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Governing Transnational Commons: How International Treaties and Multi-Stakeholder Organizations Shape Cooperation and Conflict

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ABSTRACT When common-pool resources such as freshwater, clean air, and fisheries span national borders, the collective action problems encountered are particularly severe. This study explores the role of polycentric governance systems in overcoming these pressing problems, which frequently underlie global grand challenges. Integrating political economy and management research, we hypothesize about how two governance mechanisms – *international treaties* and *multi-stakeholder organizations* – shape the likelihood of cooperation and conflict between countries. Leveraging unique, longitudinal data capturing interactions of countries bordering international river basins, our empirical analysis reveals two main findings. First, we find that the specification of multi-stakeholder organizations enhances water-related cooperation and reduces water conflict among countries, while the specification of international treaties enhances cooperation but does not affect conflict. Second, we find that leaving one of these governance mechanisms less specified than the other actually improves, rather than harms, relationships between countries. Our findings point to a superior governance configuration that simultaneously enhances cooperation and constrains conflict. This configuration combines: (1) treaties that establish property rights but leave procedural rules and uncertainty management provisions less established with (2) multi-stakeholder organizations that define processes for making decisions, sharing information, engaging the public, and resolving disputes.

Keywords: common-pool resources, international treaties, multi-stakeholder organizations, polycentric governance, transnational commons

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INTRODUCTION

Many grand challenges of our time – including climate change, environmental pollution, poverty, and natural resource scarcity – centre around managing common-pool resources (George et al., 2016; Gümüsay et al., 2022; Patala et al., 2022). As public goods, commons such as forests, oil pools, grasslands, fisheries, irrigation systems, and river basins are susceptible to the problem of the 'tragedy of the commons', which occurs when a resource is rivalrous in consumption and non-excludable in access or use (Hardin, 1968, p. 1243; Ostrom, 1990). Actors guided by short-term self-interest have strong incentives to exploit a common resource at the expense of long-term collective interest (Bridoux and Stoelhorst, 2022; McGahan and Pongeluppe, 2023). This poses a dilemma. Instead of jointly searching for solutions and establishing the cooperation necessary to tackle complex problems transcending firms, markets, and nations (Couture et al., 2023; Markman et al., 2019), different societal actors may act opportunistically and thereby trigger conflicts.

Prior research shows that property rights, rules, incentive structures, and regulatory systems can help overcome this dilemma by facilitating coordination and cooperation among actors (Hardin, 1968; Stavins, 2011). In particular, Ostrom's (1990) seminal work on *polycentric governance* – defined as governance via multiple centres of decision-making that operate with some degree of autonomy at different levels (e.g., local, regional, state, and national) – suggests ways to effectively manage common-pool resources and avoid their depletion. As an alternative to either centralized government control or decentralized market-based governance mechanisms, polycentrism describes a governance system in which collectives establish and enforce context-specific rules and norms in a cooperative manner (Bridoux and Stoelhorst, 2022; Klein et al., 2019).

Ostrom's (1990) foundational work and most subsequent studies examine smaller-scale, community-based resource systems *within single countries*. However, many commons *span national borders*, which raises the question of whether prior findings can be scaled up (Berkes, 2006). Relying on proximity, familiarity, and close communication between actors, polycentric governance becomes more difficult when resource pools increase in size and complexity (McGahan and Pongeluppe, 2023). In transnational commons, the distinct political, social, and legal systems of countries further complicate matters, especially since there is often no overarching governing authority prescribing the rules of the game for the actors involved (Ansari et al., 2013).

Against this backdrop, we aim to extend Ostrom's (1990) ideas on polycentrism to the transnational governance of large-scale resource systems (Ansari et al., 2013; Carlisle and Gruby, 2019). We focus our analysis on international river basins. Freshwater is an increasingly scarce, common-pool resource that is difficult to govern (Mekonnen and Hoekstra, 2016; Vörösmarty et al., 2000). The world's 310 international river basins account for roughly 60 per cent of the global freshwater supply (Giordano et al., 2014). These basins are shared by 150 countries that jointly cover 47 per cent of the Earth's land surface and are home to about 52 per cent of the world's population (McCracken and Wolf, 2019). *Riparians* (countries bordering the same river basin) face the strategic choice to cooperatively develop or directly compete for these shared water resources with each other. Although water cooperation is a more typical and rational form of collective action,

numerous water-related conflicts have occurred between countries in the past, ranging from minor diplomatic disputes to major military interventions (Bakker, 2012; Yoffe et al., 2003).

In this study, we examine how the design of polycentric systems composed of two governance mechanisms, *international treaties* and *multi-stakeholder organizations*, influences the emergence of water cooperation and conflict between countries. We expect treaties to set the rules of the game for managing and using shared freshwater resources, thereby reducing uncertainty and facilitating collective action (Petersen-Perlman et al., 2017). Multi-stakeholder organizations complement treaties by serving as forums for politicians, administrators, citizens, and non-governmental organizations (NGOs) to discuss and resolve freshwater issues (Schmeier et al., 2016). Our longitudinal analysis of 122 river-basin country dyads (1997–2007) utilizes Cox proportional hazard models and uncovers two main findings. First, we find that the degree of specification of multi-stakeholder organizations (i.e., the number of mechanisms for governing different water management activities that they provide) enhances water-related cooperation and reduces water conflict, while the degree of specification of international treaties (i.e., the number of water-related issues they cover) enhances cooperation but does not affect conflict. Second, interaction analyses show that leaving one of these governance mechanisms less specified than the other actually improves, rather than harms, relationships between countries. Our findings reveal a superior governance configuration that fosters water cooperation while simultaneously reducing water conflict. This configuration combines: (1) international treaties that establish property rights but leave procedural rules and uncertainty management provisions less established with (2) multi-stakeholder organizations that define processes for making decisions, sharing information, engaging the public, and resolving disputes.

These findings contribute to research at the intersection of natural resources management, grand challenges, and multi-stakeholder governance (Couture et al., 2023). Integrating Ostrom's (1990) work on polycentric governance with ideas from management research on the governance of interorganizational relationships (Faems et al., 2008; Poppo and Zenger, 2002), our study offers a new perspective on the design and functioning of governance mechanisms at the transnational level. Perhaps most importantly, we help identify multi-stakeholder organizations as an underexplored yet potentially powerful mechanism for governing transnational commons. When well-specified and supported by international treaties, such organizations bring a unique coordinative and adaptive capacity to polycentric governance systems. This is particularly useful in the multi-faceted context of international river basins and other transnational commons where contractual (e.g., international treaties) and informal (e.g., self-organized, community-based approaches) governance mechanisms alone may be less effective (Ansari et al., 2013).

TRANSNATIONAL COMMONS: CHARACTERISTICS, CHALLENGES, AND GOVERNANCE IMPLICATIONS

International River Basins as an Example of Transnational Commons

Population growth, urbanization, industrial demands, pollution, and climate change have led to increasing freshwater scarcity across the globe (Bakker, 2012; Mekonnen

and Hoekstra, 2016). The World Resources Institute warns that 25 countries – home to one-quarter of the global population – currently face the dire prospect of running out of freshwater (Kuzma et al., 2023). As a common-pool resource, freshwater 'shares the attribute of subtractability of use with private goods' (i.e., one user's consumption of freshwater, e.g., for drinking, irrigation, or hydropower reduces the level of freshwater available for other users) 'and the difficulty of exclusion with public goods' (i.e., it is difficult and costly, if not impossible, to exclude potential beneficiaries from freshwater use) (Ostrom, 2010, pp. 644–645). The existence of 'free riders' who rationally act in their own self-interest and fully benefit from using water resources without bearing the true costs of these resources compounds the 'tragedy of the commons' problem (Gardner et al., 1990; Ostrom et al., 1999). Apart from threatening human health, economic development, and natural ecosystems, freshwater scarcity drives conflicts within and between countries, especially in regions where water resources are unevenly distributed (Bakker, 2012; Bernauer and Böhmelt, 2020).

International river basins such as the Nile, Colorado, Rhine, and Mekong represent a large share of global freshwater resources (Giordano et al., 2014). Allocating these resources or deciding about water management projects (e.g., dam construction) is a contentious issue (Gleditsch et al., 2006; Yoffe et al., 2003). Riparians' geopolitical relationships are shaped by unique, history-dependent processes involving competing interests and complex power dynamics (Bernauer and Böhmelt, 2020; Petersen-Perlman et al., 2017). When river basins span sovereign states and ecosystems, the sheer size and web of interdependencies pose serious challenges to water management. For example, consider the Nile (see Appendix Figure A1 for a map and details):

> 'The Nile Basin drains a total of approximately three million square kilometers of territory in eleven riparian states: Ethiopia, Sudan, South Sudan, Egypt, Rwanda, Tanzania, Uganda, Burundi, DRC, Eritrea, and Kenya. Its catchment area encompasses 10% of Africa's landmass … The Basin's climate ranges from tropical in the equatorial region of the Great Lakes area and the Ethiopian highlands, to arid in Sudan and Egypt. About 300 million people rely on the waters of the Nile, and population growth rates in the region are projected to soar. Much of this population relies almost exclusively on the Nile as its source of freshwater. The Nile, for example, is essentially Egypt's only source of water.' (Paisley and Henshaw, 2013, p. 61)

The Nile exemplifies why managing transnational commons is a difficult task, even more so than managing smaller, less complex local resource systems such as irrigation systems (Berkes, 2006; Ostrom et al., 1999). Two distinguishing features of transnational commons are noteworthy: (1) they require the cooperation of multiple actors (e.g., states, communities, and NGOs) across multiple boundaries (e.g., spatial, temporal, cultural, and jurisdictional) while (2) they lack an overarching authority or legal structure that sets the rules of the game (North, 1990) and resolves potential conflicts (Ansari et al., 2013). Unlike domestic water problems, which might be addressed by a single local or regional government, there is no such centralized authority for river basins shared by multiple nations (Bernauer and Böhmelt, 2020). Governing complex social-ecological systems requires 'the design of multi-level institutions

to engage multiple actors, as well as those able to navigate periods of gradual and episodic change in order to ensure the sustainability of the system' (Akamani and Wilson, 2011, p. 410). This is why transnational freshwater management systems are, to varying degrees, designed as polycentric systems featuring shared governance responsibilities and multiple overlapping governance mechanisms operating at different levels (Huitema et al., 2009). With this in mind, we next discuss the governance implications of transnational commons.

Governing Transnational Commons

Governance is the process of 'creating conditions for ordered rule and collective action' (Stoker, 2018, p. 17), which may entail establishing formal and informal institutions that guide resource accumulation, development, allocation, and protection (Folke et al., 2005; Klein et al., 2019; North, 1990). Given their unique features, the governance of common-pool resources differs from organizational and interorganizational governance processes for handling proprietary resources that can be more easily managed by simply assigning property rights (Libecap, 1993). Not only are the costs of failure (ecological disaster, famine, war, etc.) and benefits of success (sustainable growth, abundance, prosperity, etc.) fundamentally different from those associated with private goods (Folke et al., 2005), but the complexity is generally higher. This complexity stems from the multitude of stakeholders involved in governing commons, including citizens, communities, private firms, as well as governments and non-governmental actors (Ostrom, 1990).

The governance of commons is essentially a problem of collective action, where the costs and benefits of cooperation, institutional design, and monitoring are weighed against each other (Adams et al., 2003; Klein et al., 2019). Recognizing that technical solutions alone may not be effective in overcoming the 'tragedy of the commons', economic theory traditionally views centralized government regulation or extensive privatization as the two main solutions to this issue (Schlager, 2004). Yet, Ostrom (1990, 2010) and others challenge this conventional, hierarchical framing of feasible solutions. They propose a third way to resolve the 'tragedy of the commons', namely through polycentric governance, which entails the 'design of durable cooperative institutions that are organized and governed by the resource users themselves' (Ostrom, 1990, p. 25). A key insight is that highly centralized governance mechanisms based on top-down decision-making are ill-equipped to handle the massive scale of ecological interdependencies and the fast pace of environmental crises. Instead, common-pool resources are managed more effectively when relevant stakeholders have a voice in resource accumulation, development, and allocation. Consequently, polycentric governance arrangements are designed as self-managed systems that achieve collective action through participation (McGahan and Pongeluppe, 2023; Ostrom, 2010).

Synthesizing the findings of an in-depth series of case studies on how collectives manage common resources and gathering insights derived from laboratory experiments (Gardner et al., 1990; Ostrom, 1990), Ostrom formulated eight fundamental principles for designing polycentric governance systems. These principles include establishing clear boundaries (i.e., the involved actors and resources are specified), rules for appropriating

resources (e.g., restricting time, place, and quantity of resource use), transparent and equitable monitoring, sanctioning, and conflict resolution, as well as mechanisms for ensuring stakeholder participation in decision-making (Ostrom, 2010). A broad range of empirical studies supports the effectiveness of these principles in managing different types of common-pool resources (see Schlager, 2004).

However, since Ostrom's (1990) design principles were originally developed in the context of local communities, there is an unresolved debate about their applicability to governing larger-scale resource systems (Berkes, 2006; Carlisle and Gruby, 2019). The governance of commons spanning national boundaries may require revisiting some of Ostrom's (1990) assumptions (Ansari et al., 2013). Recent work recognizes not only that the difficulty of achieving polycentrism rises with the size of the resource system and number of stakeholders involved (McGahan and Pongeluppe, 2023) but also that governing transnational commons requires complex, multi-level linkages (Patala et al., 2022). For example, rather than being embedded in the wider legal and institutional framework of a single country, participants of polycentric systems seeking to govern transnational commons are simultaneously influenced by the existing laws and rules of many different sovereign nation-states that are not necessarily congruent and may thereby impede collaborative action (Berkes, 2006; see also Ostrom et al., 1999). The lack of an overarching authority, which may resolve conflicts between stakeholders that frequently arise in self-governed systems, prompted Ansari et al. (2013, p. 1016) to conclude that transnational commons involve 'cooperation under anarchy'. Tables A1 and A2 of the Appendix summarize how Ostrom's design principles apply to *governing national commons* and *transnational commons*, respectively.

Tables A1 and A2 feature prominent examples drawn from freshwater management and raise several questions that require further research attention. First, regarding whether and how Ostrom's (1990) ideas are applicable to the governance of large-scale transnational commons (Ansari et al., 2013; Berkes, 2006), exploring the design implications of polycentric governance systems in this context would meaningfully extend the literature. Second, the question of how to best organize polycentric governance systems that span national borders remains unresolved. While there is evidence that the self-organized, community-based approaches to polycentric governance elaborated by Ostrom (1990) work for commons of limited scope, it is plausible to assume that governance processes involving bilateral and multilateral interactions between nation-states would require formally institutionalized forms of polycentric systems (e.g., specialized organizations) that provide greater stability and legitimacy. Third, as common-pool resources increase in scale and scope, governance systems involve an increasing number of multi-level linkages with local governance activities being nested within regional, national, or international entities (Ostrom et al., 1999). Examining how governance mechanisms operating at different levels are interrelated – a question that has received only limited empirical attention – would contribute a more nuanced understanding of polycentric governance (Berkes, 2006; Carlisle and Gruby, 2019). To address these questions, we develop and then test a set of hypotheses on the potential role and effectiveness of configurations of polycentric governance systems in managing transnational commons.

HYPOTHESES DEVELOPMENT

To examine the design of transnational polycentric governance systems, we integrate political economy research (Libecap, 1993; Ostrom, 1990) on governing common-pool resources with management research on governing interorganizational relationships (Reuer and Ariño, 2007; Schilke and Lumineau, 2018). While the former literature uncovers principles for designing polycentric systems, the latter offers complementary insights into configurations and interactions between different types of governance mechanisms. We build upon the idea that the extent to which governance mechanisms are *specified* (i.e., define in detail the roles, rights, and obligations of parties involved) predicts the behaviour and outcomes in interorganizational relationships (Faems et al., 2008; Mooi and Ghosh, 2010). Below, we develop hypotheses on how the specification of two distinct governance mechanisms of polycentric water management systems, international treaties, and multi-stakeholder organizations, influence the emergence of water cooperation and conflict.[1]

The Role of International Treaties

As international law governing freshwater management is 'poorly developed, contradictory, and unenforceable' (Wolf, 1998, p. 251), over 680 bilateral and multilateral freshwater-related treaties have been signed since 1820 to fill this void (Giordano et al., 2014; Petersen-Perlman et al., 2017). Regulating the development, allocation, and protection of freshwater resources, these written agreements established between riparians are viewed as a prerequisite for effectively managing shared resources and facilitating cooperation at international river basins (Wolf et al., 2003; Yoffe et al., 2003). However, many of these agreements lack specificity, ignoring important issues such as water allocation rights or enforcement mechanisms. Lautze and Giordano (2005) classified only 108 out of 153 water-related treaties as 'substantive'; in fact, some of these treaties were never implemented in practice or are no longer enforced.

The importance of formal contracts for governing various types of interactions at an interpersonal, interorganizational, and international level is recognized across different disciplines, including management, economics, and political science (Libecap, 1993; Weber and Mayer, 2011; Williamson, 1996). For example, there is extensive research on strategic alliances, buyer–supplier relationships, and other interorganizational arrangements highlighting that contracts specifying each party's rights, duties, and responsibilities can mitigate relational tensions between exchange partners and act as safeguards against opportunistic behaviour (Poppo and Zenger, 2002; Reuer and Ariño, 2007; Zhou and Xu, 2012). Contracts serve two primary functions in exchange relationships: *control* and *coordination*. While control problems stem from misaligned incentives, coordination problems arise from misaligned expectations and behaviours (Malhotra and Lumineau, 2011; Vlaar et al., 2007). Contracts that define the objectives of cooperation, permissible actions, and penalties incurred for violations of terms, can help to overcome control and coordination problems (Faems et al., 2008; Schilke and Lumineau, 2018).

Going beyond existing studies on the management of freshwater resources and commons more broadly that examine the influence of contractual governance on water

cooperation and conflict in dichotomous terms (i.e., the presence or absence of treaties; see Lautze and Giordano, 2005), we draw upon the notion of *contract specificity* elaborated in organizational governance research (Mooi and Ghosh, 2010; Ryall and Sampson, 2009). Also referred to as contract complexity or contract completeness (Reuer and Ariño, 2007), contract specificity captures the extent to which relevant clauses or issues are specified and codified in a treaty. The more contingencies a contract covers, the higher its specification (Poppo and Zenger, 2002). While the relational benefits of contract specificity are well-documented (Faems et al., 2008; Poppo and Zenger, 2002), some scholars caution against an over-specification of contracts (Vlaar et al., 2007) or argue that different components of contracts may have differential effects on the emergence of cooperation and conflict (Schilke and Lumineau, 2018). For instance, highly specified contracts may increase transaction costs (Williamson, 1996), reinforce rigidity (Vlaar et al., 2007), and drive distrust between the parties (Weber and Mayer, 2011). These countervailing effects imply that there might be an 'optimal' level of contract specificity that varies depending on factors such as the characteristics of the transaction and transaction partners (see Williamson, 1996).

Regarding the governance of international freshwater resources, a context characterized by substantial complexity, ambiguity, and risk of opportunism (Yoffe et al., 2003), we expect a high level of contractual specificity to be most effective. Indeed, prior evidence suggests that the likelihood of water cooperation (conflict) increases (decreases) with the number of clauses a freshwater treaty contains (Dinar et al., 2015). Well-specified treaties clarify the diplomatic rules of the game and stabilize the relations of countries sharing a river basin (Giordano et al., 2014), 'giving them a certain level of certainty and predictability that is often not present otherwise' (McCaffrey, 2003, p. 157). Ideally, consistent with Ostrom's (1990) guidelines for designing polycentric governance systems, the literature suggests that water treaties should: (1) include clear and flexible criteria for the allocation of water rights pertaining to consumption, hydropower usage, and pollution limits; (2) address the management of the uncertainty associated with flooding and drought; and (3) specify mechanisms for exchanging information, resolving disputes, and monitoring activities (Dinar et al., 2015; Drieschova et al., 2008). Such treaties may also serve as stepping stones for future cooperation. Once countries have learned how to interact and share water resources by means of well-specified treaties, they are more likely to negotiate future treaties or work together in other ways. These countries may establish diplomatic channels or protocols to proactively handle water issues, which further reinforces cooperation (Yoffe et al., 2003).

Weak or absent contractual arrangements, in contrast, may adversely affect water interactions between countries (Bernauer and Böhmelt, 2020; Wolf et al., 2003). Contractual loopholes may create uncertainty and ambiguity, especially in regions with already weak governments and legal systems. This increases the risk that countries act opportunistically and pursue their own rational self-interest, ultimately driving conflict to the detriment of riparians (Drieschova et al., 2008; Petersen-Perlman et al., 2017). Hence, we propose Hypothesis 1:

> *Hypothesis 1:* (a) The likelihood of cooperation between countries increases and (b) the likelihood of conflict between countries decreases with the degree of specification of international treaties.

The Role of Multi-Stakeholder Organizations

Issues in implementing, enforcing, and adapting treaties prompted the creation of dedicated multi-stakeholder organizations for many international river basins around the world (Meijerink and Huitema, 2017; Mukhtarov and Gerlak, 2013). Founded by governmental and intergovernmental actors (e.g., United Nations, World Bank), these so-called river basin organizations (RBOs) range from entities that are mainly facilitative in nature to entities empowered to act on their own, independent from other national institutions. Their rise marks a shift in governance from the national level to a cross-boundary level, providing permanent multi-stakeholder forums where representatives and citizens of riparians can jointly discuss and solve water-related issues. These organizations engage multiple actors across different levels, facilitate their interactions, and provide them with information (Milman and Gerlak, 2020; Schmeier et al., 2016). Compared with the community-based systems featured in Ostrom's original work (1990) or other self-organized governance initiatives such as multi-stakeholder partnerships (Dentoni et al., 2018), RBOs reflect a relatively formal, structured approach to multi-stakeholder governance.

The multi-level nature of water issues explains why multi-stakeholder organizations play a key role in establishing and maintaining peaceful relations at international river basins (Akamani and Wilson, 2011; Meijerink and Huitema, 2017). Water conflicts between countries, such as the ongoing dispute between Egypt and Ethiopia at the Nile, may be caused by a government's (in this case Ethiopia's) decision to build a dam or act opportunistically, more generally. Yet, even absent any hostile governmental actions, conflicts may emanate from behaviours at the community level, such as the systematic misappropriation of water resources by citizens or companies (e.g., pollution). Since freshwater conflicts may occur at different but interrelated levels, cooperative management institutions that allow a wide range of interest groups to be included in decision-making processes can help anticipate conflict and resolve latent disputes (see Ostrom, 1990).[2]

Another reason why multi-stakeholder organizations are assumed to contribute to cooperative relationships between riparians lies in strengthening the adaptive capacity of water systems (Blumstein and Petersen-Perlman, 2021). Due to seasonal effects and unpredictable long-term changes in climate patterns, there is often considerable variation in the availability and quality of freshwater resources at river basins. This is a potential source of uncertainty, ambiguity, and tension between different water users (Bernauer and Böhmelt, 2020; Drieschova et al., 2008). Multi-stakeholder organizations help to absorb sudden and unexpected changes in a basin's ecosystem (Mukhtarov and Gerlak, 2013; Petersen-Perlman et al., 2017). By providing data and information, such organizations foster a shared understanding among actors about the likely causes of underlying changes in water supply (e.g., droughts) and how to handle them, thereby preventing conflicts from arising due to misunderstandings (Blumstein and Petersen-Perlman, 2021).

However, the effectiveness of multi-stakeholder organizations in establishing cooperative relationships and avoiding conflicts over shared freshwater resources is a function of their design (Meijerink and Huitema, 2017). Ostrom's (1990) principles

are an instructive blueprint for designing polycentric governance systems. Ideally, organizations dedicated to the management of water and other commons should provide mechanisms for sharing information, resolving disputes, monitoring and enforcing compliance with the organization's rules and decisions, adapting to change, as well as including stakeholders in decision-making and management processes. Ostrom's (1990) recommendations highlight that multi-stakeholder organizations that implement a combination of these governance mechanisms are best equipped to facilitate water interactions between countries (see Schmeier, 2015). Here, consistent with our reasoning on the importance of contractual specificity, we expect the effectiveness of such organizations to increase with their degree of specification, that is, the number of mechanisms for governing different water management activities they have implemented. By regulating a broad range of processes relevant to water management, multi-stakeholder organizations characterized by a high degree of specification provide the consistency and stability necessary to build adaptive capacity and promote long-term cooperative relationships between riparians. Thus, we propose Hypothesis 2:

> *Hypothesis 2:* (a) The likelihood of cooperation between countries increases and (b) the likelihood of conflict between countries decreases with the degree of specification of multi-stakeholder organizations.

The Interplay between International Treaties and Multi-Stakeholder Organizations

Polycentric governance systems are complex, multi-layered systems composed of various interrelated mechanisms (Ostrom, 2010; Patala et al., 2022). This particularly applies to entities designed to manage large-scale resource systems such as international river basins, where local governance activities are embedded in and influenced by the overarching legal and institutional framework of the countries involved (Huitema et al., 2009; Ostrom et al., 1999). Referring to institutional diversity, some scholars emphasize the benefits of implementing multiple governance mechanisms that operate at different levels. They argue that a certain degree of overlap and redundancy of governance mechanisms increases the effectiveness of polycentric systems, making them less vulnerable to governance failures (Carlisle and Gruby, 2019; Huitema et al., 2009).

However, surprisingly few studies examine the cross-level linkages between governance mechanisms operating in common-pool resource systems, including, but not limited to, international river basins (Berkes, 2006; Carlisle and Gruby, 2019). Although research on (polycentric) water management systems suggests that international treaties and multi-stakeholder organizations jointly determine the institutional capacity to manage international river resources (Wolf et al., 2003; Yoffe et al., 2003), their interplay is not well understood. To theorize how these governance mechanisms act together, we draw upon ideas from the literature on interorganizational governance. Placing particular emphasis on the linkages between contractual governance and various forms of relational governance (e.g., trust, relational norms, and prior ties), this body of work argues and shows

that different governance mechanisms work together in influencing exchange relationships rather than operating independently (Lui and Ngo, 2004; Poppo and Zenger, 2002; Zhou and Xu, 2012). That said, findings on the nature of this interrelationship are equivocal. The majority of prior studies suggest that contractual and relational governance complement each other; the effectiveness of one governance mechanism increases when the other is also present (for meta-analytic evidence, see Cao and Lumineau, 2015). Yet, a smaller but still sizeable number of studies show the opposite effect. These studies report substitutive relationships where the joint presence of two governance mechanisms diminishes, rather than enhances, each mechanism's effectiveness (Lui and Ngo, 2004; Lumineau and Henderson, 2012).

Building on these ideas and prior evidence, we explore whether international treaties and multi-stakeholder organizations have complementary or substitutive effects on the emergence of water cooperation and conflict. To begin with, there are arguments to suggest that these governance mechanisms complement each other in polycentric freshwater management systems. Treaties establish enduring and static long-term rules of the game at the government level, whereas multi-stakeholder organizations facilitate the implementation of treaties and provide flexible governance processes at the local level (Mukhtarov and Gerlak, 2013). This is consistent with the view that contracts provide basic guidelines for an exchange relationship but face certain limits in their ability to deal with adaptation pressures stemming from changing circumstances (Poppo and Zenger, 2002; Zhou and Xu, 2012). Multi-stakeholder organizations, in turn, may be less successful in enforcing rules and norms for using water resources without formal agreements signed between nation-states that provide legitimacy and authority for their cause (see Ostrom et al., 1999).

Although we recognize that there is a general complementarity between international treaties and multi-stakeholder organizations (Petersen-Perlman et al., 2017; Wolf et al., 2003), when it comes to the *specification* of these governance mechanisms rather than their *mere presence*, we expect a substitutive effect. Our core argument is as follows. When both forms of governance are specified to a high degree, redundancies are likely to occur and their respective benefits will be suppressed, leading to worse outcomes (i.e., a higher likelihood of conflict and lower likelihood of cooperation) than when at least one of them is less specified. For example, it is plausible that once a certain degree of contractual control is established, multi-stakeholder organizations (or local actors more generally) may have too little room to manoeuvre for fulfilling their stakeholder integration and adaptation functions. This is consistent with research recognizing that the potential downside of highly specified treaties lies in restraining the discretionary choices of actors seeking to implement them (Faems et al., 2008).

By framing how exchange partners perceive their relationship and interact with each other (Schilke and Lumineau, 2018), highly specified treaties may signal that the rules of the game are locked in place, thereby acting as a psychological barrier to adaptation. This may become more problematic when multi-stakeholder organizations are highly specified. Such a situation may generate ongoing frustrations and deepen existing fault lines among the different stakeholder groups that are supposed to discuss and resolve water-related issues within these organizations. In turn, multi-stakeholder organizations that cover all processes relevant to water management may act as substitutes for highly specified treaties by creating

a parallel structure that over-emphasizes informal, pragmatic governance processes at the expense of contract compliance. Taken together, we propose Hypothesis 3:

> *Hypothesis 3:* International treaties and multi-stakeholder organizations have a substitutive effect on (a) cooperation and (b) conflict between countries, such that when *both* governance mechanisms are highly specified, the likelihood of cooperation (conflict) is lower (higher) than in a situation in which one of them is less specified.

METHODS

Data

To quantify and test our ideas about how international treaties and multi-stakeholder organizations shape cooperation and conflict between countries, we compile a large, unique, longitudinal dataset assembled from various public databases. Our data focus on international river basins and the events involving the dyadic relationships of riparians along these basins.[3] We utilize the International Water Event Database on country-level interactions (Wolf et al., 2011). This historical database captures media reports on river basins' events, which are manually coded by experts as collaborations or conflicts (Yoffe et al., 2003). We also use the updated International River Basin Conflict and Cooperation (IRCC) database, which features more fine-grained coverage of water-related events by: (1) extending the media archives searched for reports; (2) completing the river-basin search string of former attempts; and (3) fine-tuning the manual coding of events (Kalbhenn and Bernauer, 2012). The IRCC covers 1997–2007, constituting our observation period for riparian country dyads being at risk of events coded as cooperation or a conflict.

We augment these datasets with data from the International Freshwater Treaties Database (IFTD) (Giordano et al., 2014), which covers agreements and treaties from 1820 through 2007. To analyse the role and institutional form of RBOs as multi-stakeholder organizations, we incorporate the River Basin Organization Database (RBOD) (Schmeier, 2015), which provides additional data on the characteristics of the river basins and riparians linked to RBOs. We also integrate elements of the Peace Research Institute Oslo (PRIO) Shared River Basin Database (Gleditsch et al., 2006), the Transboundary Freshwater Spatial Database (McCracken and Wolf, 2019), as well as country-level data retrieved from the World Development Indicators (World Bank, 2020a), the World Integrated Trade Solution (WITS) (World Bank, 2020b), the World Trade Organization (WTO) (World Trade Organization, 2020), the CEPII BACI International Trade Database (Gaulier and Zignago, 2010), and the Worldwide Governance Indicators (WGI) project (Kaufmann et al., 2011).

Dependent Variables

International freshwater cooperation and conflict. The IRCC uses the British Broadcasting Corporation (BBC) Monitoring news media archive, which covers broadcast news, international newswires, and other global news sources translated into English. All

retrieved documents are coded manually to avoid coding errors (Kalbhenn and Bernauer, 2012). Events are coded according to a 13-point scale ranging from −6 (violent conflict, formal declaration of war) to +6 (alliance or ratification of freshwater treaty) with 0 referring to neutral acts like rhetorical statements. We code all events having a coding of 1 (minor official exchanges, talks, or policy expressions), 2 (verbal support), 3 (agreement of low scale), and 4 (agreement, commitment) into the category of collaborative events. Events having a coding of 5 (signing of freshwater treaty) or 6 (ratification of freshwater treaty) are covered separately as part of the treaty characteristics. We use this summary category since the occurrence of some categories of the IRCC is quite sparse. To code events as being conflictive, we use all IRCC categories ranging from −1 (verbal expressions displaying discord in interaction) over −3 (hostile actions) to −5 (any violent acts). The most negative category of −6 (violent conflict, formal declaration of war) did not occur during the observation period and was therefore excluded.

Independent and Moderator Variables

Specification of international freshwater treaty. We use the IFTD to measure the degree of specification of the international freshwater treaties of the respective river-basin country dyads. Following Giordano et al. (2014) and the 1969 Vienna Convention of the Law of Treaties (Sinclair, 1984), we define a treaty as 'an international agreement concluded between States in written form and governed by international law, whether embodied in a single instrument or in two or more related instruments and whatever its particular designation'. The IFTD follows the International Law Association framework (Dellapenna, 2001) and the framework of governance mechanisms in international freshwater treaties (Drieschova et al., 2008) to code three major jurisdictional focus areas: (1) six issues related to water as a resource, such as allocation of water quantities, hydropower, and pollution; (2) 10 issues related to uncertainty management including issues such as flood or dry season control; and (3) five procedural rules such as information exchange or conflict resolution mechanisms. In sum, the IFTD framework captures up to 21 different issues that treaties could, in principle, cover. We build an additive index counting the issues that are covered by the respective treaty. The higher the number of issues covered, the higher the degree of specification of the treaty.

Specification of river basin organization. RBOs are 'institutionalized forms of cooperation that are based on binding international agreements covering the geographically defined area of international river or lake basins characterized by principles, norms, rules and governance mechanisms' (Schmeier et al., 2016, p. 600). The RBOD captures up to five governance mechanisms an RBO can provide to its relevant stakeholders (see Schmeier, 2015): (1) decision-making, which is based on unanimity, consensus, or majority principles; (2) data and information-sharing, which includes observable parameters of the watercourse, the use of its water, as well as of the different water-related sectors; (3) monitoring that can, conceptually, be divided into compliance monitoring (i.e., evaluation of actors' conformance to principles and rules specifying the usage or protection of water resources) and environmental monitoring, (i.e., activities to capture

the state of the river basin at a point in time or over time); (4) dispute resolution; and (5) involvement of stakeholders such as civil society and NGOs, epistemic communities, or other international or regional institutions. We compute an additive index that counts the number of specified governance mechanisms of the respective RBO to estimate its degree of specification.

Control variables. We control for a number of factors known to influence water interactions (see Bernauer and Böhmelt, 2020), which may confound the hypothesized relationships of interest. For instance, we included the *rule of law* measure from the WGI project (Kaufmann et al., 2011), indicating the extent to which a country is perceived as enforcing laws. All control variables are on the dyad level and grouped together as geographical or socio-economic controls. Geographical controls are the *population weighted distance* between countries, whether countries share a *contingent border*, and the *size of the upstream basin*. The socio-economic variables are the *regional population density*, the *difference in income* per capita of the countries, the *difference in rule of law*, their *trade relations*, whether they have signed a *free trade agreement*, the number of *common WTO group memberships*, and whether they share a *colonial relationship*, a *common historical colonizer*, a *common currency*, or a *common official language*. Appendix Table A3 provides an overview of all variables of our models, their data source, and our rationale for including them.

Estimation Procedures

Our longitudinal dataset traces events among river-basin country dyads. Of the 4026 events in the IRCC database, 3201 occur in 304 river-basin country dyads where an RBO exists. The IRCC database covers 5181 events that match our coding scheme. However, 1155 events are duplicates of the same event covered multiple times, leaving us with 4026 events. Since not all of our control variables are available for all countries that are part of these events, we restrict our sample to 1283 events and 122 river-basin country dyads. Our sample includes major rivers such as the Nile, the Rio Grande, the Amazon, the Danube, and the Tigris-Euphrates as well as large freshwater bodies such as Lake Chad, Lake Victoria, and the Aral Sea.

To evaluate the effectiveness of possible configurations of international freshwater treaties and RBOs, we need to estimate whether river-basin country dyad experience collaborative or conflictive events. We specify survival analysis models to investigate the risk or hazard of the occurrence of these events. Collaborations and conflicts are not singular events, but rather may happen repeatedly for each river-basin country dyad. As such, we account for competing risks that may happen multiple times during the period of observation. Hence, in the specification of our hazard models, we observe multiple failures of multiple records. Since the standard model for competing risks (Fine and Gray, 1999) cannot handle multiple failures, we specify conditional risk set models (Prentice et al., 1981) that are stratified by failure order and failure type (i.e., entering a collaboration or a conflict) by means of Cox proportional hazard models (Cox, 1972). To account for heteroscedasticity, these models use Huber–White standard errors clustered at the level of the river-basin country dyad. To handle ties, we use Efron's method (Efron, 1977).

A river-basin country dyad enters the risk set once an international freshwater treaty is signed. This date is set to time 0, or the risk onset. Since the IRCC dataset covers only 11 years, from 1 January 1997 until 31 December 2007 (Kalbhenn and Bernauer, 2012), and most freshwater treaties were signed *before* that period (Giordano et al., 2014), we model these river-basin country dyads with delayed entry into the risk set. We assume that the risk of entering collaborations or conflicts starts accumulating with entry time (i.e., treaty signature date) and measure the time to each event accordingly (using days as the unit of time). Hence, our *unit of analysis* is the country-dyad day. When a new or the first freshwater treaty is signed during our period of observation, we reset the risk onset of subsequent river-basin country-dyad events to that treaty signature date.

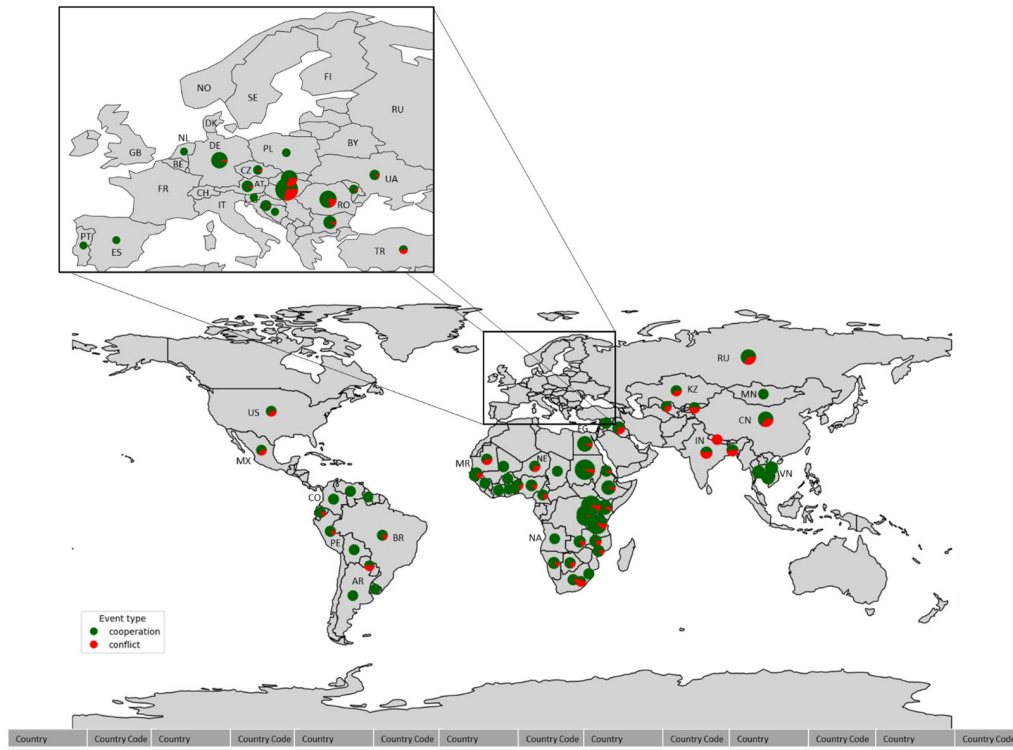
Cox proportional hazard regressions have no intercept because they are modelled as part of the baseline hazard. Thus, the coefficients of the regression are interpreted as change in the hazards for a one-unit change in the respective regressor. Cox regressions require that the effect of a predictor variable does not change over time. To provide a visual confirmation of this necessary assumption, we plot Schoenfeld residuals against time. The residuals are distributed in a band around zero for all predictors, thus supporting the proportional hazard assumption (Hess, 1995).

We standardize all variables, except categorical indicators, prior to running our Cox regression models. Hence, we interpret coefficients as a change in hazard for a one standard deviation change in the regressor. Variables in our final model result in an average variance inflation factor of 2.34 and condition index number of 5.15, both indicating no issues with multicollinearity (Kutner et al., 1983). Using daily data on freshwater events for our sample generated approximately 3.91 million total observations (country-dyad days).

RESULTS

Figure 1 shows a world map of all events included in our analysis. For illustration, we sum up events per country and show the share of cooperations and conflicts in which a country is involved. Table I contains the descriptive statistics including means, standard deviations, minimum and maximum values, as well as correlations. As Table I shows, the specification of international freshwater treaties and RBOs are only modestly correlated. Interestingly, both types of specification show, on average, considerable variation across our constructed indices. The average treaty covers just 10.536 issues of the 21 it could cover with a standard deviation of 3.608. The average RBO covers 3.495 of the five defined governance mechanisms with a standard deviation of 1.338. And while RBOs exist that have all governance mechanisms in place, no treaty exists that covers more than 18 issues. Figure 2 shows unconditional Nelson-Aalen cumulative hazard estimates indicating that the number of cooperative events far exceeds the number of conflictive events (Aalen, 1978; Nelson, 1972). We observe 1087 cooperative events and 196 conflicts.

Table II shows the results of the Cox proportional hazard regressions predicting the time until collaborations or conflicts emerge after an international freshwater treaty is signed. Our baseline, Model 1, includes only the dyad-level control variables grouped



Country	Country Code	Country	Country Code	Country	Country Code	Country	Country Code	Country	Country Code	Country	Country Code	Country	Country Code
United Kingdom	GB	Netherlands	NL	Italy	IT	Ukraine	UA	Mongolia	MN	Egypt	EG	Argentina	AR
France	FR	Switzerland	CH	Norway	NO	Belarus	BY	Kazakhstan	KZ	Niger	NE	Peru	PE
Spain	ES	Germany	DE	Sweden	SE	Romania	RO	China	CN	Mauritania	MR	Columbia	CO
Portugal	PT	Austria	AT	Finland	FI	Turkey	TR	India	IN	Namibia	NA	Mexico	MX
Belgium	BE	Czech Republic	CZ	Poland	PL	Russia	RU	Vietnam	VN	Brazil	BR	United States	US

Figure 1. World map of water events included in our analysis

together as geographical and socio-economic variables, respectively. Model 2 adds the main effects, while Model 3 is the full model also including the interaction effects. Our models present coefficients for the two competing risks of initiating cooperation or entering conflict. We present hazard ratios, that is, exponentiated regression coefficients. A hazard ratio above one indicates a positive effect that is associated with an increase in the hazard or risk of the respective event. A hazard ratio in the range of zero to one indicates a negative effect linked to a decrease in the hazard of the event.

Direct Effects of International Freshwater Treaties and RBOs

Consistent with Hypothesis 1a, we find that highly specified international freshwater treaties are associated with greater water cooperation among riparians ($\exp(b) = 1.853$, $p < 0.01$). In terms of economic significance, a one-unit (i.e., standard deviation) increase in the degree of specification of the treaty is associated with an increase in the hazard of engaging in water cooperation by 85.3 per cent ($[1.853-1] \times 100$, unit is per cent). However, we find no evidence for Hypothesis 1b. A greater degree of specification of international freshwater treaties is not associated with a lower risk of riparians engaging in water conflict ($\exp(b) = 1.671$, *ns*.).

Table I. Descriptive statistics and correlations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(13)	(14)	(15)	(16)
(1)	Specification of international freshwater treaty	1.000														
(2)	Specification of RBO	0.403	1.000													
(3)	Population weighted distance	−0.503	−0.565	1.000												
(4)	Contingent border	−0.091	−0.103	−0.008	1.000											
(5)	Upstream basin size	0.039	−0.143	0.371	0.198	1.000										
(6)	Regional population density	0.188	0.110	−0.197	−0.008	0.155	1.000									
(7)	Difference in income per capita	0.222	0.065	0.018	−0.564	−0.193	0.034	1.000								
(8)	Difference in rule of law	0.265	0.029	0.006	−0.434	0.234	0.159	0.620	1.000							
(9)	Trade relations	−0.007	−0.066	0.225	−0.218	−0.071	−0.030	0.502	0.168	1.000						
(10)	Free trade agreement	0.545	0.182	−0.355	0.109	0.021	−0.047	0.102	−0.039	0.076	1.000					
(11)	Common WTO group memberships	−0.054	0.416	−0.304	0.119	−0.349	−0.135	−0.211	−0.382	−0.005	0.049	1.000				
(13)	Colonial relationship	0.230	−0.046	0.061	0.035	0.557	−0.006	0.194	0.448	0.012	0.058	−0.288	1.000			
(14)	Common historical colonizer	−0.130	0.067	−0.103	0.198	−0.070	0.139	−0.262	−0.288	0.068	0.048	0.391	−0.166	1.000		
(15)	Common currency	0.181	−0.041	−0.031	0.048	−0.081	−0.084	−0.088	−0.171	0.146	0.092	0.160	−0.053	0.147	1.000	
(16)	Common official language	−0.080	0.205	−0.031	0.247	0.266	−0.168	−0.312	−0.232	0.090	0.052	0.461	0.146	0.439	0.286	1.000
Mean		10.536	3.495	977.524	0.819	380,289	101.971	5.175	0.796	0.899	0.673	2.194	0.104	0.192	0.037	0.279
Standard Deviation		3.608	1.338	1123.803	0.385	600,550	65.005	9.099	0.549	0.987	0.469	1.896	0.306	0.394	0.188	0.449
Minimum		1	0	162.1818	0	0	3	0	0.000	0	0	0	0	0	0	0
Maximum		18	5	5506.709	1	2,752,600	555	38.620	2.747	4	1	6	1	1	1	1

Note: All coefficients < −0.0389 and >0.0389 are significant at least at the 0.05 level. For easier interpretation, we report means and standard deviations based on unstandardized data.

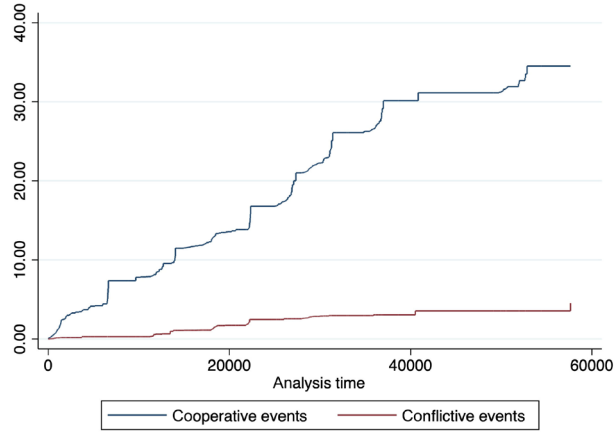


Figure 2. Nelson–Aalen cumulative hazard estimates

Next, in line with Hypotheses 2a and 2b, our results show that RBOs with highly specified designs are associated with a greater likelihood of water cooperation (exp(b) = 1.824, $p < 0.01$) as well as a lower risk of water conflict (exp(b) = 0.258, $p < 0.05$) among riparians. Regarding economic significance, a one standard deviation increase in the degree of RBO specification (i.e., an RBO that provides 1.338 more governance mechanisms than average) is associated with an 82.4 per cent increase in the hazard of riparians engaging in cooperation. Similarly, a one-unit increase in the degree of specification of an RBO is associated with a 74.2 per cent ([1 − 0.258 × 100, unit is per cent]) decrease in the hazard of water conflict.

We also further examine the extent to which RBOs reduce the hazard of water conflict. We report findings on the five different mechanisms an RBO can cover. Appendix Tables A4 and A5 report these regressions. Formally defined mechanisms for information-sharing (Model 8) and dispute resolution (Model 10) are significantly related to a decrease in the hazard of conflict. The presence of an information-sharing mechanism (exp(b) = 0.272, $p < 0.01$) yields a 72.8 per cent decrease in the hazard of entering a conflict. A dispute resolution mechanism (exp(b) = 0.343, $p < 0.1$) produces a decrease in the hazard of a conflict of 65.7 per cent.

The Interplay between International Freshwater Treaties and RBOs

For water cooperation (Hypothesis 3a), we find a significant interaction effect for the degree of specification of the international freshwater treaty and the RBO (exp(b) = 0.652, $p < 0.05$). Holding all other variables constant at their respective sample means, when the degree of specification of the treaty is one standard deviation above its mean, a one standard deviation shift in the specification of the RBO yields a hazard ratio equal to 1.853 × 0.652 = 1.208. This represents a 20.8 per cent increase in the hazard of cooperation. And while this still leads to an increase in the hazard, it is substantially smaller than if only the treaty is highly specified (see above, 85.3 per cent). Note that for water conflicts (Hypothesis 3b), we find no significant interaction effect for the degree of specification of the international freshwater treaty and the RBO (exp(b) = 4.407, *ns*.).

Table II. Regression results

Types of events (Competing risks)	*Model 1 – Controls only*		*Model 2 – Main effects*		*Model 3 – Full model*	
	Cooperation	*Conflict*	*Cooperation*	*Conflict*	*Cooperation*	*Conflict*
Geographical dyad-level control variables						
Population weighted distance	0.967	1.653*	1.215	2.029**	1.491*	0.926
	(0.140)	(0.378)	(0.171)	(0.542)	(0.275)	(0.587)
Contingent border (baseline category 0: no contingent border)	0.495**	2.825*	0.631*	2.009	0.646+	1.520
	(0.108)	(1.430)	(0.132)	(0.940)	(0.144)	(0.600)
Upstream basin size	1.288+	1.186	1.164	0.978	1.159	0.892
	(0.174)	(0.401)	(0.147)	(0.353)	(0.148)	(0.392)
Socio-economic dyad-level control variables						
Regional population density	1.103	1.693**	1.065	1.751**	0.998	1.894**
	(0.141)	(0.319)	(0.132)	(0.326)	(0.145)	(0.450)
Difference in income per capita	0.489***	0.470+	0.441***	0.331*	0.410***	0.345*
	(0.088)	(0.193)	(0.082)	(0.173)	(0.081)	(0.182)
Difference in rule of law	1.398**	1.158	1.233+	1.261	1.193	1.443
	(0.170)	(0.386)	(0.141)	(0.441)	(0.138)	(0.548)
Trade relations, Top 5, 1 out of 4	0.563**	1.049	0.612*	1.041	0.639*	1.028
	(0.124)	(0.429)	(0.125)	(0.415)	(0.131)	(0.381)
Trade relations, Top 5, 2 out of 4	0.460**	0.875	0.544*	0.975	0.634+	0.700
	(0.136)	(0.432)	(0.139)	(0.482)	(0.168)	(0.391)
Trade relations, Top 5, 3 out of 4	1.229	0.912	0.880	1.035	0.993	0.816
	(0.402)	(0.707)	(0.260)	(0.840)	(0.302)	(0.816)
Trade relations, Top 5, 4 out of 4	0.443	0.630	0.162*	0.826	0.269	0.125
	(0.280)	(0.777)	(0.133)	(1.044)	(0.227)	(0.309)
Free Trade Agreement (baseline category 0: no agreement)	1.290	0.861	1.425	0.612	1.406	0.658
	(0.412)	(0.549)	(0.373)	(0.379)	(0.368)	(0.463)
Common WTO Group Memberships	1.581*	1.795	1.283	2.463*	1.193	2.980**
	(0.291)	(0.846)	(0.256)	(0.906)	(0.231)	(1.180)
Colonial Relationship (baseline category 0: no relationship)	0.607+	0.661	0.437*	0.610	0.560	0.266+
	(0.163)	(0.487)	(0.158)	(0.447)	(0.216)	(0.180)
Common Historical Colonizer (baseline category 0: no common history)	0.917	0.969	0.952	0.903	1.072	0.516
	(0.243)	(0.344)	(0.212)	(0.353)	(0.232)	(0.368)
Common Currency (baseline category 0: no common currency)	1.491	0.674	1.584	0.330	1.347	0.230
	(0.506)	(0.574)	(0.738)	(0.243)	(0.603)	(0.216)

(Continues)

Table II. (Continued)

Types of events (Competing risks)	*Model 1 – Controls only*		*Model 2 – Main effects*		*Model 3 – Full model*	
	Cooperation	*Conflict*	*Cooperation*	*Conflict*	*Cooperation*	*Conflict*
Common official language (baseline category 0: no common language)	1.074	0.449^{+}	0.897	0.585	0.909	0.791
	(0.273)	(0.211)	(0.199)	(0.228)	(0.203)	(0.352)
Main effects						
Specification of international freshwater treaty			1.616*	1.990*	1.853**	1.671
			(0.314)	(0.542)	(0.362)	(0.576)
Specification of RBO			1.700**	0.441**	1.824**	0.258*
			(0.349)	(0.131)	(0.377)	(0.142)
Interaction effects						
Interaction of treaty and RBO specifications					0.652*	4.407
					(0.134)	(4.931)
Model statistics						
N	2566		2566		2566	
N failed	1283		1283		1283	
Clusters	122		122		122	
Time at risk (days)	3,909,940		3,909,940		3,909,940	
Model Chi^2	287.047***		455.384***		599.633***	
Pseudo-R^2	0.123		0.15		0.156	

Note: We report incidence rate ratios, that is, exponentiated coefficients. The baseline category for Trade Relations is when neither country is a top exporter or importer for the other and vice versa.
***p < 0.001; **p < 0.01; *p < 0.05; $^{+}$p < 0.10.

A more specified international freshwater treaty (+1 standard deviation) together with a less specified RBO (−1 standard deviation) yields a hazard ratio equal to 1.853 × 1/0.652 = 2.842. This represents a 184.2 per cent increase in the hazard of cooperation. Similarly, a highly specified RBO and a less specified treaty provide a hazard ratio equal to 1.824 × 1/0.652 = 2.798, which represents a 179.8 per cent increase in the hazard of cooperation. In contrast, a highly specified RBO (+1 standard deviation) in conjunction with ratification of a highly specified treaty (+1 standard deviation) produces a hazard ratio equal to 1.824 × 0.652 = 1.189. This represents only an 18.9 per cent increase in the hazard of cooperation. Taken together, in support for Hypothesis 3a, these results indicate evidence of a substitutive effect for the degree of specification of the treaty and RBO. We examine this further in Figure 3. As we run regressions stratified for the number of cooperative events, we plot the cumulative incidence functions, for example, events. We present the first, fifth, tenth, and twentieth cooperative events taking place on a dyadic level. The green line indicates that the cumulative incidence of each of these events is consistently higher whenever a highly specified international freshwater treaty is combined with a less specified RBO.

To unpack the substitution effect between treaties and RBOs on the hazard of water cooperation, we disaggregate international freshwater treaties into the different

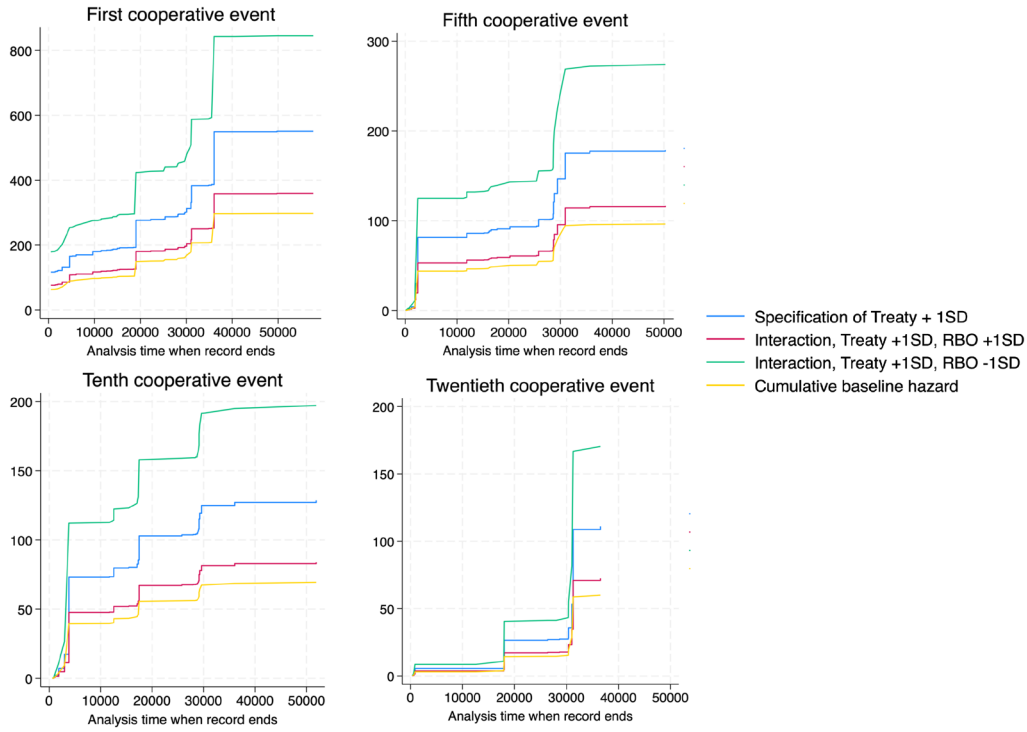


Figure 3. Cumulative incidence functions

jurisdictional content areas they can cover. Table III below reports our results replicated for the treaty areas of water as a resource, procedural rules, and uncertainty management in Models 4, 5, and 6, respectively. Although the main effects of the treaty (exp(b) = 1.384, $p < 0.1$) and the RBO (exp(b) = 1.961, $p < 0.01$) are significant, we find no significant interaction effect of the specification of the treaty regarding water as a resource and the specification of the RBO (exp(b) = 0.976, *ns*.). We do find, however, a significant interaction effect for the two other content areas of procedural rules (exp(b) = 0.673, $p < 0.05$) and uncertainty management (exp(b) = 0.550, $p < 0.05$). A treaty with more specified procedural rules (+1 standard deviation) yields a hazard ratio equal to $1.696 \times 0.673 = 1.141$, a 14.1 per cent increase in the hazard of cooperation compared with a 69.6 per cent increase if only the treaty is more specified. For uncertainty management, we find a hazard ratio equal to $1.847 \times 0.550 = 1.016$ for the interaction effect. This is a 1.6 per cent increase in the hazard of cooperation, again compared with the 69.6 per cent increase if the international freshwater treaty alone is specified.

In summary, our interaction results underscore that the substitutability of international freshwater treaties and RBOs in facilitating cooperation is observed primarily in situations requiring greater operational flexibility (i.e., procedural rules and uncertainty management provisions). These results also indicate that the respective designs of treaties and RBOs do not appear to interfere with each other when it comes to handling

Table III. Analyses of the treaty areas

Types of events (Competing risks)	*Model 4 – Water as a resource*		*Model 5 – Procedural rules*		*Model 6 – Uncertainty management*	
	Cooperation	*Conflict*	*Cooperation*	*Conflict*	*Cooperation*	*Conflict*
Geographical dyad-level control variables						
Population weighted distance	1.164	1.201	1.516*	1.051	1.306^{+}	1.315
	(0.180)	(0.585)	(0.290)	(0.688)	(0.197)	(0.385)
Contingent border (baseline category 0: no contingent border)	0.591**	1.501	0.669^{+}	1.751	0.609*	1.712
	(0.113)	(0.637)	(0.155)	(0.695)	(0.137)	(0.734)
Upstream basin size	1.248^{+}	1.151	1.130	0.905	1.263^{+}	1.050
	(0.147)	(0.407)	(0.154)	(0.418)	(0.156)	(0.417)
Socio-economic dyad-level control variables						
Regional population density	1.096	1.991**	1.078	1.897**	0.981	1.569*
	(0.156)	(0.471)	(0.131)	(0.454)	(0.119)	(0.303)
Difference in income per capita	0.455***	0.327*	0.397***	0.382^{+}	0.417***	0.367^{+}
	(0.075)	(0.160)	(0.084)	(0.190)	(0.082)	(0.190)
Difference in rule of law	1.308*	1.381	1.198	1.356	1.262*	1.302
	(0.150)	(0.498)	(0.140)	(0.499)	(0.149)	(0.464)
Trade relations, Top 5, 1 out of 4	0.590*	1.076	0.647*	0.965	0.639*	1.084
	(0.125)	(0.387)	(0.134)	(0.391)	(0.131)	(0.431)
Trade relations, Top 5, 2 out of 4	0.510*	0.868	0.676	0.682	0.567*	0.738
	(0.136)	(0.472)	(0.180)	(0.355)	(0.158)	(0.347)
Trade relations, Top 5, 3 out of 4	0.974	1.982	1.095	0.682	1.093	0.741
	(0.298)	(1.340)	(0.350)	(0.704)	(0.373)	(0.659)
Trade relations, Top 5, 4 out of 4	0.204*	0.464	0.265	0.217	0.306	0.744
	(0.153)	(0.809)	(0.227)	(0.539)	(0.240)	(0.988)
Free trade agreement (baseline category 0: no agreement)	1.407	0.643	1.474	0.750	1.565^{+}	0.559
	(0.379)	(0.452)	(0.395)	(0.574)	(0.404)	(0.329)
Common WTO group memberships	1.427^{+}	3.231**	1.189	2.208*	1.170	2.854**
	(0.265)	(1.178)	(0.224)	(0.745)	(0.223)	(1.035)
Colonial relationship (baseline category 0: no relationship)	0.421*	0.477	0.685	0.438	0.548^{+}	0.339
	(0.173)	(0.354)	(0.248)	(0.276)	(0.179)	(0.232)
Common historical colonizer (baseline category 0: no common history)	0.950	0.798	1.061	0.593	1.160	0.625
	(0.219)	(0.301)	(0.235)	(0.398)	(0.259)	(0.326)
Common currency (baseline category 0: no common currency)	1.791	0.349	1.464	0.338	1.595	0.343
	(0.866)	(0.336)	(0.625)	(0.264)	(0.705)	(0.298)

(Continues)

Table III. (Continued)

Types of events (Competing risks)	*Model 4 – Water as a resource*		*Model 5 – Procedural rules*		*Model 6 – Uncertainty management*	
	Cooperation	*Conflict*	*Cooperation*	*Conflict*	*Cooperation*	*Conflict*
Common official language (baseline category 0: no common language)	1.014	0.723	0.892	0.641	0.806	0.575
	(0.253)	(0.350)	(0.198)	(0.272)	(0.174)	(0.257)
Main effects						
Specification of international freshwater treaty area	1.384^{+}	0.996	1.696**	1.742^{+}	1.847**	1.772^{+}
	(0.251)	(0.507)	(0.306)	(0.573)	(0.373)	(0.550)
Specification of RBO	1.961**	0.451*	1.777**	0.306*	2.055***	0.301**
	(0.480)	(0.147)	(0.352)	(0.145)	(0.425)	(0.128)
Interaction effects						
Interaction of treaty area and RBO specifications	0.976	2.262	0.673*	3.289	0.550*	2.334^{+}
	(0.159)	(1.874)	(0.120)	(3.530)	(0.131)	(1.103)
Model statistics						
N	2566		2566		2566	
N failed	1283		1283		1283	
Clusters	122		122		122	
Time at risk (days)	3,909,940		3,909,940		3,909,940	
Model Chi^2	366.103***		648.158***		582.925***	
Pseudo-R^2	0.143		0.153		0.153	

Note: We report incidence rate ratios, that is, exponentiated coefficients. The baseline category for Trade Relations is when neither country is a top exporter or importer for the other and vice versa.
***p < 0.001; **p < 0.01; *p < 0.05; $^{+}$p < 0.10.

the stakes of water as a resource or handling persistent long-term issues that do not need as much short-term operating flexibility.

DISCUSSION

By adopting a polycentric governance lens, our study sought to shed some light on how to govern *transnational* commons. Based on unique, longitudinal data from international river basins, we investigated the effect of two governance mechanisms (international treaties and multi-stakeholder organizations) on the likelihood of freshwater-related cooperation and conflict between country dyads. Taken as a whole, our findings suggest that polycentric governance systems are most effective in facilitating cooperation and reducing conflict when combining: (1) treaties that clearly allocate property rights but leave procedural rules and uncertainty management less specified with (2) multi-stakeholder organizations that define processes for joint decision-making, information exchange, public participation, and dispute resolution.

Implications for Research

This study responds to the call from the *Journal of Management Studies* and management scholars, more broadly, to repurpose management research for the public good and make meaningful contributions to societal grand challenges (George et al., 2016; Markman et al., 2019). Similar to recent studies on cross-sector partnerships (Gatignon and Capron, 2023), circular economy systems (Patala et al., 2022), and sustainable entrepreneurship (Sarasvathy and Ramesh, 2019), our research demonstrates the value of adopting an interdisciplinary perspective that integrates concepts from different domains to better grasp how to tackle such challenges. Focusing on transnational commons that transcend national, cultural, and legal boundaries and that require 'cooperation under anarchy' (Ansari et al., 2013), we translate ideas on polycentric governance systems (Ostrom, 1990) from the national to the transnational level (Berkes, 2006).

A key contribution of our study lies in elucidating the role of dedicated multi-stakeholder organizations – exemplified by RBOs in our setting – as an underexplored yet effective mechanism for governing transnational commons. Multi-stakeholder organizations may serve as a means for coping with the inherent complexity and dynamism of commons, such as freshwater, that span multiple geographies and levels of stakeholders ranging from the local and regional to the national and transnational. Providing a forum for stakeholder interactions, such organizations have an important bridging and adaptation function. Similar to other forms of multi-stakeholder governance (Couture et al., 2023; Dentoni et al., 2018), these entities connect individuals, communities, for-profit and non-profit organizations, as well as governmental and non-governmental actors with potentially competing and changing demands for shared common-pool resources (Mukhtarov and Gerlak, 2013; Schmeier, 2015). Our work thus advances multi-stakeholder organizations as a potentially viable cross-level alternative to conventional macro-level (e.g., property rights, privatization; Demsetz, 1967; Hardin, 1968) and micro-level solutions (e.g., community-based self-governance; Ostrom, 1990) addressing the tragedy of the (transnational) commons. The institutional complexity of many transnational commons may exceed the capacity of self-organized, community-based approaches to polycentric governance which prior commons research has primarily focused on investigating (Ostrom, 1990). More formalized approaches to polycentric governance, such as the dedicated governance organizations examined in our study, may be needed to support collective action (Hailu and Tolossa, 2020).

Integrating ideas from the literature on the governance of interorganizational relationships, especially the notion of contract specificity (Poppo and Zenger, 2002; Ryall and Sampson, 2009), we contribute to a better understanding of how to design multi-stakeholder organizations. In particular, we show that their effectiveness increases with a greater degree of organizational specification. Yet, different governance mechanisms provided by multi-stakeholder organizations appear to have potentially diverging effects on cooperation and conflict. While mechanisms for decision-making, information-sharing, and public participation provisions enhance cooperation between countries, information-sharing and dispute resolution mechanisms mitigate

conflict. These findings could inform the design of various types of multi-stakeholder organizations (e.g., consortia; Olsen et al., 2016) operating in different contexts and help tackle other grand challenges beyond conserving freshwater resources (George et al., 2016; Wickert, 2024).

Our study also identifies key boundary conditions of multi-stakeholder organizations by exploring their interplay with international treaties as a second key element of polycentric governance systems for transnational commons. Both governance mechanisms are deeply interconnected and bring complementary strengths to polycentric governance systems, with international treaties providing the stable, long-term rules of the game (Giordano et al., 2014) and multi-stakeholder organizations allowing for efficient coordination and dynamic adaptation (Mukhtarov and Gerlak, 2013). Consistent with prior work on the potential negative effects of complex contracts, including limiting flexibility and undermining trust (Vlaar et al., 2007; Weber and Mayer, 2011), our findings show that over-specifying international treaties limits the effectiveness of multi-stakeholder organizations to contain resource-related conflict. These organizations work best when complemented by international treaties that specify property rights but that otherwise provide the flexibility needed to facilitate dialogue that empowers stakeholders to find adequate solutions to evolving circumstances and unanticipated demands.

Our findings on the interplay between treaties and multi-stakeholder organizations have implications for research on the polycentric governance of commons (Ostrom, 1990) *and* the governance of interorganizational relationships (Faems et al., 2008; Reuer and Ariño, 2007). On the one hand, we address calls to examine multi-level linkages in polycentric systems (see Berkes, 2006). We explain how governance mechanisms operating at different levels are interrelated. The observed substitution effect between multi-stakeholder organizations and treaties questions the widely held assumption that overlap and redundancy among decision-making centres necessarily enhances the resilience of a polycentric governance system (Carlisle and Gruby, 2019; Huitema et al., 2009). Overlap in the specification of both mechanisms undermined the joint effectiveness of both mechanisms in containing resource-related conflict. Further research might help uncover the circumstances under which overlap within polycentric systems tends to be beneficial or harmful.

On the other hand, our interaction analysis results inform the debate on whether governance mechanisms such as contractual and relational governance reinforce or substitute for each other in cooperative arrangements (Lumineau and Henderson, 2012; Poppo and Zenger, 2002). While previous studies mainly focus on the co-presence of two governance mechanisms (Cao and Lumineau, 2015), we examine their co-specification. Our approach reveals that two mechanisms that are complementary in terms of their co-presence may also exhibit a substitutive relationship in terms of their co-specification. Thus, scholars may find it worthwhile to examine the interplay between distinct governance mechanisms also at the deeper level of salient design features such as their specification. Such efforts appear well suited to further disentangle the multi-faceted interactions between governance mechanisms and identify superior governance configurations.

Implications for Practice and Policy

Our research is relevant for managers and policymakers involved in governing freshwater basins and other transnational commons at local, regional, national, or international levels. Our findings suggest ways to enhance cooperation and reduce conflict over common-pool resources between and within countries, which is crucial when facing unpredictable climate change impacts such as storms, disasters, famines, and droughts (Bernauer and Böhmelt, 2020). Given the existential threats and potential conflicts associated with transnational commons, we contend that governance choices should be evidence-based. Our study expands the evidence available and strengthens the empirical foundation required for designing effective polycentric governance mechanisms. Based on our findings, we offer two specific recommendations for achieving collective action and sustainable solutions in the management of common-pool resources.

First, our research stresses the essential role of multi-stakeholder organizations in fostering collaboration and mitigating conflicts, by serving as platforms for stakeholder dialogue, feedback interpretation, negotiation, and collective action coordination. Such organizational forms offer a viable yet underutilized means for dynamically responding to unexpected events as they arise. Beyond river basins, we advise governments and communities concerned about governing transnational commons to: (1) prioritize the establishment of a clear and effective decision-making framework within these organizations to ensure robust governance provisions and (2) improve these entities' coordination and adaptability by allocating resources and encouraging a learning culture.

This may be achieved by implementing governance-focused management training programmes and organizing workshops involving stakeholders from various sectors to facilitate collaboration and knowledge exchange. An example of this approach is the World Bank's 2023 Global Forum on Transboundary Water Cooperation for Climate Change. This forum convened RBOs, governments, UN agencies, civil society, the private sector, and academia to share insights and best practices.

Second, showing that multi-stakeholder organizations do not operate in isolation, our study advocates a systemic view for governing transnational commons. Practitioners and policymakers should be aware of the subtleties of different governance mechanisms that compose polycentric systems, where potential substitutive effects of over-specified governance systems may diminish the effectiveness of the system. While our study points to a superior configuration of international treaties and multi-stakeholder organizations that best balances the competing needs of stability and flexibility, we acknowledge that other governance contexts may require different configurations.

Limitations and Future Research

Our study has a number of limitations that suggest avenues for future research. First, the specialized setting of our study may raise questions about the generalizability of our findings. While freshwater is undoubtedly a prime example of a common-pool resource, our empirical findings on the effectiveness of polycentric governance hold first and foremost

for the unique context of international river basins. Replication studies focusing on other types of (transnational) commons such as pure public goods (e.g., clean air; see Ansari et al., 2013) or data commons (e.g., open source software; see Potts et al., 2023), both of which differ from freshwater resources in that they are non-rivalrous in consumption, are needed. The governance mechanisms we uncovered may be even more effective in reinforcing collaboration and preventing conflict when resources are more abundant and less competitive than freshwater.

Another question that may arise is to what extent our ideas about multi-stakeholder organizations are applicable to other contexts such as strategic alliances or innovation ecosystems. While these coordinating forums are a prevalent feature of water management systems around the world (Schmeier et al., 2016), they are less utilized in traditional organizational contexts. Standard-setting organizations (Vasudeva et al., 2015) and consortia (Olsen et al., 2016) that facilitate collective action among heterogeneous actors might be the nearest equivalents to the organizations we examined. Building on our theorizing and measurement, future work could examine how and when standard-setting organizations or consortia benefit from incorporating Ostrom's (1990) polycentric governance principles.

We also acknowledge methodological limitations. First, our approach to capturing the design of international treaties and multi-stakeholder organizations via additive indices that estimate the degree of specification of these governance mechanisms is far from perfect. Additional validation checks, which we were unable to conduct due to a lack of available data (e.g., information about the length of treaties), would be desirable. Second, we believe there is substantial value in complementing our large-scale quantitative study with qualitative research that could explore the design and functioning of transnational governance systems in greater detail. Stakeholder dialogue, behaviour, and motives remain unobserved in our quantitative study but are likely essential for strongly linking the design of multi-stakeholder organizations to observed cooperation and conflict between countries. Third, although we controlled for various geographical and socio-economic factors identified as predictors of water cooperation and conflict (Bernauer and Böhmelt, 2020), our findings should be interpreted with some caution. The design of our hazard model does establish a *clear temporal sequence* where the signing of treaties in a country-dyad precedes any water events (i.e., cooperation and conflicts). However, due to incomplete historical records, we are unable to conduct counterfactual analyses to examine country dyads that experience cooperation and/or conflict but *do not have* treaties and multi-stakeholder organizations in place. Future studies replicating and extending our research should employ additional strategies for handling endogeneity concerns and conducting counterfactual analyses of plausible scenarios.

CONCLUSION

Notwithstanding these limitations, we believe that our study provides valuable insights into how to design polycentric governance systems that enable collective action and help avoid the tragedy of the (transnational) commons. In the spirit of this *Journal of Management Studies*

Special Issue on 'Repurposing Management for the Public Good: Processes, Obstacles and Unintended Consequences', we hope that our work will inspire future research seeking to improve managerial knowledge and practices for tackling grand challenges.

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NOTES

[1] Rather than representing mutually exclusive events, water cooperation and conflict often co-occur. For example, two countries cooperating on water-related projects may at the same time compete over water resources and engage in hostile acts. This and the fact that cooperation and conflict are distinct constructs that may emerge through unique processes suggest that studies should consider both types of water events (Zeitoun and Mirumachi, 2008).

[2] While not directly comparable, steering committees, standard-setting organizations, and industry consortia that govern interorganizational relationships serve a somewhat similar function to multi-stakeholder organizations at river basins. For example, steering committees can help alliance partners prevent conflicts or address them at an early stage before they become more serious (Reuer and Devarakonda, 2016).

[3] A dyadic level of analysis is common practice in the literature on water interactions (Bernauer and Böhmelt, 2020).

REFERENCES

Aalen, O. (1978). 'Nonparametric inference for a family of counting processes'. *The Annals of Statistics*, **6**, 701–26.

Adams, W. M., Brockington, D., Dyson, J. and Vira, B. (2003). 'Managing tragedies: Understanding conflict over common pool resources'. *Science*, **302**, 1915–6.

Akamani, K. and Wilson, P. I. (2011). 'Toward the adaptive governance of transboundary water resources: Adaptive governance of transboundary water resources'. *Conservation Letters*, **4**, 409–16.

Ansari, S., Wijen, F. and Gray, B. (2013). 'Constructing a climate change logic: An institutional perspective on the "tragedy of the commons"'. *Organization Science*, **24**, 1014–40.

Bakker, K. (2012). 'Water security: Research challenges and opportunities'. *Science*, **337**, 914–5.

Berkes, F. (2006). 'From community-based resource management to complex systems: The scale issue and marine commons'. *Ecology and Society*, **11**, 1–15.

Bernauer, T. and Böhmelt, T. (2020). 'International conflict and cooperation over freshwater resources'. *Nature Sustainability*, **3**, 350–6.

Blumstein, S. and Petersen-Perlman, J. D. (2021). 'When the water runs dry: Supporting adaptive governance in transboundary river basins'. *Water International*, **46**, 306–24.

Bridoux, F. and Stoelhorst, J. W. (2022). 'Stakeholder governance: Solving the collective action problems in joint value creation'. *Academy of Management Review*, **47**, 214–36.

Cao, Z. and Lumineau, F. (2015). 'Revisiting the interplay between contractual and relational governance: A qualitative and meta-analytic investigation'. *Journal of Operations Management*, **33**, 15–42.

Carlisle, K. and Gruby, R. L. (2019). 'Polycentric systems of governance: A theoretical model for the commons'. *Policy Studies Journal*, **47**, 927–52.

Couture, F., Jarzabkowski, P. and Lê, J. K. (2023). 'Triggers, traps, and disconnect: How governance obstacles hinder progress on grand challenges'. *Academy of Management Journal*, **66**, 1651–80.

Cox, D. R. (1972). 'Regression models and life-tables'. *Journal of the Royal Statistical Society: Series B: Methodological*, **34**, 187–220.
Dellapenna, J. W. (2001). 'The customary international law of transboundary fresh waters'. *International Journal of Global Environmental Issues*, **1**, 264–305.
Demsetz, H. (1967). 'Towards a theory of property rights'. *The American Economic Review*, **57**, 347–59.
Dentoni, D., Bitzer, V. and Schouten, G. (2018). 'Harnessing wicked problems in multi-stakeholder partnerships'. *Journal of Business Ethics*, **150**, 333–56.
Dinar, S., Katz, D., De Stefano, L. and Blankespoor, B. (2015). 'Climate change, conflict, and cooperation: Global analysis of the effectiveness of international river treaties in addressing water variability'. *Political Geography*, **45**, 55–66.
Drieschova, A., Giordano, M. and Fischhendler, I. (2008). 'Governance mechanisms to address flow variability in water treaties'. *Global Environmental Change*, **18**, 285–95.
Efron, B. (1977). 'The efficiency of Cox's likelihood function for censored data'. *Journal of the American Statistical Association*, **72**, 557–65.
Faems, D., Janssens, M., Madhok, A. and Looy, B. V. (2008). 'Toward an integrative perspective on alliance governance: connecting contract design, trust dynamics, and contract application'. *Academy of Management Journal*, **51**, 1053–78.
Fine, J. P. and Gray, R. J. (1999). 'A proportional hazards model for the subdistribution of a competing risk'. *Journal of the American Statistical Association*, **94**, 496–509.
Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005). 'Adaptive governance of social-ecological systems'. *Annual Review of Environment and Resources*, **30**, 441–73.
Gardner, R., Ostrom, E. and Walker, J. M. (1990). 'The nature of common-pool resource problems'. *Rationality and Society*, **2**, 335–58.
Gatignon, A. and Capron, L. (2023). 'The firm as an architect of polycentric governance: Building open institutional infrastructure in emerging markets'. *Strategic Management Journal*, **44**, 48–85.
Gaulier, G. and Zignago, S. (2010). *BACI: International trade database at the product-level (the 1994-2007 version)*. CEPII Working Paper 2010–23. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1994500 (accessed 29 April 2021)
George, G., Howard-Grenville, J., Joshi, A. and Tihanyi, L. (2016). 'Understanding and tackling societal grand challenges through management research'. *Academy of Management Journal*, **59**, 1880–95.
Giordano, M., Drieschova, A., Duncan, J. A., Sayama, Y., De Stefano, L. and Wolf, A. T. (2014). 'A review of the evolution and state of transboundary freshwater treaties'. *International Environmental Agreements: Politics, Law and Economics*, **14**, 245–64.
Gleditsch, N. P., Furlong, K., Hegre, H., Lacina, B. and Owen, T. (2006). 'Conflicts over shared Rivers: resource scarcity or fuzzy boundaries?'. *Political Geography*, **25**, 361–82.
Gümüsay, A. A., Marti, E., Trittin-Ulbrich, H. and Wickert, C. (2022). 'How organizing matters for societal grand challenges'. In Gümüsay A. A., Marti, E., Trittin-Ulbrich, H. and Wickert, C. (Eds), *Organizing for Societal Grand Challenges (Research in the Sociology of Organizations)*. Bingley: Emerald Publishing Limited, **79**, 1–14.
Hailu, R. and Tolossa, D. (2020). 'Multi-stakeholder platforms: institutional options to achieve water security in the awash basin of Ethiopia'. *World Development Perspectives*, **19**, 100213.
Hardin, G. (1968). 'The tragedy of the commons'. *Science*, **162**, 1243–8.
Hess, K. R. (1995). 'Graphical methods for assessing violations of the proportional hazards assumption in Cox regression'. *Statistics in Medicine*, **14**, 1707–23.
Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C. and Yalcin, R. (2009). 'Adaptive water governance: Assessing the institutional prescriptions of adaptive (co-) management from a governance perspective and defining a research agenda'. *Ecology and Society*, **14**, 1–20.
Kalbhenn, A. and Bernauer, T. (2012). *International water cooperation and conflict: A new event dataset. SSRN*. Available at https://ssrn.com/abstract=2176609 (accessed 23 July 2019).
Kaufmann, D., Kraay, A. and Mastruzzi, M. (2011). 'The worldwide governance indicators: Methodology and analytical issues'. *Hague Journal on the Rule of Law*, **3**, 220–46.
Klein, P. G., Mahoney, J. T., McGahan, A. M. and Pitelis, C. N. (2019). 'Organizational governance adaptation: Who is in, who is out, and who gets what'. *Academy of Management Review*, **44**, 6–27.
Kutner, M. H., Nachtsheim, C. J. and Neter, J. (1983). *Applied Linear Regression Models*. Homewood, IL: Irwin.
Kuzma, S., Bierkens, M. F., Lakshman, S., Luo, T., Saccoccia, L., Sutanudjaja, E. H. and Van Beek, R. (2023). *Aqueduct 4.0: Updated Decision-Relevant Global Water Risk Indicators*. Washington, DC, USA: World Resources Institute. 1–52.

Lautze, J. and Giordano, M. (2005). 'Transboundary water law in Africa: Development, nature, and geography'. *Natural Resources Journal*, **45**, 1053.
Libecap, G. D. (1993). *Contracting for Property Rights*. Cambridge, England, UK: Cambridge University Press.
Lui, S. S. and Ngo, H. (2004). 'The role of trust and contractual safeguards on cooperation in non-equity alliances'. *Journal of Management*, **30**, 471–85.
Lumineau, F. and Henderson, J. E. (2012). 'The influence of relational experience and contractual governance on the negotiation strategy in buyer–supplier disputes'. *Journal of Operations Management*, **30**, 382–95.
Malhotra, D. and Lumineau, F. (2011). 'Trust and collaboration in the aftermath of conflict: The effects of contract structure'. *Academy of Management Journal*, **54**, 981–98.
Markman, G. D., Waldron, T. L., Gianiodis, P. T. and Espina, M. I. (2019). 'E Pluribus Unum: Impact entrepreneurship as a solution to grand challenges'. *Academy of Management Perspectives*, **33**, 371–82.
McCaffrey, S. C. (2003). 'The need for flexibility in freshwater treaty regimes'. *Natural Resources Forum*, **27**, 156–62.
McCracken, M. and Wolf, A. T. (2019). 'Updating the register of international river basins of the world'. *International Journal of Water Resources Development*, **35**, 732–82.
McGahan, A. M. and Pongeluppe, L. S. (2023). 'There is no Planet B: Aligning stakeholder interests to preserve the Amazon rainforest'. *Management Science*, **69**, 7860–81.
Meijerink, S. and Huitema, D. (2017). 'The institutional design, politics, and effects of a bioregional approach: Observations and lessons from 11 case studies of river basin organizations'. *Ecology and Society*, **22**, 1–16.
Mekonnen, M. M. and Hoekstra, A. Y. (2016). 'Four billion people facing severe water scarcity'. *Science Advances*, **2**, e1500323.
Milman, A. and Gerlak, A. K. (2020). 'International river basin organizations, science, and hydrodiplomacy'. *Environmental Science & Policy*, **107**, 137–49.
Mooi, E. A. and Ghosh, M. (2010). 'Contract specificity and its performance implications'. *Journal of Marketing*, **74**, 105–20.
Mukhtarov, F. and Gerlak, A. K. (2013). 'River basin organizations in the global water discourse: An exploration of agency and strategy'. *Global Governance*, **19**, 307–26.
Nelson, W. (1972). 'Theory and applications of hazard plotting for censored failure data'. *Technometrics*, **14**, 945–66.
North, D. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge, MA: Cambridge University Press.
Olsen, A. Ø., Sofka, W. and Grimpe, C. (2016). 'Coordinated exploration for grand challenges: The role of advocacy groups in search consortia'. *Academy of Management Journal*, **59**, 2232–55.
Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.
Ostrom, E. (2010). 'Beyond markets and states: Polycentric governance of complex economic systems'. *American Economic Review*, **100**, 641–72.
Ostrom, E., Burger, J., Field, C. B., Norgaard, R. B. and Policansky, D. (1999). 'Revisiting the commons: local lessons, global challenges'. *Science*, **284**, 278–82.
Paisley, R. K. and Henshaw, T. W. (2013). 'Transboundary governance of the Nile river basin: Past, present and future'. *Environmental Development*, **7**, 59–71.
Patala, S., Albareda, L. and Halme, M. (2022). 'Polycentric governance of privately owned resources in circular economy systems'. *Journal of Management Studies*, **59**, 1563–96.
Petersen-Perlman, J. D., Veilleux, J. C. and Wolf, A. T. (2017). 'International water conflict and cooperation: Challenges and opportunities'. *Water International*, **42**, 105–20.
Poppo, L. and Zenger, T. (2002). 'Do formal contracts and relational governance function as substitutes or complements?'. *Strategic Management Journal*, **23**, 707–25.
Potts, J., Torrance, A., Harhoff, D. and Von Hippel, E. (2023). 'Profiting from data commons: Theory, evidence, and strategy implications'. *Strategy Science*, **9**, 1–17.
Prentice, R. L., Williams, B. J. and Peterson, A. V. (1981). 'On the regression analysis of multivariate failure time data'. *Biometrika*, **68**, 373–9.
Reuer, J. J. and Ariño, A. (2007). 'Strategic alliance contracts: Dimensions and determinants of contractual complexity'. *Strategic Management Journal*, **28**, 313–30.
Reuer, J. J. and Devarakonda, S. V. (2016). 'Mechanisms of hybrid governance: Administrative committees in non-equity alliances'. *Academy of Management Journal*, **59**, 510–33.
Ryall, M. D. and Sampson, R. (2009). 'Repeated interaction and contract structure: evidence from technology development contracts'. *Management Science*, **55**, 906–25.
Sarasvathy, S. D. and Ramesh, A. (2019). 'An effectual model of collective action for addressing sustainability challenges'. *Academy of Management Perspectives*, **33**, 405–24.

Schilke, O. and Lumineau, F. (2018). 'The double-edged effect of contracts on alliance performance'. *Journal of Management*, **44**, 2827–58.
Schlager, E. (2004). 'Common-pool resource theory'. In Durant R. F., Fiorino D. J. and O'Leary R. (Eds), *Environmental Governance Reconsidered: Challenges, Choices, and Opportunities*. Cambridge: MIT Press, 145–75.
Schmeier, S. (2015). 'The institutional design of river basin organizations – empirical findings from around the world'. *International Journal of River Basin Management*, **13**, 51–72.
Schmeier, S., Gerlak, A. K. and Blumstein, S. (2016). 'Clearing the muddy waters of shared watercourses governance: Conceptualizing international River Basin Organizations'. *International Environmental Agreements: Politics, Law and Economics*, **16**, 597–619.
Sinclair, I. M. (1984). *The Vienna Convention on the Law of Treaties*. Manchester: Manchester University Press.
Stavins, R. N. (2011). 'The problem of the commons: Still unsettled after 100 years'. *American Economic Review*, **101**, 81–108.
Stoker, G. (2018). 'Governance as theory: Five propositions'. *International Social Science Journal*, **68**, 15–24.
Vasudeva, G., Alexander, E. A. and Jones, S. L. (2015). 'Institutional logics and interorganizational learning in technological arenas: Evidence from standard-setting organizations in the mobile handset industry'. *Organization Science*, **26**, 830–46.
Vlaar, P. W. L., Van Den Bosch, F. A. J. and Volberda, H. W. (2007). 'On the evolution of trust, distrust, and formal coordination and control in interorganizational relationships: toward an integrative framework'. *Group & Organization Management*, **32**, 407–28.
Vörösmarty, C. J., Green, P., Salisbury, J. and Lammers, R. B. (2000). 'Global water resources: Vulnerability from climate change and population growth'. *Science*, **289**, 284–8.
Weber, L. and Mayer, K. J. (2011). 'Designing effective contracts: Exploring the influence of framing and expectations'. *Academy of Management Review*, **36**, 53–75.
Wickert, C. (2024). 'Prescriptive theorizing to tackle societal grand challenges: Promises and perils'. *Journal of Management Studies*, **61**, 1683–91.
Williamson, O. E. (1996). *The Mechanisms of Governance*. Oxford: Oxford University Press.
Wolf, A. T. (1998). 'Conflict and cooperation along international waterways'. *Water Policy*, **1**, 251–65.
Wolf, A. T., de Silva, L. and Veilleux, J. C. (2011). *International Water Event Database: 1950–2008*. Available at http://Ocid.Nacse.Org/Tfdd/internationalEvents.Php(2016-09-30) (accessed 12 December 2019)
Wolf, A. T., Stahl, K. and Macomber, M. F. (2003). 'Conflict and cooperation within international river basins: The importance of institutional capacity'. *Water Resources Update*, **125**, 31–40.
World Bank. (2020a). *World development indicators* [Data set]. Available at https://databank.worldbank.org/source/world-development-indicators (accessed 29 April 2021)
World Bank. (2020b). *World integrated trade solution* [Database]. Available at https://wits.worldbank.org (accessed date is 29 April 2021)
World Trade Organization. (2020). *WTO Negotiation Groups Database* [Data set]. Available at https://www.wto.org/english/tratop_e/dda_e/negotiating_groups_e.htm (accessed 21 November 2020).
Yoffe, S., Wolf, A. T. and Giordano, M. (2003). 'Conflict and cooperation over international freshwater resources: Indicators of basins at risk'. *Journal of the American Water Resources Association*, **39**, 1109–26.
Zeitoun, M. and Mirumachi, N. (2008). 'Transboundary water interaction I: Reconsidering conflict and cooperation'. *International Environmental Agreements: Politics, Law and Economics*, **8**, 297–316.
Zhou, K. Z. and Xu, D. (2012). 'How foreign firms curtail local supplier opportunism in China: Detailed contracts, centralized control, and relational governance'. *Journal of International Business Studies*, **43**, 677–92.

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