Promoting Freshwater Cooperation: Substitutability or Complementarity of International and Domestic Institutions

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Prepared for the 7th Annual Conference on the
Political Economy of International Organizations*

Abstract

To what extent can international institutions promote international cooperation in the absence of functioning domestic institutions? Much of international cooperation research assumes that international institutions can *substitute* for the potential weakness of domestic institutional capacity to implement cooperative policies. We argue that functioning domestic institutions *complement* the cooperation-inducing effect of international institutions. We examine the interaction between international and domestic institutions in the critical issue area of interstate cooperation over transboundary rivers, an important test case given dire predictions about looming water wars in face of increasing water scarcity. Using freshwater-related events data over shared water resources, 1984-2006, and information on the institutionalization of river treaties and domestic institutional capacity, we find that institutionalized river treaties need higher-quality domestic bureaucracies to promote interstate cooperation; thus, *international and domestic institutions function as complements*. This finding has important implications for institutional research and policy approaches to cooperation problems.

*We thank Douglas Stinnett for helping us develop the original research idea and, for helpful comments, Jessica Green, Charles Lipson, and the members of the Institutions Program at the Institute of Behavioral Science at the University of Colorado Boulder. This research was partially funded by the Department of Defense Minerva Program under the National Science Foundation grant number 0904245.

To what extent can international institutions successfully promote international cooperation in the absence of functioning domestic institutions? Much of international cooperation research to date has advanced the argument that international institutions can resolve various interstate cooperation dilemmas (e.g., coordinating policies, preventing disputes, resolving conflicts, enforcing norms and rules; see Axelrod and Keohane 1985; Abbott and Snidal 1998; Mitchell 1994). More recent updates to this view point out that international institutions need to be designed -- or institutionalized — appropriately.[1] Yet, an often unstated assumption behind these views is that international institutions can accomplish their objectives even when member countries do not possess domestic institutions that are actually capable of implementing the policies needed to achieve the desired international cooperation objectives. This assumption implies that properly designed international institutions can act as a *substitute* for the potentially lacking domestic institutional capacity. Substitution therefore means that international institutions can fill in for the role of domestic institutions when the latter are either poorly developed or dysfunctional.

The wisdom of this assumption has started to come into question as international institutions have started to spread beyond the more developed parts of the world, where domestic institutional capacity to implement and sustain international-level agreements can usually be taken for granted. In the less developed parts of the world, however, domestic institutions are often dysfunctional — due to issues such as resource constraints, poorly trained staff, or corruption. This can help provide an explanation for why international cooperative interactions remain at relatively shallow levels despite the presence of sophisticated international institutions. Indeed, evidence that functioning domestic institutions are needed to implement policies called for by international commitments has recently started to emerge (e.g., Tobin and Rose-Ackerman 2011; Gray forthcoming). Applying this view to our question suggests that domestic institutions *complement* the roles of international

[1] By "institutionalized," we mean a treaty that calls for relevant institutional features such as centralized decision-making, monitoring, conflict management, enforcement, and other mechanisms (Mitchell 1994; Abbott, Keohane, Moravcsik, Slaughter, and Snidal 2000; Abbott and Snidal 2000; Koremenos, Lipson, and Snidal 2001; Boehmer, Gartzke, and Nordstrom 2004; Koremenos 2008).

institutions. By complementing, we mean that international and domestic institutions necessarily work in tandem to achieve desired international cooperation objectives.

In this paper, we address the international institutions as substitutes versus complements question by focusing on a specific issue area, the *politics of international freshwater cooperation over transboundary rivers*. Our argument is that even properly institutionalized river treaties require well-functioning domestic institutions in order to help steer the politics between riparian states away from conflictual and toward cooperative outcomes. Because river treaties cover both more and less developed parts of the world,[2] international freshwater cooperation presents a particularly apt opportunity for investigating the political outcomes of the interplay between domestic and international institutions. As we demonstrate below, evidence that international river treaties can actually substitute for lacking domestic institutional capacity is scant. Rather, our results clearly show that that international institutions need domestic institutions of sufficient quality in order to steer transboundary freshwater politics away from conflictual and toward cooperative outcomes. That is, our argument and findings lend strong support to the complements view and negate the rather engrained substitutes assumption. In turn, this holds an important implication for theories of international cooperation: because domestic institutional capacity is needed to achieve higher levels of international (water) cooperation, the way international institutions can achieve their objectives needs to be re-thought.

The topic of how best to steer the freshwater politics away from conflict and toward cooperation is also timely from a practical perspective, given dire predictions about looming water wars (Klare 2001; Lonergan 1997), assessments that climate change will increase water stress in many areas of the world (Busby 2008; Bates, Kundzewicz, Shaohong, and Palutikof 2008), and evidence that freshwater has been a frequent subject of international cooperation for some time (Wolf 2007). Showing good intentions but also inadequate attention to the complements vs. substitutes issue, a high-profile UN development report (UNDP 2006) has, for example, called for river treaties as

[2]See Figure A1 in the online appendix for an illustration of the distribution of river treaties across the world.

the answer to steadily increasing international freshwater problems. Specifically, the report identifies the institutionalization of international river treaties as well as strengthening the institutional capacity of these international-level treaties as a high priority (UNDP 2006, 228-231). By doing so, it essentially assumes that international institutions can simply substitute for lack of domestic institutional capacity. Our argument and findings in contrast suggest that such recommendations make an erroneous assumption and set the politics of international freshwater cooperation up for failure.

Following the theoretical discussion, we examine empirically the effects of the interaction between institutionalized international river treaties and domestic institutional capacity on the politics of freshwater cooperation and conflict in the period 1984 to 2006. Evidence in favor of the complementary relationship is robust to a multitude of empirical specifications, including using an instrumental variable approach to avoid endogeneity bias.

The problem: International-Level Conflict and Cooperation over Transboundary Water Resources

With growing frequency, scholars and policymakers are voicing concerns about the looming potential for militarized interstate conflict over shared water resources, particularly in the context of water stress induced by climate change. Some scholars have already found evidence for a higher probability of militarized disputes over river claims by states that share access to a river (Hensel, Mitchell, and Sowers 2006). Meanwhile, others have suggested that states sharing river basins are generally more likely to engage in militarized conflict over issues including, but not limited to water (Toset, Gleditsch, and Hegre 2000; Furlong, Gleditsch, and Hegre 2006; Gleditsch, Furlong, Hegre, Lacina, and Owen 2006; Brochmann and Gleditsch 2012), particularly when water is scarce (Tir and Stinnett 2012). In all, a recent survey of the literature suggests that while such results are not uniformly unconditional and robust, increasing scarcity of water resources can heighten the risk of states engaging in hostile interactions (Bernauer, Böhmelt, and Koubi 2012).

One basic source of the above problems is that transboundary rivers create interdependence between countries sharing river basins. The consumption of water by one state can diminish the water available to another state, and externalities generated by one state can damage water quality for another state. As with many other areas of international interdependence, some degree of international coordination is necessary for the effective management of the politics of transboundary river basins. Otherwise, unmanaged interdependence sets the stage for (highly) conflictual interactions (see Starr 1997).

States have long used river treaties to respond to the problem of transboundary freshwater management (Wolf 2007; Bernauer and Kalbhenn 2010; Tir and Ackerman 2009; Marty 2001; Dombrowsky 2007). International river treaties can help countries avoid developments that are commonly associated with interstate conflict over water resources, such as disputes over water quantity, quality, and the navigation of shared bodies of water (Brochmann 2012; Tir and Stinnett 2011). Furthermore, these treaties are supposed to help river-sharing countries avoid so-called water wars of the future (Elhance 2000; Klare 2001; Lonergan 1997; Marty 2001) and turn their interactions into a cooperative direction (Wolf 2007).

Further research on international water policy, international environmental cooperation, and international cooperation in general has emphasized the importance of regime design for effective cooperation (Koremenos, Lipson, and Snidal 2001; Boehmer, Gartzke, and Nordstrom 2004; Haftel 2007). Investigating the institutional design of river treaties, researchers have identified the particular features that make river treaties more effective conflict managers and cooperation promoters (Tir and Stinnett 2012; Brochmann 2012). For instance, Tir and Stinnett (2011) note that common institutional design features include provisions for joint monitoring, conflict resolution, treaty enforcement, and the delegation of authority to intergovernmental organizations. Moreover, the availability of institutional features that oversee agreement implementation as well as address disputes have been associated with a reduced probability of militarized interstate conflict (Tir and Stinnett 2012).

The logic of the theory behind these findings points to a number of conflict-mitigating func-

tions of the aforementioned institutional features. Monitoring can deter practices such as states' use of water resources beyond the agreed-upon quantity. Conflict resolution mechanisms offer an avenue to negotiate disputatious claims without engaging in hostile behavior. Enforcement provisions, though not as common, provide avenues to punish treaty violators in legitimate and measured ways and thus avoid an escalatory spiral of retaliatory and counter-retaliatory actions. And the delegation of authority to intergovernmental organizations reinforces the above functions and thus enhances their political effectiveness through multiple channels, such as reputational consequences, neutrality, institutional efficiency, and centralized information (Tir and Stinnett 2012).

Turning to conflictual outcomes, the processes behind the occurrence of militarized disputes are complex and subject to strategic interaction between political actors within and between countries (Bernauer, Böhmelt, and Koubi 2012). While prior systematic research typically accounts for established correlates of militarized disputes, more direct proof for the political effectiveness of river treaties would emerge from evaluating state interactions directly related to the water resources these treaties are covering. That is, one would expect that pairs of states subject to river treaties with extensive institutionalized features should not only engage in less conflictual behavior, but should also exhibit more cooperative behavior over water resources. This can take several forms: addressing water-related grievances within existing institutions, deepening extant institutional arrangements, or pursuing joint efforts to conserve or manage shared water resources. In our empirical analyses below, we therefore examine data that deal specifically with riparian states' interactions over freshwater.

Yet, countering these promising theoretical and policy developments, recent investigations of river treaties and their actual functioning suggest that river treaties too often fail to deliver the expected levels of cooperation (Dinar 2006; Zawahri 2009*a*;*b*). We note that what many of these skeptical case studies have in common is that they examine river treaties among the less developed countries of the world. We thus suspect that the reason for subsequently poor political relationships over freshwater may be a lack of domestic institutional capacity to implement policy objectives stated in the treaties. For instance, a treaty calling for reduced river water withdrawal rates will

be meaningless without a member government's ability to curtail thousands of its farmers from individually siphoning off river water. And the inability to meet environmental objectives set forth in the treaty sets the signatory states up for frustration and ultimately a conflict-ridden relationship. We hence argue that without adequately functioning domestic institutions, the effectiveness of even highly institutionalized river treaties to move riparian state relations away from conflict and toward cooperation will be undermined. In other words, international institutions need well-functioning domestic institutions to accomplish their objectives.

Domestic Institutions and Transboundary River Management

The optimistic arguments about states' potential to use international institutions to successfully manage disputes over shared water resources are, however, subject to a number of qualifications, foremost the potentially moderating role of domestic institutions. Such a moderating role of domestic environments has recently started to receive attention: scholars have found that it is often unrealistic to assume a constant effect of international institutions across a wide range of country-level variance in the quality of domestic institutions. For instance, Tobin and Rose-Ackerman (2011) have pointed to such a moderating role of domestic investment environments for the impact of international investment treaties. This conditional relationship is beginning to resonate in the literature on transboundary water resources. Bernauer and Kuhn (2010), for instance, suggest that domestic factors may complicate interstate cooperation over water resources. More specifically, river-sharing states are more likely to slip into water conflicts under conditions of stress where the domestic "institutional capacity to absorb stress" is lacking (Wolf, Yoffe, and Giordano 2003, 42). Consequently, policy efforts would need to focus on building domestic institutional capacity to manage events that increase water-related stress (see, e.g., Wilhite 2005).

Many interstate problems over shared freshwater sources can be traced back to the issues of water use: consumption, diversion, or as a depository for pollutants. If one state consumes or pollutes river water, this has the potential to create problems for other states depending on the

river. In turn, the interstate relationship can become acrimonious. When such problems arise, the causes are often not malicious intentions, but rather a lack of knowledge, expertise, or resources (Chayes and Chayes 1993). This perspective suggests that among various domestic institutions, a strong and well-functioning bureaucracy is key to managing freshwater resources effectively and in ways that produce fewer externalities. In other words, capable bureaucracies can help address the water usage and pollution issues domestically and thus prevent problems from spiraling into conflictual interstate interactions. For example, a capable bureaucracy can upgrade inefficient or poorly functioning water infrastructure, reduce unnecessary water loss due to leaky pipes, provide for more efficient irrigation, clean polluted water before it is released back into the river, and engage in related activities. These measures can have the effect of dealing with water problems domestically, thus passing fewer externalities on to river users in other countries.

Furthermore, water users are numerous, spanning farmers, ranchers, industry, city dwellers, and others. Monitoring individual use is thus not necessarily easy and there is a great potential that undesirable water use behavior goes undetected or cannot be effectively curtailed. This in turn creates negative externalities for other water users both at home and abroad. Capable bureaucracies can help here by monitoring water use and punishing violators (e.g., by fining them or withholding water use licenses). Importantly, their effect ultimately becomes a deterrent one, where the near-certain threat of detection and punishment can go a long way toward preventing undesirable behavior in the first place (see the off-the-path behavior argument by Weingast 1996). As a result, fewer externalities are generated; this decreases the conflict potential between river-sharing states.

Strained and ineffective bureaucracies can in contrast contribute to making interstate relations between river sharing states conflictual. For one, the unconstrained use of water resources can have direct effects on neighboring states by polluting water that crosses borders, or by reducing the water supply available to the neighboring state. Lacking access to sufficient quantity and quality of water may also generate political pressure from domestic audiences on governments to resolve the problem. Yet, unable to resolve problems such as water scarcity or pollution due in part to a lacking bureaucracy, the government may see few alternatives but to try to deflect the blame

by pointing a finger at another riparian state. That is, the government accuses another state in the river basin of over-using or polluting the shared resource. This is of course a hostile strategy that can hardly be expected to yield positive international outcomes. Yet, such moves are far less necessary if the bureaucracy is capable of developing internal solutions to the country's water problems. For instance, it might be able to upgrade existing water delivery systems to reduce pipe leakage or implement water-conserving policies. A capable bureaucracy will be far quicker and more effective in setting up domestic solutions than a bureaucracy that is overloaded, underfunded, or insufficiently trained. As a result, fewer domestic problems will unduly affect the arena of international freshwater politics.

Beyond their ability to resolve domestic water problems that can find their way to the international level, capable bureaucracies will, importantly, also help states implement the requirements of international river agreements. In tandem with international treaties that set the agreed-upon parameters for shared river management and provide international-level institutional structures for dealing with potential problems, capable domestic bureaucracies promote more cooperative political outcomes between river sharing states. The type of relationship between these two levels of institutions — substitutive or complementary — has important consequences for theory and practice, as the following section shows.

The Interplay Between Domestic and International Institutions

International cooperation has frequently been analyzed by considering mostly domestic or international factors — such as democracy, international trade, or international regimes — in isolation. Recently, however, scholars have cautioned that theoretical models of international cooperation outcomes focusing exclusively or overwhelmingly on either domestic or international factors are inaccurate and suffer from omitted variable bias. This bias is only starting to be demonstrated, for instance in the area of international political economy (Simmons and Elkins 2004; Oatley 2011). We develop this argument further with an eye toward the *design* of international institutions. Be-

yond extant calls to consider international and domestic institutions simultaneously (Bernauer, Kalbhenn, Koubi, and Spilker 2010), our argument suggests a specific conditional relationship. That is, we build a theoretical case for exploring a complementary relationship between the institutionalization of international river treaties and the quality of domestic institutions.

Complements and Substitutes in International Relations Scholarship

Domestic and international institutions can interact in two basic ways: as complements or substitutes. For an example from international political economy, consider Bernhard, Broz, and Clark (2002) and Bearce (2008), who investigate two types of commitment mechanisms to achieve the same goal of exchange rate stability: fixed exchange rates (an internationally-oriented mechanism that depends on another country's exchange rate) and central bank independence (a domestic mechanism). If two institutions function as substitutes, the absence of one can be offset by the presence of another. Complementarity requires the presence of both types of institutions to exert an effect.

Instructive discussions of the interplay between domestic and international institutions also come from work on bilateral investment treaties (BITs) and international trade. Scholars have found that focusing only on the international or domestic domain is insufficient in explaining both the creation and effects of such treaties. A fairly robust consensus in economics states that domestic institutions are highly conducive to attracting foreign direct investment (FDI; see Globerman and Shapiro 2002; Méon and Sekkat 2004). However, given that those countries that are most in need of foreign investment to spur growth are also often facing challenges in building reliable governance institutions, states have turned to international solutions and attempted to attract FDI through BITs (Elkins, Guzman, and Simmons 2006) or international trade agreements (Büthe and Milner 2008). There is indeed evidence that BITs increase investment flows (Neumayer and Spess 2005), possibly suggesting that international institutions can function as substitutes in cases of weak domestic capacity. However, more recent research presents evidence consistent with a complementary effect, where BITs are more effective when the domestic environment is conducive to business (Tobin and Rose-Ackerman 2011; Büthe and Milner 2012). A similar dynamic has been observed for trade

agreements, where the implementation of agreements, such as increasing trade between members, hinges on the domestic institutional capacity of member states (Gray forthcoming).

Our final examples concern human rights and domestic political conflict. Numerous scholars have addressed the puzzle of why governments with documented recent human rights violations would join the International Criminal Court (ICC) and expose themselves to prosecution. Simmons and Danner (2010) have explored this question through the lens of a substitute-based variant of credible commitment theory. In their words, "domestic processes are often less than effective, and [...] the ICC can in these cases provide a more effective — because more credible — substitute" (Simmons and Danner 2010, 237). When governments are vulnerable and the quality of domestic institutions does not guarantee a due political and legal process, commitment to the ICC offers governments a substitute. These arguments also travel into the domain of civil wars. Domestic political conflicts often escalate because weak domestic institutions fail to help governments and rebels achieve bargains; in this case, international institutions can fulfill this function with a notable degree of effectiveness (Karreth and Tir 2013).

Institutions as Complements or Substitutes for Shared Water Resources

In the context of managing transboundary shared water resources, the debates about complements vs. substitutes have important implications. Thus far, international water research and policy practice has not paid adequate attention to this issue. Perhaps unwittingly, the assumption favoring the substitutes view — ignoring the potential conditioning role of domestic institutions — is made frequently. For example, given the large push toward developing new river-sharing treaties and, explicitly, *international* institutional features as parts of these treaties (UNDP 2006, 227-228) without noting the need for capable domestic institutions, capable domestic institutions are assumed to be either always present or irrelevant. Neither of these scenarios is likely accurate. Therefore, our study investigates the dynamics of the relationship between domestic and international institutions in more detail.

Treaty institutionalization as substitute. The first dynamic specifies that bolstering river treaties with institutionalized features can mitigate problems arising from weak domestic governance capacity. For instance, states sharing basins may be unable to monitor water consumption and quality adequately themselves. They may also face problems in regulating water usage. In this case, international river institutions could take on this role when they contain features such as provisions for joint monitoring, conflict resolution, treaty enforcement, or the delegation of authority to intergovernmental organizations; see Tir and Stinnett (2011). Referring to our previous discussion about the detrimental consequences of weak domestic institutions for interstate relations over shared water resources, in a substitute-based logic, international institutions are thought to be able to fill this gap — if they themselves contain institutionalized provisions to address these problems. In fact, this role for international institutions has been advocated by a variety of researchers (e.g., Wolf, Yoffe, and Giordano 2003). This approach is built on the argument that a lack of domestic institutional capacity and quality is one of the prime factors putting river basins at the risk of interstate conflict. Consequently, providing international river treaties with enhanced institutionalized provisions is sufficient to substitute for weak domestic bureaucratic quality. In hypothesis form, the expectation derived from this view is,

> *H1*: River treaty institutionalization promotes water-related political cooperation between riparian states even when the quality of domestic bureaucracy is low.

Treaty institutionalization as complement. The logic flowing from our argument about the practicalities of implementing the obligations of river treaties suggests a different dynamic for the interaction between domestic and international institutions. We argue that the ability of even the most institutionalized river treaties to improve relations between riparian states will depend heavily on the presence of capable domestic institutions. Even when international institutions have taken on one or more of the tasks of monitoring, adjudicating, enforcing, or centralized management, they will likely need to rely on domestic institutions to contribute administrative functions or information. For instance, domestic institutions might still be needed to measure water quality,

regulate dams and hydroelectric facilities, and help with the navigation of waterways. If domestic institutions are unable to perform these tasks, even highly institutionalized river treaties will lack the foundation to ultimately achieve interstate cooperation over water issues.

In other words, while highly institutionalized river treaties may perform a number of cooperation-inducing and conflict-reducing functions, the absence or weakness of quality domestic institutions will ultimately make the implementation of treaty terms difficult and keep the politics of transboundary freshwater resources fragile. Simply put, treaties have little ability to reach deep down into domestic societies to affect the behavior of many individual water users (e.g., households, farmers, ranchers, or industry) and eventually yield returns from institutionalized treaty features. Lacking this ability, changing the behavior of the very users from which problematic water diversion, consumption, or pollution behavior stems will not be easy to accomplish. For this change, capable, on the ground domestic bureaucracies are needed to complement institutionalized treaty features. Well-functioning domestic administrative structures can, for example, police user behavior via a system of fines, improve the efficiency of use, fix leaky water delivery systems, or run filtration stations to get rid of pollutants. These activities all contribute to supporting the functioning of institutionalized treaty features and ultimately help promote cooperation between states over freshwater resources. For instance, monitoring institutions formed by river treaties rely on information provided by domestic institutions. Enforcement agencies of river treaties and even international organizations emanating from treaties need to rely on cooperating with domestic bureaucracies to implement obligations from treaties.

To be sure, we are *not* arguing that institutionalized treaties are irrelevant. While they need capable domestic bureaucracies, the treaties themselves offer value added beyond what the domestic bureaucracies can themselves accomplish. Most notably, due to their essential centralization and independence properties (see Abbott and Snidal 1998), institutionalized treaties can, for example, help assure that the information being passed between signatory states is unbiased, that decisions are made in collaborative and even-handed manner, that disagreements are resolved effectively and fairly, and that undesirable behavior is punished properly so that dispute escalation is pre-empted.

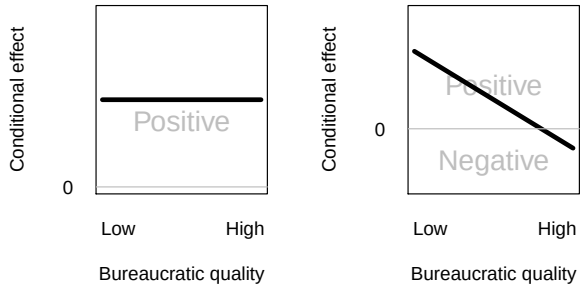
Yet, for these tasks related to the institutionalized treaty features to be ultimately accomplished, functioning domestic bureaucracies are needed. Given that this complementary effect should improve the chances of achieving environmental goals dealing with freshwater access and use, we expect that the political relationship between the river treaty signatory states will be better as well when both institutionalized treaties and quality domestic bureaucracies are present.

In contrast, the inability to implement treaty terms will be problematic for the relationship between the states that have signed a river treaty. Problems with water quality and quantity that may have spurred riparian states to pursue river treaties in the first place will persist and fail to improve the states' relationship. The situation can become even more problematic as in addition to the original water-related problems between the states they are now also frustrated by failures of implementing treaty terms. A mutual blame game can therefore result and escalate toward an even more conflictual situation.

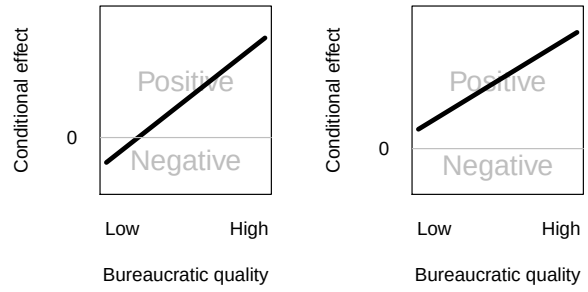
In sum, to ultimately affect environmental cooperative outcomes, international treaties and their institutionalized features require a link toward the many domestic users that are the likely source of problematic behavior. This critical supportive role is performed, we argue, by capable domestic bureaucracies. And with environmental outcomes affected positively, the political relationship between riparian states stands to be more cooperative and less conflictual. We summarize our expectation in the following hypothesis:

> *H2*: The ability of river treaty institutionalization to promote water-related cooperation between riparian states depends on both states possessing high-quality domestic bureaucracies.

Figure 1 provides stylized illustrations of substitutive and complementary relationships between river treaty institutionalization and the quality of domestic bureaucracies.



(a): Illustrations of substitutive effects



(b): Illustrations of complementary effects

Figure 1: Stylized illustrations of substitutive and complementary effects of river treaty institutionalization. The solid black line indicates the relationship between river treaty institutionalization and cooperation at different levels of domestic bureaucratic quality. This relationship is positive above the 0 line and insignificant on the 0 line. Panel (a) illustrates a substitutive relationship, per H1: the effect of treaty institutionalization is either independent of domestic bureaucratic quality, or it disappears when high domestic bureaucratic quality substitutes for it. Panel (b) illustrates conditional effects for a complementary relationship, per H2: the effect of treaty institutionalization only materializes at higher levels of domestic bureaucratic quality, or it is significantly higher under better domestic bureaucratic quality.

Research Design

Because this study examines the impact of the interplay between domestic and international institutions on the politics of interstate cooperation and conflict over freshwater, the empirical domain is restricted to those countries that share international freshwater basins.[3] Following common practice in international relations scholarship, we conduct the empirical analysis at the level of the dyad because cooperative and conflictual behavior typically occurs in a dyadic setting. Data availability for the quality of domestic institutions makes our temporal domain the years between 1984 and 2006.[4] The dyad-year is the unit of analysis for the statistical methods presented below.

Outcome: Conflict and Cooperation over Shared Water Resources

To capture the nature of the political relationship between the basin members, we use the Basins at Risk (BAR) Water Events database. Yoffe, Wolf, and Giordano (2003, 1110) define "water events as instances of conflict and cooperation that occur within an international river basin, involve the nations riparian to that basin, and concern freshwater as a scarce or consumable resource (e.g., water quantity, water quality) or as a quantity to be managed (e.g., flooding or flood control, water levels for navigational purposes)." These data are advantageous for two reasons: they include both cooperative and conflictual interactions, and they are limited to only those events that concern shared river basins. The events were collected systematically from a variety of news sources and existing international events databases. The intensity of interactions is mapped onto the conflict-cooperation BAR scale, which, with minor modifications, follows the COPDAB coding procedures (Azar 1980).

Per Yoffe, Wolf, and Giordano (2003, 1112), "of 1,831 events, 28 percent were conflictive

[3] For our purposes, an international river basin "comprises all the land that drains through a given river and its tributaries into an ocean or an internal lake or sea and includes territory of more than one country" (Yoffe, Wolf, and Giordano 2003, 1110).

[4] 1984-2008 for models using the overall quality of governance as a predictor.

(507 events), 67 percent were cooperative (1,228), and the remaining 5 percent were neutral or nonsignificant." Events relate to issues of, in particular, water quantity, riparian infrastructure development, joint management of river resources, and hydropower generation. The average cooperative and conflictual score tends to be slightly positive (i.e. cooperative) and relatively similar across the world regions. Yoffe, Wolf, and Giordano (2003) provide a detailed description of coding sources and procedures as well as additional descriptive statistics relating to the database.

Since we are interested in the overall quality of the political relationship, we use the database to generate our outcome variable by calculating the average level of conflict-cooperation interactions in a given year for a given dyad. Dyad-years without any events recorded in the BAR database are coded as neutral (0).

Predictors: Domestic and International Institutions

Treaty institutionalization. Because our theoretical argument emphasizes the role of institutionalized treaty features, our first key explanatory variable is an additive river treaty institutionalization index, adapted from Tir and Stinnett (2011). The index is composed of the following institutional features potentially contained in each of the agreements: monitoring, enforcement, conflict resolution, and delegation of authority to an international organization. For each basin-sharing dyad, we score each potential institutional component as 0 or 1, and then add them up. This produces a scale of institutionalization ranging from 0 to 4, where 0 indicates informal dyadic cooperation only (i.e. no treaty or no institutionalized features if a treaty was signed) and 4 indicates that a dyad has institutionalized all four features.[5] On the whole, river treaties have a mean and median of 2 institutional features.

[5]All information on treaty characteristics, including the overall index, are coded with respect to changes over time. That is, if a treaty is renegotiated and deepened, the new information is reflected in the treaty institutionalization index.

Domestic Bureaucratic Quality. To capture a country's domestic institutional ability for dealing with challenging issues, we rely on data provided by the International Country Risk Guide (ICRG) project (The PRS Group 2009). ICRG uses multiple dimensions (bureaucratic quality, democratic accountability, government stability, socioeconomic conditions, etc.) to generate its overall Quality of Governance index for a large number of countries. Per our theoretical argument, we are most interested in the *Bureaucratic Quality* measure. As a robustness check, we replace this variable with the overall quality of governance index in alternate models reported below. Our findings remain the same.

Following the weak link logic that the less bureaucratically capable dyadic member is the determinative actor in the relationship (i.e., it is "holding the dyad back" from greater levels of cooperation; see Oneal and Russet 1997, 273), we use the lower score in the analyses. Bureaucratic quality ranges continuously from 0 to 4, with a mean (median) of 1.6 (1). The overall quality of governance is a continuous variable ranging from 0 to 1, with a mean and median of 0.4 in our sample.

Control Variables

Our models control for potential influences on conflict and cooperation patterns drawn from the water politics literature. We capture the political pressure related to water scarcity by measuring water availability for the water poorer dyad member, using data on renewable water per capita found in the FAO Aquastat database (Food and Agriculture Organization of the United Nations 2012). In order to verify that the observed freshwater politics outcomes are not simply a function of the quantity of treaties signed, we control for the number of treaties in effect between the dyad members, using data from Stinnett and Tir (2009) and Tir and Stinnett (2011), based on Wolf (2012).

Reflecting (neo)liberal international relations scholarship, the models include an indicator for joint democracy, operationalized as a joint score of 7 or higher on the net regime score from the Polity IV data (Marshall and Jaggers 2009), a dataset commonly used to measure the characteristics

of political regimes. The level of economic development affects water affordability (Feitelson and Chenoweth 2002) and is considered by some to affect relations between riparian states (Biswas 2001). This variable is measured by the wealthier dyad member's gross domestic product per capita (Heston, Summers, and Aten 2009). The final three control variables reflect arguments growing out of the realist literature. The models account for the influence of relative power distribution, which we measure as the natural logarithm of the stronger divided by the weaker state's capabilities, based on the Correlates of War Material Capabilities composite index (Singer, Bremer, and Stuckey 1972). Data from Gibler and Sarkees (2004) provides information on whether the states are allies. Finally, using data from Stinnett, Tir, Diehl, Schafer, and Gochman (2002), contiguity enters the statistical models that do not contain fixed effects for dyads.

Estimation

The data cover several hundred cross-sectional units (dyads) and varying amounts of years. Having identified serial correlation in the error term of a naive OLS model, we follow common convention and include a lagged dependent variable in our models (Keele and Kelly 2006). We estimate fixed effects (FE) models for three reasons. First, we are particularly interested whether institutionalized river treaties have an effect *within* dyads after they are signed. Second, we detect unit heterogeneity and, heeding the advice of Clark and Linzer (2012), because the number of cross-sections is higher than the number of temporal units, the FE estimator is preferable. Third, the correlation between predictors and the unit effects is substantial. For comparison, we also present results from random-effects models in the online appendix; they are substantively similar to our main findings.

In sum, we estimate the following linear model containing an interactive term to adjudicate between a substitutive and complementary effect of river treaty institutionalization and domestic

bureaucratic capacity:

$$\begin{aligned}\text{Cooperation \& Conflict}_{i,t} \;=\; & \lambda\ \text{Cooperation \& Conflict}_{i,t-1} \\ & +\alpha_0+\alpha_i+\beta_1\text{Treaty institutionalization}_{i,t}+\beta_2\text{Bureaucracy}_{i,t} \\ & +\beta_3\text{Treaty institutionalization}_{i,t}\times\text{Bureaucracy}_{i,t} \\ & +\gamma\mathbf{C}_{i,t}+\varepsilon \qquad (1)\end{aligned}$$

In the model, α_i are fixed effects (separate intercepts) for i dyads and $\mathbf{C}_{i,t}$ is a matrix of the remaining control variables discussed above.

Discussion

Main Results

The results for the conditional relationships between domestic and international institutions can be found in Table 1. To facilitate interpretation of the interaction terms (Brambor, Clark, and Golder 2006), we turn the reader's attention to the graphical representation of the conditional effects of international institutions, represented in Figure 2. The results point strongly toward the complementary effect of international institutions specified in *H2*. Meanwhile, *H1*, expressing a substitutive relationship, receives no empirical support.

To evaluate the moderating role of domestic bureaucratic quality for the effect of river treaties on interstate cooperation, we turn to Model 1. Here, graphically represented in Figure 2 (a), we find clear evidence for a complementary relationship: only at higher levels of domestic bureaucratic quality does the institutionalization of river treaties steer the interactions of riparian states away from conflict and toward cooperation. Below those levels, more institutionalized features of river treaties have no significant impact on cooperation between riparian states. The magnitude of the effect is considerable; at higher quality levels of domestic bureaucracies, adding one institutionalized feature to international river treaties increases the average yearly cooperation score by more

Table 1: Fixed effects estimates of determinants of water-related cooperation and conflict.

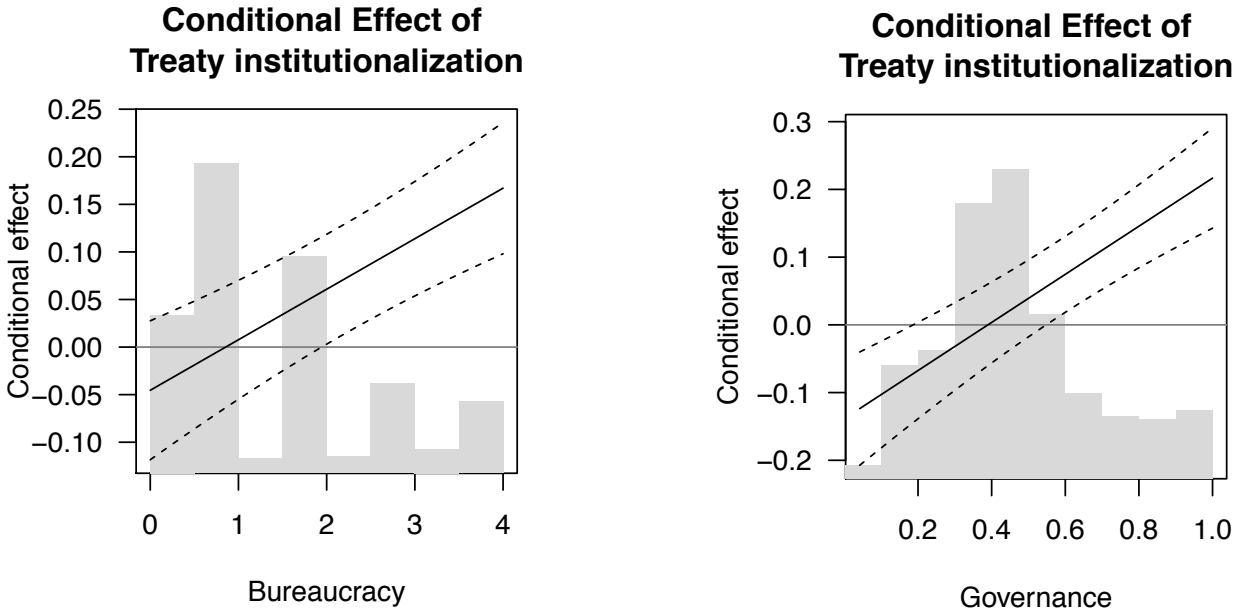
	Model 1	Model 2
BAR_{t-1}	-0.005	-0.007
	(0.010)	(0.010)
Treaty institutionalization	-0.045	-0.138^{*}
	(0.037)	(0.045)
Treaty count	0.032	0.031
	(0.021)	(0.021)
Bureaucracy (lower)	0.014	
	(0.017)	
Treaty institutionalization	0.053^{*}	
$\times$ Bureaucracy (lower)	(0.011)	
Governance (lower)		0.188^{*}
		(0.094)
Treaty institutionalization		0.355^{*}
$\times$ Governance (lower)		(0.059)
Water availability (lower)	-0.124^{*}	-0.101^{*}
	(0.038)	(0.037)
Democratic dyad	-0.155^{*}	-0.129^{*}
	(0.038)	(0.035)
GDP p.c. (higher, logged)	-0.052	-0.045
	(0.044)	(0.043)
Power ratio	-0.023	0.016
	(0.042)	(0.019)
Alliance	0.049	0.049
	(0.032)	(0.031)
Intercept	1.885^{*}	1.252
	(0.808)	(0.788)
Dyads	664	675
N	10947	11361
Dyad fixed effects	✓	✓

Outcome: Average yearly cooperation/conflict score (higher BAR score denotes greater cooperation levels).

Standard errors in parentheses. $^{*}p < 0.05$

than 0.1 points. Moving from no institutionalized river treaty features at all to all four elements would thus increase the propensity of a dyad with high quality (at the 90th percentile) domestic bureaucratic institutions by little less than one standard deviation of the conflict & cooperation score — a noteworthy effect size.

In Figure 2 (b), based on Model 2, we replace the narrow measure of domestic bureaucratic quality with the broader measure of the quality of domestic governance. The results again support the complements view, that is *H2*. The effect of the institutionalization of river treaties on cooperation only becomes significant and positive once the domestic institutions' quality exceeds a value of about 0.55.[6]



(a): Moderator: Bureaucratic quality

(b): Moderator: Governance

Figure 2: The effect of treaty institutionalization, conditional on domestic institutional quality, on the average yearly conflict/cooperation score. The solid line shows the effect of treaty institutionalization at different levels of domestic institutional quality. Dashed lines indicate the 95% confidence intervals. Gray histograms show the distribution of the variables measuring domestic institutional quality. Results based on Models 1 and 2 in Table 1.

[6]In the few dyads (fewer than 10% of observations) where domestic governance is rated as very low (below 0.2 on the 0 to 1 ICRG scale), higher treaty institutionalization is actually associated with lower values on the cooperation scale.

Endogeneity Concerns

A typical concern in the literature on international institutions is that cooperative states might selectively establish international institutions with other cooperative states, and that resulting cooperative behavior cannot be attributed to the treaties themselves (see, e.g., Downs, Rocke, and Barsoom 1996; von Stein 2005). To address this issue in the context of river treaties, we turn to an instrumental variable (IV) solution.

Instrument: Number of States in Basin

The IV approach requires an instrumental variable Z that predicts both the endogenous X (the institutionalization of river treaties) and Y (water-related cooperation) variables. In addition, the exclusion restriction means that the relationship between Z and Y must be solely through X (see, e.g., Angrist and Pischke 2008, chapter 4). We use as an instrument the average number of states in the basins shared by the dyad members. This variable predicts the institutionalization of river treaties well ($p < 0.001$, see Table A1 and more information in the online appendix). We also have a good theoretical reason to assume that its impact on water-related conflict and cooperation exclusively comes from the (potentially) endogenous variable, treaty institutionalization, as we discuss in the next paragraph.

There are theoretical grounds for fulfilling the exclusion restriction. The rational design literature has emphasized that states turn to institutional solutions under scenarios such as a high number of states in a collaboration problem (Koremenos, Lipson, and Snidal 2001, 797). The more states in a basin, the more difficult it is for all basin members to ascertain others' behavior (due to the multiplicity of strategic options), and the more difficult it is to enforce behavior bilaterally. Following this rational design logic, states in these situations are more likely to turn to institutional solutions with the features we measure in the river treaty institutionalization index: centralization and delegation via monitoring, enforcement, conflict resolution, and international organizations. Thus, the empirical and theoretical justifications for using the number of river basins (and, in addition, dummy variables for years to address temporal effects) are both strong.

Estimation

In the first stage, we estimate the relationship between the endogenous variable X (treaty institutionalization) and the original instrument, the number of states in the basin.[7] Next, following Wooldridge (2010, 942-945), we construct two instruments: the predicted values for treaty institutionalization and the interaction between domestic institutions and the predicted values for treaty institutionalization. Finally, we estimate the IV regression, using the above instruments we just constructed. The resulting estimates shown in Table 2 are substantively similar to the main results in the preceding discussion. Figure 3 in fact provides equally strong evidence in favor of H2 and the *complementary* argument regarding the role of international and domestic institutions. Notably, the cooperative effect almost triples at high levels of bureaucratic quality, again supporting the complementary argument. The dynamics are similar for the more general quality of governance measure.

Control Variables

Our findings are robust to controlling for the influence of several variables that may have a bearing on the relationship between riparian states. Water availability has a consistently significant and negative effect on cooperation, supporting the argument that water scarcity provides an important incentive for states to cooperate over water resources (Tir and Ackerman 2009; Stinnett and Tir 2009). Democratic dyads are less likely to cooperate as well. This finding does not necessarily indicate that democratic states are conflictual. Rather, the finding is likely an artifact of authoritarian states' attempts to over-compensate for their lack of credibility by going overboard with frequent cooperative actions; see Drezner's (2003) argument on how authoritarian leaders need to exhibit more cooperative behavior in order to signal credible commitment. The coefficient on the number of treaties variable is generally insignificant. Combined with the finding that institutionalized river

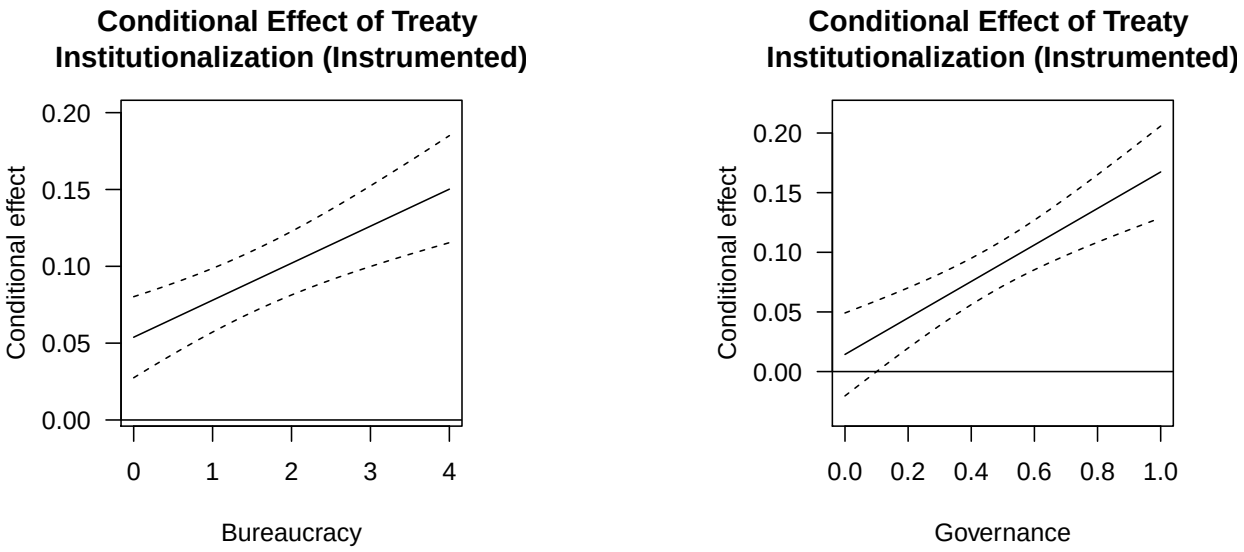
[7] See Equations 2-7 in the online appendix for the equations for the steps mentioned in this section.

Table 2: Instrumental variable estimates of determinants of water-related conflict and cooperation.

	Model 1-IV	Model 2-IV
BAR_{t-1}	0.103*	0.099*
	(0.009)	(0.009)
Treaty institutionalization (instr.)	0.054*	0.014
	(0.013)	(0.018)
Treaty count	−0.011*	−0.011*
	(0.005)	(0.005)
Bureaucracy (lower)	0.012	
	(0.010)	
Treaty institutionalization (instr.)	0.024*	
× Bureaucracy (lower)	(0.005)	
Governance (lower)		0.175*
		(0.055)
Treaty institutionalization (instr.)		0.153*
× Governance (lower)		(0.032)
Water availability (lower)	−0.003	−0.002
	(0.006)	(0.005)
Democratic dyad	−0.082*	−0.097*
	(0.026)	(0.024)
GDP p.c. (higher, logged)	−0.006	−0.018*
	(0.009)	(0.009)
Power ratio	0.012*	0.013*
	(0.006)	(0.005)
Alliance	−0.002	0.001
	(0.020)	(0.019)
Intercept	0.169*	0.200*
	(0.080)	(0.078)
Dyads	664	675
N	10835	11231

Outcome: Average yearly cooperation/conflict score (higher BAR score denotes greater cooperation levels).

Standard errors in parentheses. * $p < 0.05$



(a): Moderator: Bureaucratic quality

(b): Moderator: Governance

Figure 3: Instrumental variable results: Effects of treaty institutionalization, conditional on domestic institutional quality, on the average yearly conflict/cooperation score, based on Models 1-IV and 2-IV.

treaties significantly improve the relationship though, the number of treaties result suggests that the quality of the treaty as opposed to the quantity of treaties signed is the better way of managing the riparian interdependence. Much like, for instance, Gleditsch et al. (2006) and Tir and Ackerman (2009), we find no evidence for an impact of economic development on water relations. Our findings do not, however, mean that liberal influences are irrelevant for the water politics relationship. After all, our key explanatory variables deal precisely with the properties of domestic and international institutions and perform consistently well in our models. Our explanatory variables are hence better at capturing liberal-institutionalist influences in the context of conflict and cooperation in the arena of water politics than are the traditional but broad liberal factors commonly utilized in conflict studies. Finally, neither power preponderance, alliances, or geographic contiguity display robust relationships with the politics of freshwater resources.

Robustness Checks

We briefly report a number of robustness checks and refer to detailed results in the online appendix. The choice to model water-related conflict and cooperation between dyads with dyad-level fixed effects, that is, focusing on variation within rather than between dyads, is preferable because of the remaining heterogeneity between dyads in extant model specifications. Nevertheless, allowing both within-dyad and between-dyad variance by estimating random effects models returns substantively similar findings, as the respective columns in Table A2 and Figure A2 show. Conversely, it might be possible that changes in institutionalization within dyads mask broader temporal trends. To address this concern, we stripped all temporal variance of the coefficients for treaty institutionalization and domestic institution by using fixed effects for years, in addition to dyads. These results are substantively identical (see Table A3 and Figure A3).

In the original analyses, we assigned an institutionalization score of 0 to those dyads that have either not signed treaties or have signed treaties that contain no institutional features at all. As a robustness check, in an alternate coding specification we differentiate between these two types of situations. That is, dyads that have not signed river treaties at all are given the score of 0, while treaties with no institutional features are assigned a score of 1. Institutionalization scores of 2 through 5 then account for the number of institutionalized features as discussed above. The findings remain unchanged and are reported in Table A4 and Figure A4.

Implications and Conclusion

This study uses the critical case of the politics of cooperation and conflict over transboundary freshwater resources to investigate the degree to which international institutions can perform their tasks in the absence of functioning domestic institutions. Our findings suggest that turning to multifaceted high-capacity international institutions to promote cooperation between states requires the presence of high-quality domestic bureaucracies. Building up international treaties with multiple institutional features requires the complement of functioning domestic institutions and cannot

substitute for their absence. This finding is consequential, considering that much of international cooperation research to date has advanced the argument that properly designed international institutions can resolve various interstate cooperation dilemmas. In line with this view, states with shared water resources have used river treaties to improve transboundary freshwater management and improve water-related cooperation. Our findings raise doubts about this optimistic view of a constant positive effect international institutions, independent of domestic institutions, on interstate cooperation. We find instead that the complementary view of institutionalized international river treaties and domestic institutions is consistent with the empirical record. The causes of interstate conflict over water are often grounded in domestic problems, such as water use and management, and the solutions to these problems may thus also hinge on domestic factors. Yet, the frequent turn towards the buildup of institutionalized river treaties in the domain of international freshwater politics suggests that our findings have important implications for the way in which policymakers in governments and international organizations deal with the management of transboundary freshwater resources.

The importance of these findings in favor of the complementary perspective transcends the politics of river cooperation. If domestic institutional capacity is indeed necessary to achieve international cooperation, the way international institutions function will need to be reconsidered. For instance, after World War II, international institutional cooperation started with highly developed countries, mostly in Western Europe. Scholarship examining these institutions focused on the institutions themselves and their design. Later on, this type of institutionalized cooperation has spread to the countries in the middle ranges of economic development. Yet, in both highly and mid-developed countries, some degree of domestic institutional capacity can be assumed. The potential problem of omitted variable bias thus does not become apparent until the least developed countries participate in international institutions. For the proper theoretical and policy-oriented analysis of institutionalized cooperation it is therefore paramount to consider the moderating role of domestic institutions.

In addition to the theoretical and conceptual angle, this issue has substantial practical impli-

cations. The effects of climate change are expected to be felt particularly strongly in the least developed part of the world. As an adaptive response, the international institutional management of shared water resources has been heralded as a solution (see, e.g., Giordano, Giordano, and Wolf 2005; UNDP 2006). Yet, without addressing the issue of domestic institutional capacity, international-level institutional solutions may fall short.

The evidence in this study, clearly supporting the complementary view of international and domestic institutions, suggests two broader additional implications. First, the international institutions literature may benefit from taking more seriously the dependency of international institutions, in terms of their effectiveness, on the quality of domestic governance. It should also avoid omitted variable bias resulting from ignoring the conditionality of this relationship. Second, policymakers cannot assume that problems of shared water resources can be resolved by establishing multifaceted high-capacity international institutions alone. Instead, to achieve politically effective and meaningful interstate cooperation over shared water, addressing domestic institutional shortcomings will be necessary as well.

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Online Appendix

This appendix will be provided on the authors' websites and contains:

- additional information on river treaties
- the equations used to construct instrumental-variable estimates
- results from random-effects estimates of Models 1-2 (Table A2)
- results from estimates of Models 1-2 including fixed effects for dyads and years (Table A3)
- results from estimates of Models 1-2 using an alternative coding of treaty institutionalization (Table A4)
- plots to evaluate the conditional effects in Tables A2, A3, and A4

The Spatial Distribution of River Treaties

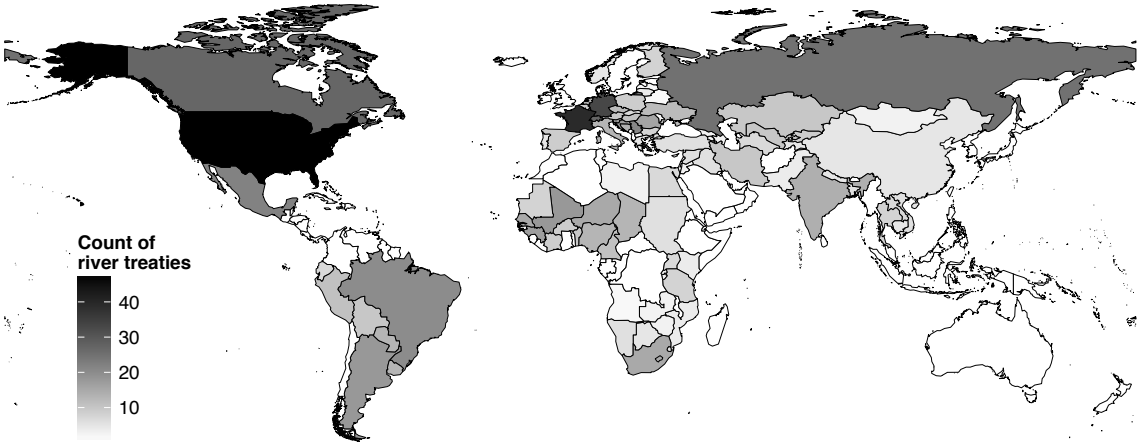


Figure A1: Freshwater cooperation treaties across the world in 2000. Darker shades indicate that a country is party to more freshwater cooperation treaties. No shading indicates that the country has signed no such treaties at all.

Details on Estimating the Instrumental Variable Solution

In the first stage, we estimate the relationship between the endogenous variable X (treaty institutionalization) and the original instrument, the number of states in the basin:

$$\text{Treaty institutionalization}_{i,t} = \alpha_0 + \beta_1 \text{Number of states}_i + \alpha_i + \gamma_t + \varepsilon \tag{2}$$

Table A1: First stage estimates of river treaty institutionalization, used in the IV solution in Table 2.

	First stage
Number of states in basin	0.02*
	(0.005)
R^2	0.94
F-statistic	250.5
Dyads	675
N	11231
Dyad fixed effects	✓

Outcome: River treaty institutionalization (higher numbers denote more institutionalized features).

Coefficients for dummy variables for years not displayed.

Standard error in parentheses. $^{*}p < 0.05$

The results are shown in Table A1. Next, following Wooldridge (2010, 942-945), we construct two instruments based on the model in Table A1: the predicted values for treaty institutionalization and the interaction between domestic institutions and the predicted values for treaty institutionalization.

$$Z_{i,t} = \widehat{\text{Treaty institutionalization}}_{i,t} \tag{3}$$

$$Z_{i,t} \times X_{i,t} = \widehat{\text{Treaty institutionalization}}_{i,t} \times \text{Governance}_{i,t} \tag{4}$$

Finally, we estimate the IV regression, using the above instruments we just constructed:

$$\text{Conflict \& Cooperation}_{i,t} = \alpha_0 + \beta_1 Z_{i,t} + \beta_2 X_{i,t} + \beta_3 Z_{i,t} \times X_{i,t} + \boldsymbol{\gamma}\mathbf{C}_{i,t} + \varepsilon \tag{5}$$

where $\mathbf{C}_{i,t}$ is a matrix of the remaining control variables discussed above.

Just as in the previous analyses, we then calculate conditional effects and their variances σ^2 via Brambor, Clark, and Golder (2006) using the formulae:

$$\frac{\partial \text{Conflict \& Cooperation}}{\partial \text{Treaty institutionalization}} = \beta_1 + \beta_3 \text{Governance}_{i,t} \tag{6}$$

$$\sigma^2 = var(\hat{\beta}_1) + \text{Governance}_{i,t}^2 \times var(\hat{\beta}_3) + 2 \times \text{Governance}_{i,t} \times cov(\hat{\beta}_1 \hat{\beta}_3) \tag{7}$$

Additional Robustness Tests

Table A2: Random-effects estimates of determinants of water-related cooperation and conflict.

	Model 1-RE	Model 2-RE
BAR_{t-1}	0.061^{*}	0.056^{*}
	[0.042; 0.082]	[0.038; 0.076]
Treaty institutionalization	0.032^{*}	-0.019
	[0.001; 0.063]	[−0.060; 0.022]
Treaty count	-0.013^{*}	-0.012^{*}
	[−0.025; −0.001]	[−0.024; −0.001]
Bureaucracy (lower)	0.015	
	[−0.008; 0.038]	
Treaty institutionalization	0.032^{*}	
× Bureaucracy (lower)	[0.020; 0.045]	
Governance (lower)		0.212^{*}
		[0.091; 0.332]
Treaty institutionalization		0.205^{*}
× Governance (lower)		[0.134; 0.274]
Water availability (lower)	−0.007	−0.006
	[−0.021; 0.007]	[−0.019; 0.008]
Democratic dyad	-0.104^{*}	-0.115^{*}
	[−0.159; −0.049]	[−0.166; −0.064]
GDP p.c. (higher, logged)	−0.006	−0.021
	[−0.027; 0.014]	[−0.041; 0.000]
Power ratio	0.007	0.009
	[−0.007; 0.021]	[−0.004; 0.022]
Alliance	−0.008	−0.004
	[−0.053; 0.035]	[−0.047; 0.039]
Contiguity	0.100^{*}	0.099^{*}
	[0.057; 0.143]	[0.057; 0.141]
Intercept	0.176	0.217^{*}
	[−0.018; 0.370]	[0.026; 0.407]
Log Likelihood	−13614.700	−14006.471
Dyads	664	675
N	10947	11361

Outcome: Average yearly cooperation/conflict score (higher BAR score denotes greater cooperation levels).

Confidence intervals in parentheses. * 0 outside the confidence interval.

Table A3: Fixed effects estimates (dyads and years) of determinants of water-related cooperation and conflict.

	Model 1-DYFE	Model 2-DYFE
BAR_{t-1}	−0.003	−0.003
	(0.010)	(0.010)
Treaty institutionalization	−0.043	−0.138*
	(0.037)	(0.045)
Treaty count	0.028	0.026
	(0.022)	(0.021)
Bureaucracy (lower)	−0.010	
	(0.018)	
Treaty institutionalization	0.054*	
× Bureaucracy (lower)	(0.011)	
Governance (lower)		−0.062
		(0.103)
Treaty institutionalization		0.354*
× Governance (lower)		(0.058)
Water availability (lower)	−0.096*	−0.092*
	(0.043)	(0.041)
Democratic dyad	−0.128*	−0.102*
	(0.042)	(0.039)
GDP p.c. (higher, logged)	0.040	0.036
	(0.049)	(0.048)
Power ratio	−0.010	0.004
	(0.042)	(0.025)
Alliance	−0.009	0.005
	(0.036)	(0.035)
Intercept	0.747	0.601
	(0.821)	(0.798)
Dyads	664	675
N	10947	11361
Dyad fixed effects	✓	✓
Year fixed effects	✓	✓

Outcome: Average yearly cooperation/conflict score (higher BAR score denotes greater cooperation levels).

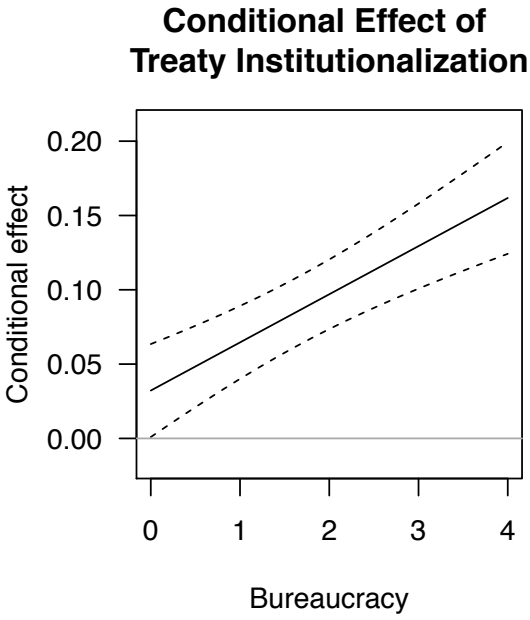
Standard errors in parentheses. $^{*}p < 0.05$

Table A4: Fixed effects estimates of determinants of water-related cooperation and conflict; alternative coding of treaty institutionalization.

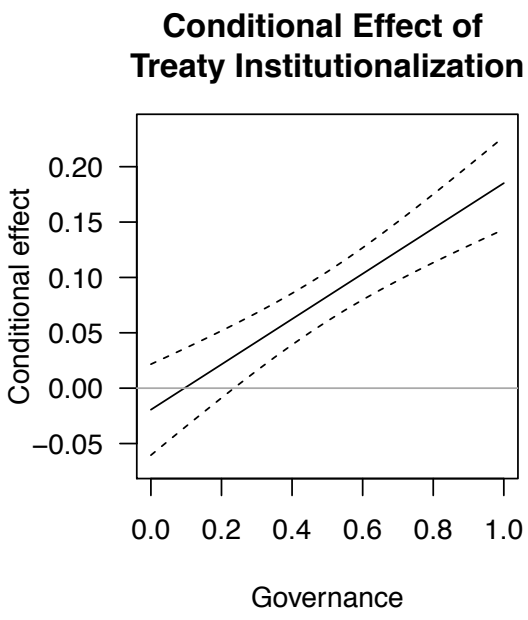
	Model 1-AC	Model 2-AC
BAR_{t-1}	−0.004	−0.006
	(0.010)	(0.010)
Treaty institutionalization	−0.030	−0.092*
	(0.027)	(0.033)
Treaty count	0.039	0.038
	(0.021)	(0.021)
Bureaucracy (lower)	0.012	
	(0.018)	
Treaty institutionalization	0.036*	
× Bureaucracy (lower)	(0.008)	
Governance (lower)		0.174
		(0.098)
Treaty institutionalization		0.240*
× Governance (lower)		(0.045)
Water availability (lower)	−0.122*	−0.100*
	(0.038)	(0.037)
Democratic dyad	−0.157*	−0.133*
	(0.038)	(0.035)
GDP p.c. (higher, logged)	−0.050	−0.045
	(0.044)	(0.043)
Power ratio	−0.024	0.015
	(0.042)	(0.019)
Alliance	0.049	0.047
	(0.032)	(0.031)
Intercept	1.731*	1.118
	(0.806)	(0.788)
Dyads	664	675
N	10947	11361
Dyad fixed effects	✓	✓

Outcome: Average yearly cooperation/conflict score (higher BAR score denotes greater cooperation levels).

Standard errors in parentheses. $^{*}p < 0.05$

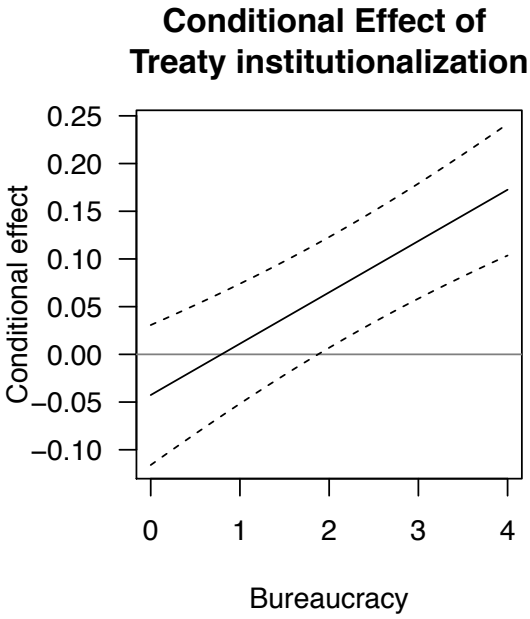


(a): Moderator: Bureaucratic quality

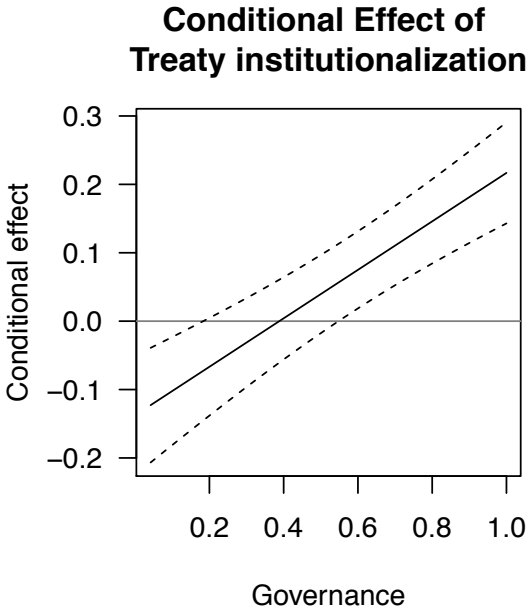


(b): Moderator: Governance

Figure A2: The effect of treaty institutionalization, conditional on bureaucratic quality and governance, on the average yearly conflict/cooperation score. Estimates include random effects for dyads and are based on Models 1-RE and 2-RE in Table A2.

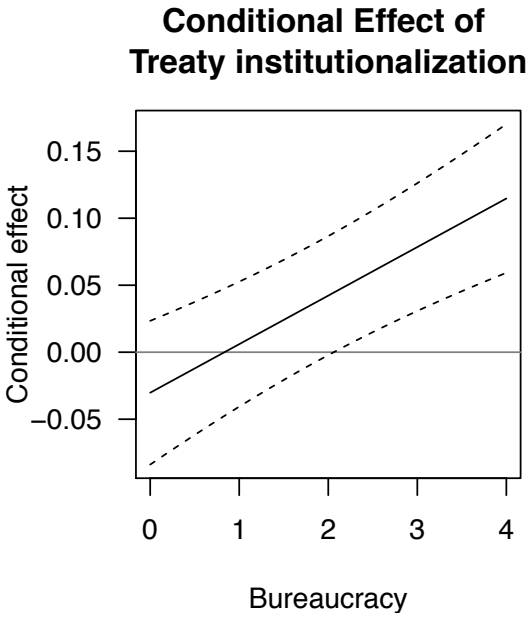


(a): Moderator: Bureaucratic quality

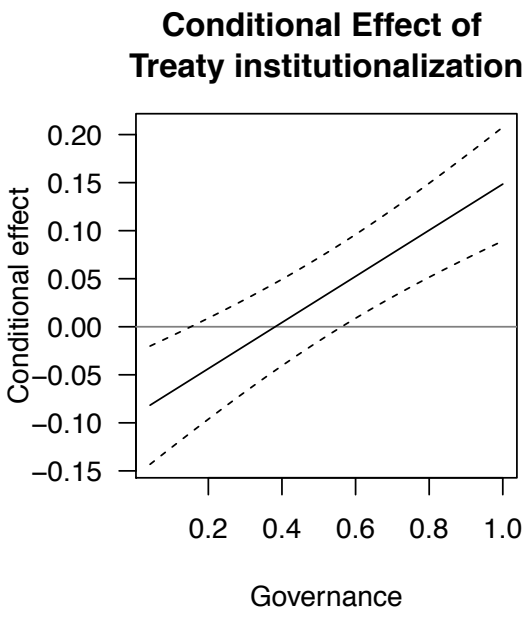


(b): Moderator: Governance

Figure A3: The effect of treaty institutionalization, conditional on bureaucratic quality and governance, on the average yearly conflict/cooperation score. Estimates include fixed effects for dyads and years and are based on Models 1-DYFE and 2-DYFE in Table A3.



(a): Moderator: Bureaucratic quality



(b): Moderator: Governance

Figure A4: The effect of treaty institutionalization, conditional on bureaucratic quality and governance, on the average yearly conflict/cooperation score. Alternative coding of treaty institutionalization: 0 = no treaty, 1 = treaty w/o institutional features, 2 = 1 institutional feature, etc. Results based on Models 1-AC and 2-AC in Table A4.