lead to water allocation agreements in bilateral and multilateral basins. These findings confirm the expectation that states select bilateral negotiations to address issues requiring deep cooperation. By separating BTBB and BTMB, we are able to confirm the general expectation that states tend to manage multilateral basins in a fragmented manner and not an integrated approach (Conca et al. 2006). Bilateral water allocation agreements over multilateral basins may contribute to unstable cooperation because excluded riparians may have the capacity to influence the quantity of water flowing in the basin and challenge compliance with treaty commitments. Upstream withdrawals from the Yarmouk River by Syria challenges downstream quantitative treaty commitments between Israel and Jordan. Mediators need to take these findings into consideration in their attempt to avert tensions and conflict between riparians by encouraging basin-wide agreements.

A higher degree of institutionalization is more likely in MTMB, as opposed to the other negotiation contexts. The finding that BWTMB is likely to have a low degree of



institutionalization confirms the need to appreciate the complexities of multilateral negotiations. In this issue, it appears that states are again not heeding to the Watercourses Convention arguing for the need to build basin-wide institutions. It confirms previous findings regarding the prevalence of fragmented governances of international rivers and a general weakness of this norm's diffusion (Conca et al. 2006). This finding suggests that experts, third parties, and the donor community need to work harder to persuade states to build basin-wide institutions. Moreover, with few exceptions, the bilateral negotiation context over bilateral and multilateral basins appears to perform similarly, which negates the potential influence of coalition building suggested by the behavioral and economic literature.

Several of the control variables appear relevant for treaty design. A higher concentration of IENGOs decreases the prospects that states will reach economic development accords but increases the chances of an environmental agreement. Power asymmetries decrease the prospects for environmental and quantitative accords along with decreasing the degree of institutionalization. Democratic dyads and shared legal traditions decrease the transaction costs of negotiating. Joint democracies are more likely to reach economic development and environmental treaties, and have a higher degree of institutionalization, while similar legal traditions are more likely to contribute to water allocation agreements, but lower degree of institutionalization. Third party mediators need to take these variables into consideration as they seek to facilitate riparian treaties.

In future research, we seek to explore the role of third parties in influencing the negotiation context by compiling a database that captures the presence and role of third parties. In this study, we focus on empirically examining individual design features, but in our next study, we seek to add these design features to see whether treaties have a combination of features and how the negotiation contexts influence this combination.

The findings in this paper advance the rational design literature and the literature on managing international rivers. It appears that the negotiation context does influence treaty content, and multilateral, along with basin-wide accords, can provide states with opportunities for managing issues that require deeper cooperation. States seem to behave differently, especially in the context of multilateral and basin-wide treaty design. This difference in behavior needs further consideration through future research on treaty design. With very few exceptions, the bilateral negotiation context appears to have a similar impact on treaty design in bilateral and multilateral basins. Finally, the fact that the multilateral negotiation context can provide opportunities for deeper international cooperation is an important finding in advancing the international relations literature.

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