A River Runs Through It

Democracy, International Interlinkages and Cooperation over Shared Resources

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Abstract

The aim of this paper is to empirically analyse the context dependency of Kantian Peace arguments. In particular, I highlight the impact of democratic structures and countries' interlinkages on cooperation and conflict over shared resources. The gist of my argument is that democratic leaders have an incentive to cooperate on such resources, as long as the costs of cooperation are outweighed by their supporters loyalty. Further, following Kantian Peace arguments, both economic and political interlinkages may foster cooperation. Empirically, I focus on governments' behaviour regarding transboundary river management using a new dataset on transboundary water events covering all international basins for a period of eleven years (1997-2007). Based on these event data, I analyse the effect of democracy, political and economic interlinkages on conflictive versus cooperative behaviour. Additionally, I assess in how far government actions with respect to joint river management are driven by the severity and salience of transboundary water issues and consider other context specific factors, such as river geography.

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1 Introduction

The aim of this paper is to shed light on the context dependency of the allegedly pacifying effects of democracy, political- and economic interlinkages (the Kantian[1] triangle). Whereas some authers note the context dependency of the determinants of intergovernmental cooperation (cf. Russett 1994, 28), there are little empirical studies that explicitly take into consideration under which circumstances democracy, political- and economic interlinkages lead to more intergovernmental cooperation. In this paper, I focus on intergovernmental cooperation over shared resources, the latter bearing the potential for both cooperation and conflict. Rather than simply relying on standard liberal theories (emphasizing the pacifying effect of democracy and interlinkages), I develop a theoretical argument highlighting the different circumstantialities under which democracy and interlinkages might have a cooperation enhancing effect. Democratic leaders' willingness to cooperate might, for instance, depend on the cost of coopeartation. I thus argue that democratic[2] leaders have an incentive to cooperate over shared resources as long as the costs of cooperation (e.g. abatement costs) are outweighed by supporters' loyalty. Whereas both political and economic integration are expected to foster intergovernmental cooperation, their effect is expected to differ depending on power and interest asymmetries. Further, certain problem characteristics, such as salience and severity are expected to have a different impact on cooperation, given different levels of democracy. By carefully differentiating between different geographic contexts and incentive structures, this paper aims at providing a more encompassing picture of the circumstancialities of intergovernmental cooperation.

The empirical focus of this paper is on governments' actions regarding cooperation over shared resources, in particular transboundary freshwater management. Given that many resources are not confined to the national territory, and, likewise many pollutants are transported across national boundaries, governments depend on cooperating with their neighbours in order to provide public goods (Bergin et al. 2005, 28), avoid public bads, or overcome externalities. I rely on freshwater rather than on transboundary air pollution, since rivers are shared by a "small and well-defined group of countries" (Sigman 2003, 01), whereas the origin of transboundary air pollutants is often diffuse. In addition, transboundary rivers particularly lend themselves to study different contexts of intergovernmental cooperation, since they display various power and interest constellations (upstream-downstream scenarios versus border demarkating rivers). Further, some countries share several rivers with the same neighbour, or "different rivers with different neighbors, giving rise to cross-sectional variation even within countries" (Sigman 2003, 01) and some rivers are shared by multiple countries. When considering different contexts given by river geography, we can thus held country characteristics constant. Similarly, we can study the effect of certain country characteristics (or, in fact, country pair characteristics, such as the joint membership in international organisations) given certain river characteristics. Finally, we can consider different interest constellations within the same pair of riparians in different rivers..

Currently, more than 260 watersheds cross national boundaries and these basins cover some 45.3% of the Earth's land surface (Wolf et al. 1999; Wolf, Yoffe & Giordano 2003). Accordingly, the management of transboundary water reserves is of substantial importance with respect to conserving humanity's most valuable natural resource. Knowledge of the determinants of successful transboundary management of water pollution and scarcity problems can enhance future actions in this respect. Further, about 40% of the world's total population lives within the basin areas of internationally shared rivers (Giordano & Wolf 2003, 163). Consequently, decisions on water issues, such as covering fresh water needs versus altering the stream of a river for industrial reasons (such as hydropower generation) are not merely a political decision but of real concern for many citizens (Brochmann 2006).

In recent years, some large-N empirical studies on transboundary freshwater issues have been published. Many of these focus on potential conflict between river sharing countries over either the shared water resource or the borders it constitutes (cf. Toset et al. 2000; Stroh 2004; Furlong et al. 2006;

[1] The gist of the Kantian peace argument is that democracies do not fight each other. Extensions of the argument include liberal explanations in more general terms, emphasising the pacifying effects of democracy, economic interdependence and International Organisations (cf Russett & Oneal 2001)

[2] When referring to democratic leaders, or democracy as such, the latter is understood as a multidimensional concept, characterised by certain institutional features and political rights. I argue that several dimensions of democracy have a non-neglegible impact on democratic leaders' decision whether or not to cooperate over shared resources, but act through different channels. The corresponding conceptualisations of democracy are given below, alongside with the respective theoretical argument.

Gizelis et al. 2007; Gleditsch et al. 2006). Whereas these studies provide relevant and important insights on the risk for militarized conflict between river-sharing countries, they neglect whether water related issues are actually at the core of such conflicts between river sharing countries. In an effort to disentangle river related from other types of conflict, the Issue Correlates of War Project (ICOW)[3] is coding events data on official interaction between countries that express claims on cross border rivers, such as demanding "the right to navigate along the river (typically for purposes of commerce or travel)" (Hensel 2005, 02). Analysing these data, Hensel et al. (2006) and Brochmann & Hensel (2009) find that river institutions help solving ongoing river claims and that the likelihood of successful negotiations over ongoing river claims increases with greater water demands and closer overall relations between riparian countries. Further, Hensel et al. (2008, 132) conclude that "peaceful and militarized means for managing contentious issues are substitutable and driven by similar processes".

In terms of cooperation on shared resources, several scholars posit that despite "clear epistemic consensus in academia in favour of the 'water peace' hypothesis" (Stucki 2005, 05),[4] there is still little systematic empirical research on the circumstantialities of cooperative behaviour over shared rivers. Some early studies on transboundary water issues treat cooperation mainly as the opposite of conflict (cf. Brochmann & Gleditsch 2006b), others focus on institutionalised cooperation over rivers, i.e. river treaties (cf. Conca & Wu 2006; Hamner 2009; Gerlak & Grant 2009; Tir & Ackerman 2009; Stinnett & Tir 2009). Regarding the latter, we can distinguish efforts to explain why formal cooperation over shared rivers comes about and studies on specific aspects of such institutionalized cooperation. Hamner (2009) finds evidence for the hypothesis that states are more likely to enter into water treaties during times of water stress. In particular, bilateral treaties are more likely to come into being "during a drought shared by both signatory states." (Hamner 2009, 01). Also Tir & Ackerman (2009) examine under what conditions riparian countries enter into treaties dealing with water quantity and quality, highlighting the importance of neo-liberal explanatory factors such as riparians' trade relationships, trade interdependencies and joint democracy. A recent study by Zawahri (2009) analyses the effect of third party mediation on resolving river disputes and establishing stable institutional frameworks. Based on a case study of the river Indus, she finds that third party mediators play an important role in monitoring and coordination.

Based on a sample of 118 bilateral water treaties from 1944 to 1998 in 157 international river basins, Espey & Towfique (2004), in turn, find that the most important driving factors of bilateral water treaties are basin- rather than country-specific covariates such as the share of a country's territory covered by a river basin. Country- and dyad specific characteristics appear to have smaller effects on the probability of treaty formation. Hoffman (2003) considers both basin- and country-specific explanatory variables to analyse which countries form river treaties in which basins. She finds that "basins with treaties tend to be larger, have more riparians sharing the water, and be located at least partially on an international border" (Hoffman 2003, 20). These results are similiar to the ones by Gerlak & Grant (2009), who analyse which factors explain the emergence of cooperative institutional arrangements for river cooperation, considering 63 institutional arrangements in 245 international river basins between 1975 and 2000. The authors' main finding is that institutional arrangements are more likely to be established over basins shared by multiple countries (more than two), and between predominantly democratic riparians with asymmetrical military capabilities (Gerlak & Grant 2009, 29). The depth of institutional arrangement is best explained by existing formalized organizational structures and high economic capabilities.

Going beyond the mere question of when and why water treaties come about, Stinnett & Tir (2009) center their attention to the degree of institutionalisation of river treaties, and Zawahri & Mitchell (2008) explore when and why riparians choose bilateral over multilateral treaties. They compare "three contexts for cooperation: 1) bilateral river treaties on bilateral river basins, 2) bilateral river treaties on multilateral river basins, and 3) multilateral river treaties on multilateral river basins" (Zawahri & Mitchell 2008, 02). They argue (and find empirical evidence) that the chosen treaty type depends on state interests (e.g. dependency on a particular river), transaction costs, and balance of power. Stinnett & Tir (2009) argue that certain river issues are rather complex, which is why potential member states value more institutionalized treaties.[5]

[3] `http://garnet.acns.fsu.edu/~phensel/icow.html`

[4] Other critics of the water war hypothesis (stating that rising population density and thus increasing water demands and limited water resources will ultimately lead to war (cf. Starr 1991)) include Wolf (2000) and Dinar (2009)

[5] A more extensive overview on this and related literature can be found in Bernauer & Kalbhenn (2009).

In this paper, I contribute to the existing literature in several ways. First, I emphasize the context dependency of Kantian peace arguments and their applicability to cooperation over shared resources.

Second, I understand cooperation over shared resources as including both formal agreements (such as river treaties) and non-institutionalized forms of cooperation, such as meetings between environmental ministers to initiate or foster joint management of shared basins. This conceptualization of conflict and cooperation allows for a more encompassing test of the applicability of the Kantian triangle to cooperation over shared resources.[6]. Apart from pioneering papers by Wolf (1998), Wolf, Stahl & Macomber (2003), Wolf, Yoffe & Giordano (2003), existing studies on non-institutionalized forms of cooperation rely mainly on case study evidence (cf. Stucki 2005). Case studies can help us to form educated expectations on when and why transboundary river management is possible and successful, but case studies alone may not suffice to support such considerations with generalizable empirical evidence. Relying on event data on shared rivers, Wolf (1998), Wolf, Stahl & Macomber (2003), and Wolf, Yoffe & Giordano (2003) were among the first authors to show that there is more cooperation than conflict among river sharing countries.

Third, in an effort to expand and complement existing datasets on transboundary freshwater issues, I compile a new events data set. In particular, I examine cooperative and conflictive events between riparian countries' governments with respect to shared international basins.[7] Currently, two datasets are widely used in work on international water cooperation and conflict, namely the ICOW River Claims dataset (`http://garnet.acns.fsu.edu/~phensel/icow.html`) and the Transboundary Freshwater Disputes Database (`http://www.transboundarywaters.orst.edu`). The ICOW River Claims dataset focuses on river claims exclusively, and has so far been completed for the Americas, Northern and Western Europe, and the Middle East. The Transboundary Freshwater Dispute Database (TFDD) reports events regarding conflict and cooperation over shared rivers based on a content analysis of different news sources. It features three variables relevant for the study of cooperative management of international freshwater resources, namely events on "water quality", "joint management" and "water quantity". In building the new dataset, I rely on the TFDD approach, adapting the coding scheme to be tailored to water related issues, extending the dataset by including more recent events, additional news sources, and some additional variables.

Fourth, my empirical analysis is conducted at the basin-dyad-year level, where dyad refers to a pair of countries. This structure allows to test for context dependency in several ways, since basin, country, and dyad specific effects may be varied both across and within samples. Existing studies often either aggregate the data to the dyad-, basin, or country level. As such, Tir & Ackerman (2009)'s study on river treaty formation has the dyad-year rather than the basin-dyad-year as the unit of analysis. Whereas the study by Tir and Ackerman allows inference on country- or dyadic specific factors explaining treaty formation, their design does not allow for conclusion as to whether specific basins (such as those densely populated, afflicted by droughts, highly polluted, etc.) are more prone to be the subject of bilateral treaties than others. Gerlak & Grant (2009) in turn, focus on the basin level, implicitly defining a basin as the aggregate of riparian countries. Certain basin-specific effects might thus only partially reflect the situation in the basin in question (e.g. using water pollution data of all riparian countries as a proxy for pollution in a specific basin, rests on the implicit assumption that country-level water pollution is uniformly distributed across rivers). Hoffman (2003) conducts two separate analyses, one on the country level (considering only country specific effects), the other on the basin level (considering basin level effects). This approach, however, ignores that both effects are probably not independent of each other. Others, such as Brochmann & Gleditsch (2006b); Hensel et al. (2006); Hensel & Brochmann (2007); Zawahri & Mitchell (2008), pool the data and analyse it at the basin(or river)-dyad-year, but their statistical analyses ignore that this creates non-independent observations.[8] I try to explicitly account for both interdependencies between dyads located in the same basin (some basins are shared by more than two countries) and interdependencies between basins shared by the same dyad (some dyads share more than one basin) by introducing respective

[6] Both Tir & Ackerman (2009) and Bernauer & Kuhn (2009) rely on Kantian arguments, their dependent variables (river treaties, water pollution), however, differ from the one applied in this study.

[7] Considering both conflictive and cooperative events, is in line with Zawahri and Gerlak's advice to jointly study cooperation and conflict, because both might occur simultaneously in the same river basin (Zawahri & Gerlak 2009, 218).

[8] Brochmann & Hensel (2009) use standard errors clustered on the dyad, but this does not account for interdependencies on the river or basin level (many of the rivers in their sample are located in the same basin, for instance Iguazu, Paraguay, Parana, Pilcomayo, and the Uruguay River are all part of the La Plata basin).

spatial lags.

The remainder of this paper is structured as follows: section 2 delineates the theoretical framework and presents empirically testable hypotheses. Following the theoretical part, section 3 is dedicated to the research design and discussion of some methodological questions. The empirical part is completed by the discussion of results (section 4), section 5 concludes.

2 Theoretical Framework

According to Tir & Ackerman, "the resources rivers offer are often not purely public (defined as non-rival and non-excludable) or private (defined as rival and excludable) goods. Instead, they are partially rival and partially excludable, making them collective goods or common pool resources" (Tir & Ackerman 2009, 3). Whether or not these resources can be considered as non-rival and non-excludable, depends both on river geography and on the issue at stake. Border demarkating rivers, for instance, are non-excludable. Whether or not they are non-rivalrous depends on the issue at hand. In terms of water quality, one can easily see non-rivalry. All countries riparian to a border demarkating river benefit from water quality and suffer from water pollution to more or less the same extend (that is, potential externalities are reciprocal (cf. Barrett 1994)). Water quality in border demarkating rivers thus comes closest to a public good. In terms of water quantity, however, a country might overexploit the resource (rivalry), hence characterising a common-pool good situation. In upstream-downstream situations, clear power asymmetries between up- and downstream countries prevail. The main concern here are, therefore, unilateral transboundary externalities.

In setting up the theoretical argument, I therefore distinguish between different scenarios. Depending on the circumstantialities, I expect different incentives regarding potential government action. The next sections considers the effect of democracy and interdependencies on intergovernmental cooperation, distinguishing different geographical settings and issue areas of concern.

2.1 Democracy

The gist of the Kantian Peace argument is that democracies do not fight each other. Many scholars have extended this argument to show that in addition, democracies tend to behave more cooperatively.

As alluded to before, in case of pollution in border-demarkating rivers, citizens of all countries located in the same international basin would gain from cooperation aimed at better river management, but would also have to bear the costs of this management action.

In order to better understand governments' behaviour in case of shared public goods (or public bads,[9] respectively), two questions have to be addressed: First, do governments have an incentive to provide their constituents with public goods in the first place? Second, if governments have an incentive to provide their constituents with public goods, do they choose to cooperate with other countries in case of shared public goods (or public bads)? With respect to common pool resources, the crucial question is whether or not countries have an incentive to collaborate to mutually beneficially manage the shared resource. Building on the literature on the domestic provision of public goods, I develop an argument regarding the first question in section 2.1.1, and then proceed to governments interaction in section 2.1.2.

2.1.1 Provision of public goods

There exists a vast literature on the determinants of domestic public goods- and domestic environmental quality provision more specifically. Whereas many economics studies highlight the relationship between per capita income and environmental quality (Grossman & Krueger 1995), more recent studies from the field of political science stress the importance of political variables such as democracy (c.f. Li & Reuveny 2006; Fredriksson & Wollscheid 2007; Ward 2008; Bernauer & Koubi 2009). Many studies on monadic provision of public goods have shown democracies to outperform autocracies in providing public goods (cf. Fredriksson & Wollscheid 2007; Ward 2008; Bernauer & Koubi 2009). It should be noted, however, that empirical applications to environmental quality, have led to mixed results regarding different types of pollutants (c.f. Midlarsky 1998). Conclusive results are obtained only in the case of SO_2 concentrations. Non-democratic regimes, in turn, tend to underprovide public goods (Olson 1993; McGuire & Olson 1996; Deacon 1999). At the core of the argument why democracies outperform autocracies is the assumption that, in order to survive in office, political leaders must satisfy their "winning coalition" (the group of people whose support is crucial to stay in office) to ensure continuous support (Bueno de Mesquita et al. 2003, 30). Non-democratic political leaders

[9] Public bads are simply defined as the counterpart to public goods. Whereas public goods have the connotation of people benefiting, public bads imply the reverse. For example, clean air is considered a public good, whereas air pollution might be defined as a public bad. In both cases non-rivalry and non-excludability apply.

typically depend on the loyalty of a small elite. Such a small winning coalition, can beneficially be compensated with private goods, only beneficial for those supporting the leader, to ensure loyalty of a privileged few (Bueno de Mesquita et al. 2003, 197). The benefits of public goods provision are uniformly distributed among the population. If non-democratic political leaders decided to spend more money on public goods provision rather than accumulating rents and supplying their supporting elite with private goods, the leading elite would bear disproportionately high opportunity costs of spending tax revenue on public goods provision. The median voter in a democracy, in turn, incurs lower marginal cost of public goods provision. In addition, democratic leaders are responsive to a larger winning coalition. They consequently have to resort to the provision of public goods to ensure political support, given that they lack sufficient resources to reward their supporters with high levels of private goods. According to the weak loyalty norm in democratic regimes, supporters might defect to opposition parties (or opposing candidates) if their demands are not satisfied. Democratic leaders are thus responsive to and accountable for public demand. Bueno de Mesquita et al. (2003) conclude that "the size of a government's winning coalition is a significant factor in promoting public-goods production" (Bueno de Mesquita et al. 2003, 198). The relevant dimension of democracies in this respect thus is accountability, manifested by the fact that the executive is recruited by competitive elections.

Applying this argument to the given context implies a rather strong assumption, namely, that citizens' support depends on the provision of goods such as clean water. However, many rivers are of great economic importance, especially with regards to water quantity. In addition, pollution levels can be crucial if rivers supply drinking water. Accordingly, the link between democratic structures and government action regarding shared rivers might be much stronger for rivers of substantial importance to the population, be it with respect to sanitation or for economic reasons, such as generation of electricity (hydropower), than for less important rivers. The effect of democracy might thus be context-dpendent with regards to river characteristics. In the empirical application, I therefore control for river characteristics, such as the population living in the basin area. By explicitly considering certain river features, I expect to gain further insights into governments' incentives to cooperate in order to solve transboundary river problems. Further, I try to explicitly account for environmental awareness and concern.

Having laid out under which circumstances I expect governments to have an incentive to provide public goods, the next section addresses the question of whether governments choose to cooperate with other countries in case of shared public goods, public bads, or common pool resources.

2.1.2 Government interaction

Bac (1996) sees government interaction regarding transboundary public goods as a dynamic game of incomplete information. In his set-up, the two states play a repeated game, where both countries prefer the other country to contribute to the provision of the public good and not having to incur the cost of provision themselves. Neither country knows the other country's type, which can be either H (high valuation of environmental quality) or L (low valuation of environmental quality). The main idea is that if the other country does not abate, H-types eventually abate and thus reveal their type. Accordingly, whenever a country abates, it is of H-type with probability one.

Applying these ideas to the case at hand, one could argue that democracies would have a hard time hiding their type in the first place. This is because government action is transparent[10] to citizens which implies that it is also observable by other riparian countries, whereas in the case of an autocracy the assumption that the other country does not know the type might be more plausible. Accordingly, in a mixed dyad, one would expect democracies to act (if they were of the H type) and autocracies not to reveal their type and thus free-ride on the democracy's efforts. Yet, given the repeatedness of the game, potential equilibria also depend on how heavily governments discount the future. On the one hand, one might argue democratic leaders to behave rather myopicly given that they have the short term goal of surviving the next election rather than relying on long term effects of their current action. This would justify to assume that democratic leaders heavily discounted future payoffs. On the other hand, Congleton argues that rather than democracies, "authoritarians [...] probably tend to have a shorter than average time horizon given the high turnover of authoritarian regimes" Congleton

[10] It is a common assumption that democracies are more transparent than other regimes, empirical evidence is provided by Rosendorff & Vreeland (2006)

(1992, 417). Higher turnover of authoritarian regimes also implies that democratic leaders are much more likely to have another turn in office (even if they were outvoted once) than their authoritarian counterparts, which again implies a higher valuation of future payoffs. Whether or not democratic leaders discount the future more heavily than their democratic counterparts is thus theoretically controversial.

An implicit assumption by Bac (1996), made more explicit by Taylor & Ward (1982, 354) is that "each player can profitably provide some of the public good alone, though he would prefer not to contribute when the other does". The authors suggest a repeated game of chicken to model such situations where each player prefers the other to provide the good. This chicken supergame gives raise to several equilibria (Taylor & Ward 1982, 366–367), with the likelihood of a fully cooperative equilibrium rising "with decreases in the rate at which players discount future payoffs" (Taylor & Ward 1982, 367). This implies that if governments care about future interactions with other riparian countries, cooperation should become more likely.

If the above assumption that "each player can profitably provide some of the public good alone" (Taylor & Ward 1982, 354) does not hold, that is if "a single individual's contribution is insufficient to provide any public good, or provides only very little of it", Taylor & Ward (1982, 353) argue that each player might prefer to defect if the other player defects, "but may prefer to contribute if the other contributes too" (Taylor & Ward 1982, 353). The authors argue that in such assurance games it is unlikely to have a collective action problem, and that the pareto-optimal outcome of both countries cooperating is likely to occur (Taylor & Ward 1982, 354). However, under incomplete information, mistrust might prevent countries from taking the risk of cooperation.

Coming back to the situation of transboundary rivers, the latter assumption appears more plausible. Even if one country made an enormous effort in avoiding pollution, this would help little if the other country kept polluting heavily. This is even more obvious when it comes to common pool good situations, such as water withdrawal, where each country might over-exploit the resource. Borrowing from a similar argument by Levy & Razin (2004) on peaceful conflict resolution, it could then be argued that successful provision of transboundary public goods or management of common pool goods, depends on mutually beneficial concessions. This means that both countries affected by a common public bad would need to abate, if they wanted their citizens to benefit from the public good or sustainably manage a common pool resource. Yet, such concessions are linked to certain costs, in the case at hand the costs of abatement, or the cost of withdrawing less water for irrigation, etc.. These costs are the highest in case of one country conceding far-reaching commitments while the other country in the respective dyad makes no concessions whatsoever. In such a case, the first state would need to bear the full costs of abatement, whereas the second would benefit without any associated costs. This implies that both countries' governments would receive higher pay-offs (in terms of better environmental quality or water availability) if they cooperated, but, with imperfect information, they have an incentive to unilaterally defect. A government has no incentive to agree on mutual concessions, if cooperation of the respective other government is not guaranteed. Such problems of comitment and distrust are also highlighted by Ward (1996, 859) in a game theoretic paper on FCCC. In Levy & Razin (2004)'s setup, each government would receive higher pay-offs if it defected unilaterally. In the given context of river events, it seems most plausible that governments interact repeatedly. In this case, there is a crucial difference of democratic dyads compared to all other dyads with respect to this problem: the risk of defection is rather low in democracies given that information on possible government action is public and thus observable by the other country's authorities (Levy & Razin 2004, 03) and its citizens. This is why democratic dyads are expected to be able to coordinate on mutual concessions (Levy & Razin 2004, 03). Transparency can facilitate trust, since defection would easily be observed. The dimension of democracy that is of importance in this context is thus transparency.

Further, if countries' play conditionally cooperative stategies, that is, they only cooperate if the other side does so, one side may threaten the other side that it would itself resort to conflictive strategies once the other side defected (cf. Barrett 1994, 28). Given audience costs in democracies such threats might be more credible depending on the regime type.

Bergin et al. (2005, 25) emphasise that cooperation to reduce transboundary pollution requires trust and democratic governments have more reason to trust each other than to trust their non-democratic counterparts. Consequently, democratic governments can collaborate with their neighbours – without the fear of being cheated – in providing transboundary public goods or managing common pool resources, as long as their citizens demand such action and the gains from acting in line with their constituents' preferences outweigh the respective costs of provision (in the case at hand abatement

costs). That is, given demand for transboundary public goods, electoral punishment should be applicable to the context of transboundary resources. The reason for this is that "the superior ability of elections in democracies to constrain leaders prompts democratic rulers to be more cooperative internationally than their nondemocratic counterparts" (Mansfield et al. 2002, 480).

A further reason why democracies tend to be more cooperative is that they usually share some common values, such as a shared culture of cooperation and a habit of peacefully resolving domestic conflicts that may translate to the international level (cf. Maoz & Russett 1993; Russet 1993; Layne 1994; Levy & Razin 2004; Zinnes 2004). Accordingly, a democratic government can safely expect another democratic government to act sensibly and to be trustworthy and thus comply with its commitments (cf. Hamner 2009, 22). Hence, democratic leaders perceive that possible gains from cooperation with other democratic governments outweigh the risk of defection. In conjunction with the arguments provided above (section **??**), namely that democracies are better providers of public goods, these considerations lead to the following hypothesis:

> **H1a:** The higher the level of democracy[11] in a river sharing dyad, given citizens' demand, the more efforts are made by the respective governments towards mutually beneficial river basin management.

This hypothesis is further supported by arguments put forward by Midlarsky (1998, 346). He posits that "[...] regime responsiveness, political learning especially as the result of mutual identification, and the tendency toward cooperation in international institutions [...]" are important aspects of democracy for both peaceful relationships between democracies (kantian peace) and environmental protection. Empirically, Hensel et al. (2008, 136) find a negative impact of democracy on militarized settlements of river claims and a positive impact on peaceful settlement attempts.

2.1.3 Transboundary externalities

Thus far, I have only discussed transboundary environmental problems affecting both countries to more or less the same extent. An example of such a problem is pollution in border demarcating rivers. However, many rivers cross national borders, thus bearing the potential of upstream-downstream problem settings. Such situations differ from those described above in that the downstream country is dependent on the upstream country to attend to water quality and water quantity, whereas the latter can act independently. Accordingly, we are no longer dealing with a transboundary public good/ bad, or common pool good, but with a unidirectional transboundary externality. In their study on institutionalised cooperation (river treaties), Song & Whittington (2004) consider both river geographic and dyadic specific domestic variables. In analysing treaty data provided by the Transboundary Freshwater Disputes Database (TFDD) and FAOLEX, they find that fewer treaties are concluded in upstream-downstream settings. They thus point to a crucial difference between such settings (upstream-downstream) and the border demarkating context described in the previous section (2.1.2).

Several studies on upstream-downstream settings rely on the arguably rather strong assumption that the upstream, or emitting country does not suffer from pollution at all (c.f. Petrosjan & Zaccour 1996; Jørgensen & Zaccour 2001). This assumption appears plausible in cases of water scarcity, where the upstream country might fully exploit the shared resource, causing water scarcity in the downstream country. When water quality is at stake, it only holds for extreme cases in which all upstream pollution is caused by point source pollution just before an international border and no pollution occurs before the river reaches the border of a downstream country, or if at all, such pollutants are transported downwards before causing any damage to the upstream country's environment. A weaker assumption is that upstream downstream situations are asymmetric in the sense that the upstream country is in an advantageous situation, but nevertheless it also suffers from its own pollution, albeit to a lesser extend than the downstream country. That is, upstream countries may reap direct benefits themselves from abating pollution. Given that they still have to bear the cost of pollution reduction, they should only be interested in cooperating beyond the level they would if they were not affected themselves if the benefits from cooperation outweigh the cost of abatement. The degree to which the same logic as

[11] As laid out in the section on operationalization, I understand the level of democracy as that of the initiator in directed interactions and – following the weakest link logic – use the lower level of democracy in a dyad in case of mutual action.

before on government interaction to provide transboundary public goods holds, therefore depends on the affectedness of the upstream country. In other words, the expected cooperation enhancing effect of democracy depends on the assumptions made with respect to that country's affectedness and is thus again expected to be context dependent. I therefore hypothesize:

> **H1b:** The higher the upstream country's level of democracy and the higher its own affectedness, the more efforts are made by this country's government towards mutually beneficial river basin management.

2.2 Political and Economic Interdependency

According to liberal theories, financial openness and trade interlinkages[12] foster cooperation (Oneal & Ray 1997; Oneal & Russett 1997). The cooperation enhancing effect of interlinkages is of particular importance, when dealing with upstream-downstream situations, as interlinkages might weaken the effect of assymmetries. Relying on Durth (1996) and Marty (1997, 2001), Bernauer (2002) describes such upstream-downstream situations as a deadlock game, where the upstream country's dominant strategy is to pollute, whereas the downstream country's dominant strategy is to reduce pollution. However, as mentioned above, this approach appears to oversimplify the situation, since intergovernmental actions may be (infinitely) repeated (c.f. Bannett et al. 1998, 64), giving raise to additional equilibria other than the deadlock pattern. Petrosjan & Zaccour (1996, 837) show that in the repeated game, there indeed exists a cooperative Nash equilibrium. Under certain conditions, cooperative strategies are time consistent, that is, players never diverge to a noncooperative strategy at any intermediate date (Petrosjan & Zaccour 1996, 837).

Bhaduri & Barbier (2008) depart from a slightly different assumption, namely that countries display a certain degree of altruism in the sense that they care about a good political relationship with other countries. Expecting the other country to favour a good political relationship, the upstream country diverts less than the individually rational amount of water and the downstream country agrees to a lesser amount of water to be received from the upstream country, independent of side payments (Bhaduri & Barbier 2008, 02). The resulting water allocation is Pareto efficient and depends on the countries' altruism parameters (e.g. if both countries are equally altruistic, the countries solve the social planner's problem). The altruism parameter is derived via median voter preferences in both countries.

Notwithstanding the upstream country's advantagous situation, one might thus observe cooperation in upstream-downstream country pairs under certain conditions. The main reason is that governments are usually concerned about the (future) relationship with their neighbours, be it because of economic interdependencies or because they are linked via agreements on other issue areas (c.f. Bannett et al. 1998; Carraro & Marchiori 2003; Dinar 2009) or simply because they care about possible future interactions, and "condition actions in one time period on observed, past actions" (c.f. Bannett et al. 1998, 64). In terms of trade interdependencies, both Bernauer & Kuhn (2009) and Sigman (2004) argue that trade interdependencies facilitate implicit side-payments and issue linkages so that the upstream country feels inclined to contribute to lower pollution levels, if the downstream country takes advantage of a possible asymmetric trade dependency.

These insights could easily be incorporated in Bhaduri & Barbier (2008)'s model by substituting the altruism parameter with an interlinkage weight. That is, rather than having a country's concern for the other country depend on the expectation of the latter's willingness to have a good political relationship, one could model the concern to depend on the degree of interlinkages that might induce countries to be concerned about each other.

Whereas Bernauer & Kuhn (2009) find rather mixed results on the effect of trade ties on transboundary water pollution, Sigman (2003, 2004) finds that rivers shared by dyads with stronger trade ties are less polluted, and Tir & Ackerman (2009) shows that economic integration fosters the conclusion of bilateral environmental treaties. Also Neumayer (2002) demonstrates that trade openness promotes multilateral environmental cooperation. He argues that multilateral cooperation might be a signalling device to facilitate future cooperation (Neumayer 2002, 816).

[12] Note that, as Dorussen & Ward (2008) show, such interlinkages need not necessarily be direct, but also indirect interlinkages might play an important role

Summing up, there is reason to believe that strong trade-induced relationships create opportunities for agreeing on means to internalise transboundary externalities and to provide transboundary public goods. Consequently,

> **H2a:** The higher the level of economic interdependence in a river sharing dyad, [13] the more efforts are made by the upstream country's government towards mutually beneficial river basin management.

Other forms of interaction, such as political agreements also bear the possibility to change governments' incentive structures. In fact, the Kantian peace literature highlights both political and economic interdependence (Russett & Oneal 2001). Behaving uncooperatively on transboundary river issues might damage a country's international reputation. This, in turn, diminishes a government's prospects of successful negotiations on other issue areas with the same actors involved. Therefore,

> **H2b:** The higher the level of political interdependency in a river sharing dyad, the more efforts are made by the upstream country's government towards mutually beneficial river basin management.

Whereas the effect of interdependencies is expected to matter for both border crossing and border demarkating rivers, the size of its effect might differ depending on river geography and thus countries' affectedness.

2.3 Salience and Severity

The arguments presented in the preceding subsection rely on the simplifying assumptions that governments face the same incentive to react to or ignore transboundary water issues, regardless of the characteristics of the issue at hand. However, there is reason to believe that both the severity and salience of water issues alter government's incentives to deal with them. If no real problem existed, such that the costs of abatement came close to zero, cooperation might become more attractive. In this case, political leaders can only gain: they face practically no abatement costs and cooperation might improve their reputation, thus putting them in an advantageous situation in future negotiations on other issues with the same actors involved. Given that cooperation might entail some costs in its own right (such as transaction costs), I expect to observe rather low levels of cooperation, such as governmental visits and talks or policy expressions that do not incur any substantive costs rather than high level cooperation, such as the establishment of a treaty. Otherwise, the ratio of costs to benefit would be rather high. Although severe problems are not necessarily associated with higher abatement costs, especially if adequate technologies are readily available, severity and abatement costs are often positively correlated. Dinar (2009), for instance, argues that while moderate levels of scarcity might induce the necessity to cooperate, high levels might deter countries from cooperation because of prohibitively high costs. It thus appears reasonable to assume that the more severe the environmental problem under consideration, the higher the costs of abatement. If abatement costs are high, autocratic leaders have little incentive to tackle the respective environmental problem. This is because in autocratic regimes it is the elite that overproportionally bears the cost of providing public goods, since spending money for the population as a whole implies that less money is left to pay rents for the elite. Given that autocratic leaders depend on the support of the elite rather than the population as a whole, it would be more rational to spend less money on public goods. In essence, the ratio of costs to benefits of abatement is higher than the one of providing private goods to the leading elite. Therefore,

> **H3:** The more severe a transboundary water issue and the more autocratic the affected country, the less political leaders cooperate with their neighbours sharing the problem.

However, under certain circumstances, democratic leaders have an incentive to act in case of severe problems inspite of the associated high costs. Namely, if the ratio of costs to benefits from acting is lower than the one of refraining from tackling the problem. As aforementioned, this incentive is present if the risk of electoral punishment outweighs the costs of abatement. I argue that in this particular case, the crucial element in shaping governments' incentives to act is issue salience, where

[13] Note that, in principle, this holds for any type of government. However, democracies generally tend to have higher interlinkages with other countries both in terms of trade and IGO co-membership.

salience is defined as referring to those issues that feature high on voters' preferences. That is, if salience is high, such problems are prone to alert the electorate, which might punish the incumbent by defecting to opposing parties. Both severity and salience thus alter the incentive structure of the governments involved. Although salience increases the pressure on democratic leaders to act, whether or not they chose to cooperate with river sharing countries presumably also depends on their relationship to their neighbours and possible power asymmetries. In purely democratic dyads, governments in both countries are in a similar situation. Under the assumptions of public goods/ bads (polluted border rivers, lakes, I would thus expect them to cooperate in order to provide the public good to their citizens. This line of reasoning is in accordance with Hamner (2009), who highlights both the challenges and the opportunities to cooperate created by severe droughts (Hamner 2009, 40–41).

> **H4a:** The more salient a transboundary water issue in border demarkating rivers (or lakes) and the more democratic the affected countries, the more likely political leaders resort to cooperative measures to solve the problem.

However, in upstream-downstream situations, power asymmetries might affect whether or not political leaders choose to cooperate. Despite its advantageous situation, even if the upstream country's government faces extreme pressure by its electorate and might thus choose a rather conflictive approach (i.e. unilaterally withdraw all water for its own citizens), the downstream country's government, also faced by domestic pressure, might be willing to incur even higher side-payments to ensure cooperation with the upstream country. Accordingly, I expect a curvilinear relationship between salience and cooperation/conflict in that salience promotes both extremely conflictive and extremely cooperative events, especially in democratic dyads.

> **H4b:** The more salient a transboundary water issue in an upstream-downstream setting and the more democratic political leaders, the more extreme (highly cooperative/ conflictive) the measures they resort to.

3 Research Design

I empirically test the above theoretical claims on time-series-cross-sectional (TSCS) data of country pairs (dyads) sharing a river basin. This includes riparian states of both transboundary and border demarcating rivers worldwide. At the time of writing this paper, some models where still running, which is why I only present preliminary results for hypotheses 3 and 4.

The main challenge regarding empirical tests is to collect data on transboundary river events. I therefore dedicate the next paragraphs to data collection and conclude this section by discussing certain econometric considerations.

3.1 Variables and Operationalisation

3.1.1 Dependent Variable

The dependent variable is a river-sharing country-pair's degree of conflictiveness/cooperation in interaction on the shared resource. To assess the degree of conflictiveness and cooperation, I rely on event data on governments' interaction regarding joint management, water quality and water quantity. Whereas most independent and control variables can be obtained from secondary datasources as listed in table 1 in the appendix, the most obvious reason why there is little quantitative empirical work on the management of international freshwater resources is the lack of adequate data on the dependent variable. I therefore decided to construct a new dataset on events over shared waters. This new dataset covers more than 260 river basins and 130 countries over the past ten years.

I retrieved information on water interactions from local newspapers made accessible through BBC-Monitoring (`http://www.monitor.bbc.co.uk/`). This database provides translations of local media sources from around the world and thus lends itself for extensive content analysis to create event-datasets relying on local news rather than on western press agencies such as Reuters. This is especially helpful for the project at hand, where events that are of local (or even regional) importance, but do

not feature high on the international agenda, are relevant for the topic of study. It thus allows to capture events not reported by major western press agencies and to avoid respective bias.

Based on reported newspaper events, I code the degree of cooperation/ conflictiveness of each event in integers ranging from -6 (most conflictive) to +6 (most cooperative). This categorisation relies on, but differs quite considerably from those of the TFDD (Yoffe and Larson 2002). An illustration of the data coding can be found in appendix B. Some governments tend to re-negotiate the same problem over and over again. I therefore aggregate all events that pertain to the same issue by coding the dependent variable as the median cooperation/conflict score within the same event, if the latter is split into several interactions. I then apply a modified version of the approach suggested by Crescenzi & Enterline (2001) to account for the dynamics in interstate interaction. The main idea behind Crescenzi and Enterline's approach is that interstate relationships are defined by previous interactions, whose influence on the perceived current interstate relationship depends on how much time has passed between such interactions, the accumulation of occurrences of conflict and cooperation, and on current cooperative and conflictive "shocks", that is events that take place between two states at time t. This leads to the following measure of interstate relationships:

$$\begin{aligned} y_{i,j,t} &= \left(e^{-\frac{\text{confl temp dist}}{\text{confl hist}_{i,j,t}+1}}\right) y_{i,j,t-1} \\ &- \frac{\text{degree of confl}}{\text{confl temp dist}_{i,j,t}} + \frac{\text{degree of coop}}{\text{coop temp dist}_{i,j,t}}, \end{aligned}$$

where the subscripts i, j, and t refer to the basin, dyad, and year, respectivly. The first term of expression 1 differs from what Crescenzi & Enterline (2001, 418) propose as it only considers conflict. Crescenzi & Enterline (2001, 418) in turn have event, i.e. cooperation and conflict, temporal distance in the numerator and event history in the denominator. The idea behind this decay function weighing the impact of past interaction is that "in the absence of interaction between two states, the relationship should dissipate" (Crescenzi & Enterline 2001, 417). I opt for only including conflict in the decay function, since cooperation might simply cease after a certain number of events, because riparian states have agreed on how to deal with their common resource, i.e. by establishing a treaty stipulating certain pollution targets. Although the conclusion of a freshwater treaty does not preclude these states from cooperative interactions (i.e. reporting on their compliance with the agreement, etc.), but such interactions are rather unlikely to be reported by local newspapers. A graphical illustration of the aggregation can be found in appendix B.

3.1.2 Independent Variables

Democracy: According to the theoretical framework of this paper, two measures of democracy are relevant. On the one hand, I rely on Bueno de Mesquita's argument on democratically elected leaders' incentives to provide public goods in order to survive in office (section 2.1.1). On the other hand, I argue that because of the transparency of democratic systems, transboundary actions are more likely in democratic dyads (section 2.1.2). Whereas the former largely relies on the concept of the winning coalition captured by a respective dataset by Bueno de Mesquita (The Logic of Political Survival Data Source; Bueno de Mesquita et al. (2003)),[14] the latter refers to institutional aspects of democracy that are reflected by the polity IV dataset by Marshall & Jaggers (2002) (updated and modified by Gleditsch (2008)).I use both measures in alternative specifications. Given that Bueno de Mesquita builds on the polity IV dataset, I do not expect results to change substantially. Rather, using different measures of democracy is a means of checking the robustness of my results.

Obviously, there are different means of assessing dyadic democracy (Goertz 2006, 03–05). For those events that emanate from a particular country and are directed[15] toward another country, I rely

[14] I have recoded the so-called W_{mod} from the original Logic of Political Survival Data using the updated polityIV Data by Gleditsch (2008). This forces me to use the measure of winning coalition rather than winning coalition over selectorate due to lack of data on the legislative selection data. Given that both measure correlate almost perfectly (which is presumably due to the fact that whether or not a country's legislature is elected or not is highly correlated with a countries winning coalition), this seems to be a minor issue.

[15] The direction is coded within the scope of the event data collection described above. I include a

on the initiators democracy score. An example for such an event is the Bulgarian environmental minister sending a letter to his Serbian counterpart proposing a joint expert group on waste water discharge in the Danube (initiator: Bulgaria, target: Serbia). In case of mutual events, e.g. joint talks on pollution levels, I follow common practice (cf. Russett & Oneal 2001) and use the weakest link logic. That is, the dyadic democracy score assumes the democracy score of the country in the dyad with the lower (monadic) democracy score of the two. I plan to rerun all models using the age of democracy (operationalised as the years since a country has become democratic), because there might be a qualitative difference between younger and more mature democracies, i.e. democratic norms might be more prominent in more mature democracies.

Finally, one might want to consider whether different types of democracies have different attitudes than other (e.g. presidentialism versus parlamentary democracies, etc.). In terms of federalism, there is some debate as to whether or not federal structures hinder or enhance environmental protection (Jahn & Wälti 2007). Jahn & Wälti (2007) conclude that federalism as such does not necessarily lead to different environmental performance, but it might influence the relevance of other factors such as corporatism.

Citizens Concern Hypothesis 1 not only requires data on democracy, but also whether citizens demand government action. Obviously, this can only be tested for democratic governments, which is why I rely on a subsample when including this variable. I have tried different proxies for citizens' general environmental concern using data on green parties' vote share compiled by Armingeon et al. (2008), an item of the World values survey on the willingness of incurring a tax increase for better environmental quality, and the average emphasis placed by parties on the environment (Cusack & Fuchs 2002, adapted by Hugh Ward). Unfortunately, all indicators are only available for a small subset of country-years, such that including the data dramatically reduces the original sample. In case of the World value survey, the sample reduction led to the dependent variable being constant making the use of this proxy unfeasible. Below, I report results using the average emphasis placed by parties on the environment. Given that the environment can be considered a valence rather than a positional issue, all parties are expected to emphasise it to the extent to which the public are interested so that this proxy appears a good indicator for citicens' concern. Cross-checking with green seats does not alter the main results.

Interdependence: trade dependence Trade dependence is measured by the ratio of the sum of one country's exports to and imports from the other country in the dyad to the total sum of the first country's exports and imports (cf. Bernauer & Kuhn 2009, 16). Data is retrieved from version 4.1 of the expanded trade and GDP dataset by Gleditsch (2006) and augmented with data from the IMF direction of trade statistics. To allow for indircet links, I use the "third party linkage statistic" proposed by Dorussen & Ward (2006):

$$\text{ln triadic trade links}_{ij} = ln\left(\sum_{k\neq i,j} v(i,k)v(k,j)\right), \tag{1}$$

where v refers to the value at the edge of a network node. That is, the value at the edge is higher if two countries i and k are not only linked by direct trade relationships, but also via third parties.

One might argue that rather than pure trade relationships, other financial flows such as FDI are important measures of countries' economic integration. Zeng & Eastin (2007, 991) point out the importance of measuring both FDI and trade openness to fully capture global economic integration. Similarly Araya (2002), Guerin & Manzocchi (2006), and Büthe & Milner (2008) highlight the complementarity of trade and FDI. For none of the models estimated below, the coefficient on FDI was statistically singnificant, respective results are presented in the appendix (to be added). Data for FDI is taken from (OECD 2008)

variable indicating whether cooperation is mutual or "directed", i.e. one country approaches the other and if so, which country is the initiator of the event.

Interdependence: Political integration I count the number of joint membership in international organisations relying on data by Pevehouse et al. (2007). Further, I use (Dorussen & Ward 2008, 197)'s measure of third party IGO links:

$$\text{links3}_{ij} = ln\left(\sum_{k \neq i,j} v(i,k)v(k,j)\right),$$

with the notation corresponding to the one in expression 1.

Given that third-party- and direct links are highly correlated for both trade and IGO interlinkages ($> .8$, depending on the respective sample), I run reduced models only including direct links.

Severity of problem With respect to the severity of environmental problems, I rely on pollution proxies and further consider water scarcity. Regarding pollutants, data on point- and non-point sources is provided by the Global Environmental Monitoring System (GEMS). However, as shown in Beck et al. (2009), such data does not come without problems and there are serious doubts on the representativeness of such pollution figures. I therefore proxy pollution by the population density in a basin to assess severity in case of (potential) water quality events.

Water scarcity (assessed via precipitation and temperature in a basin area) measures severity in case of (potential) water quantity events and is assessed using data provided by Mitchell (2004).

Following Dinar (2009) one might consider including the squared term of salience indicators to allow for an inverted U-shaped relationship between, for instance, scarcity and cooperation. However, the coefficient on the squared term turned out to be statistically insignificant, which is why respective results are not reported below.

Salience I capture the *salience* of water issues by coding the degree of citizens' concern as expressed in press articles. The reliability of this measure is of course questionable if the press in the respective country is not free. Accordingly, I cross-check with the reports of the other country in the respective dyad. Further, I control for the neutrality of the sources I use (see below).

To test hypothesis 4b, predicting a curvilinear relationship between salience and cooperation/conflict levels in upstream-downstream settings, I transformed the salience measure to be the positive square root of the original salience value for cooperation and the negative square root for conflictive interaction.

3.1.3 Control Variables

Press Freedom/ Source neutrality The main caveat when using newspaper articles is that information is reported selectively (Franzosi 2004, 167). However, Franzosi (2004, 172) concedes: "perhaps all data are biased in some ways. What is important is to know the type and form of bias in order to be able to gage its effect on evidence and conclusions". Accordingly, I introduce a variable indicating the neutrality of the media source, based on whether or not reporting is independent of the government. This data still needs to be retrieved from the World News Connection.[16] For the time being, I therefore rely on press freedom indices by freedomhouse.

Trade openness Following common practice, I account for trade openness by including the ratio of the sum of exports and imports to GDP as a measure of exposure to foreign trade. I take logs to account for the non-normality of this measure.

Environmental commitments Countries that are generally more committed to international environmental protection might also do so in the freshwater realm. I therefore control for the number of multilateral environmental agreements a country is a party to in each year. Data is adapted from Mitchell (2002-2008) and the environmental treaties dataset by CIESIN (Columbia University: http://sedac.ciesin. columbia.edu/entri/).

[16] `http://wnc.fedworld.gov/`

Ideological affinity Governments might be more willing to cooperate with those governments with whom they share common values. I therefore introduce a variable controlling for ideological affinity. This concept is operationalised via voting patterns in the United Nations (Gartzke & Jo 2002). That is, countries that tend to vote similarly are conceived as being ideologically closer to each other than countries that usually vote in opposite ways.

Economic strength and capabilities Apart from the willingness or incentives to sustainably manage shared resources, governments also need to have the ability to do so (Appelgren & Klohn 1999; Recchia 2001). I therefore control for economic strength (measured as per capita income), as reported in the Penn World tables, version 6.2 (Heston et al. 2006).

Further, I include total gdp as well as the difference in gdp and gdp per capita in a dyad to capture power asymmetries and relative capabilities. For instance Low (1993, 192–193) argues that cooperation over shared waters depends on the distribution of power between riparians. Dinar et al. (n.d.) expect cooperation between riparians to occur in both symmetric and asymmetric cases, and argues "it is the ability of the richer state to provide incentives that facilitates cooperation in the asymmetric context", in particular "cooperation in asymmetric contexts will be facilitated by the wealthier state's ability to provide incentives and inclination to create 'good will' with the poorer riparian" (Dinar et al. n.d., 07). I use gdp rather than composite capability measures, such as the correlates of war Composite Index of National Capability (CINC) score, because the latter is highly collinear with other variables in the model and is based on indicators such as military expenditure, military manpower or iron and steel production that are not relevant for the type of cooperation and conflict considered in the study at hand. I use the log of both gdp and gdp per capita because of skewed distribution.

Population would be a further indicator for power. I intend to include population density to account for severity once data on the basin-level is available.

River Characteristics Finally, the importance of a river should be taken into consideration (see page 7). This is captured by the basinsize and the number of riparians.

Further, to proxy whether or not the upstream country is indeed suffering from its own pollution, I control for the share of the basin in the upstream country when testing hypotheses 2 and 4b. This is a rather crude proxy, since large industrial plants could still be based downstream just before the border to downstream riparians. Still, chances are higher that the upstream country is affected by its own pollution if a basin occupies a larger part of its territory.

Some dyads share several basins. I account for whether or not upstream-downstream country pairs share basins with other flow directions (so that they reverse their role of up- and downstream- country, respectively).

3.2 Econometric Approach

Some rivers are simply shared by two countries, such as the Don, shared by Russia and the Ukraine. Others are shared by three, four or even more countries. Zimbabwe, South Africa, Mozambique, and Botswana are all riparian to the Limpopo, yielding six country pairs. The Danube with 17 riparians (136 country pairs) is the largest basin in terms of the number of riparian countries. Further, each of these country-pairs might share more than one river. Russia and the Ukraine, for instance, are both riparian to the Dnieper. Chile and Argentina share a total of 17 basins (the maximum number observed). This gives raise to a non-nested structure of basin-dyads with 783 dyads, 263 basins, and 1367 basin-dyads (depending on the respective subsample).

I expect neither the interaction of dyads in the same basin nor the interaction taking place in different basins shared by same dyad to be independent of each other. I therefore introduce spatial lags, accounting for both types of interdependencies, by specifying two $NT \times NT$ block-diagonal binary[17]

[17] Rather than introducing binary spatial weights one might consider more sophisticated weights, such as giving more weight to dyads further up-stream or (in case of many riparians) to those geographically or economically closer to the dyad in question. From an empirical point of view, I expect little insight by such (arbitrary) modification of weights given that in most cases events are either confined to one particular dyad (or basin) or they embrace all riparians.

spatial weights matrices, $\mathbf{W}^b$ and $\mathbf{W}^d$ and introducing the respective spatial lags $\mathbf{W}^b\mathbf{y}$ and $\mathbf{W}^d\mathbf{y}$ on the right-hand side of my regression equation. Entries in $\mathbf{W}^b$ assume the value 1 if both the row- and column-basin coincide, 0 otherwise, diagonal entries are 0. Likewise, entries in $\mathbf{W}^d$ assume the value 1 if both the row- and column-dyad coincide, 0 otherwise, diagonal entries are 0. Both spatial weights matrices are row-standardized (i.e. each cell is divided by the row sum).

Several estimators have been proposed for time-series-cross-sectional models with spatial lags.[18] Franzese & Hays (2007) assess different specification and estimation choices[19] both in terms of their asymptotic properties and small sample performance. They conclude that "S-ML seems to offer weakly dominant efficiency and generally solid performance in unbiasedness and SE accuracy, although it sometimes yields relatively little in reduced bias or enhanced efficiency relative to S-OLS and falls a little short of S-2SLS on unbiasedness grounds" (Franzese & Hays 2007, 163). In a follow-up paper, Hays et al. (2009) develop the *multiparametric spatiotemporal autoregressive* (m-STAR) model, which is estimated via S-ML, a maximum likelihood estimator that jointly estimates the exogenous, non-spatial, effects and temporal and spatial interdependence (the former via the introduction of the lagged dependent variable). In contrast to other spatial approaches, m-STAR allows for multiple contemporaneous spatial-weights matrices. In matrix notation (analogous to (Hays et al. 2009, 21)),

$$\mathbf{y} = \rho_b\mathbf{W}^b\mathbf{y} + \rho_d\mathbf{W}^d\mathbf{y} + \phi\mathbf{M}\mathbf{y} + \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\epsilon}, \tag{2}$$

where $\mathbf{y}$, the dependent variable, is a $NT \times 1$ vector of basin-countries stacked by years, ρ_b and ρ_d are the spatial-autoregressive coefficients on the basin- and dyad contiguity matrices, $\mathbf{M}$ is an $NT \times NT$ matrix with ones on the minor diagonal and zeros elsewhere ($\mathbf{My}$ is thus simply the lagged dependent variable) and ϕ its coefficient; $\mathbf{X}$ is a $NT \times k$ matrix containing the exogenous non-spatial variables described above and $\boldsymbol{\beta}$ its $k \times 1$ vector of coefficients, and $\boldsymbol{\epsilon}$ is the $(NT \times 1)$ *i.i.d.* error term. Hayes et al.'s Monte Carlo simulations show that, compared to OLS and S-OLS, the m-STAR model estimated with S-ML is "clearly dominant for all estimates and estimate-properties" (Hays et al. 2009, 25). That is, even for small T,[20] S-ML outperforms the other estimators.

Whereas possible basin-specific unit effects are captured by time invariant basin characteristics (I estimated basin unit effects and regressed them on time-invariant basin characteristics to test this claim), I account for country-specific unit effects by introducing country fixed effects. In the current version, some results are presented without country fixed effects. This is simply because these models rely on rather large samples and estimation takes more than a weeks time and is therefore still running. The results will be updated once the estimation is finished.

4 Results

Beginning with hypothesis 1a, table 3 presents the results disaggregated by issue area. The results for the full sample of water quality (as outlined above, an example of a public good), as well as water quantity support the claim that democracies are better providers of public goods. As anticipated, we observe a positive, statistically significant influence of the size of the winning coalition on the cooperativeness of countries interaction in non-upstream-downstream basins. I added the size of the winning coalition squared to allow for a possible curvilinear effect. Apparently, the larger the winning coalition, the more cooperation takes place, but once a certain threshold is reached the effect dampens. The same effect occurs when using the polity IV score rather than the size of the winning coalition (results not reported here). As anticipated, results are less clear for joint management. In fact, most of the variance of the model presented in column 3 of table 3 seems to be accounted for by the lagged-dependent variable, basin, and dyad interdependencies.

Regarding the effect of citizens' concern on democratic leaders behaviour, column 2 of table 3 reports results on a subsample of 44 countries[21], exploring the effects of citizens' concern. Citizens' concern,

[18] For an overview, see Elhorst (2003); Beck et al. (2006); Franzese & Hays (2007)

[19] spatial ordinary least squares (spatial OLS), spatial maximum likelihood (S-ML), spatial two stage least squares (S-2SLS)

[20] In the analysis at hand, $T = 11$, the Monte Carlo simulations rely on $T = 10$

[21] The case selection is due to data availability, in particular I use the sample for which data is provided by (Cusack & Fuchs 2002)

proxied by the average emphasis parties put on the environment, does not exert a statistically significant effect on cooperative or conflictive events, nor do any other of the variables presented for this subsample. Figure 5 shows the marginal effect of citizens' concern given different levels of democracy, which is statistically insignificant for all values of democracy. The non-significance of the results may be partly due to the smaller sample. Further, given that the sample only consists of very similar countries in terms of their degree of development, infrastructure, political and economic integration, etc. there simply is rather little variation to be observed in the first place.

Abstracting from the impact of citizen concern, we thus find general support for Hypothesis 1a. Hypothesis 1b postulates the affectedness of upstream-countries to play a role in the degree to which they engage in cooperative or conflictive events. As shown in figure 6, the size of the basin in the upstream country (meant to proxy affectedness) is indeed positive and - as predicted - the effect is stronger for democracies than it is for autocracies. Although the independent effect of democracy appears counter-intuitive, table 6 displays a negative coefficient for the winning coalition with the square term being positive, it should be noted that an independent interpretation of these coefficients is meaningless, since they refer to the case where the size of the basin upstream is zero. By definition of a border crossing river, such hypothetical cases are inexistent.

As to hypothesis 2 (interlinkages), for all of the three issues (ignoring the water quality subsample) presented in table 3, joint IGO membership positively affects cooperative behaviour, thus hinting at typical kantian peace interdependency arguments applying. The effect of trade dependencies, however, is less clear. Whereas the coefficient is positive for all three issues (again ignoring the water quality subsample), it is only statistically significant for water quantity. Regarding upstream-downstream settings, we find both trade dependency and joint IGO membership to display the predicted positive effect on cooperation levels. We thus find strong support for hypothesis 2b and weak support for hypothesis 2a.

Regarding country-specific control variables, both gdp per capita and gdp as such show the expected positive coefficient for both water quality and joint management in border demarkating rivers (table 3), but a negative one for water quantity. Considering border crossing rivers, the coefficient on gdp is again positive, but the one on gdp per capita is negative (and statistically significant), thus putting in question whether capacities have an impact on cooperativeness. The difference in gdp in a dyad, that is, power asymmetries, exhibits a predominantly positive coefficient. This is in line with Kantian peace arguments that consider balance of power an important aspect of peaceful dyadic relationships (cf. Singer et al. 1972; Russett & Oneal 2001). The results further indicate that - compared to the independent base category - both government owned and partly independent sources are related to more cooperative events across issues and for both border demarkating and border crossing rivers. This result might imply that countries with less free media over-report cooperative events. However, this result does not appear to dillute the democracy effect, given that the coefficient on the latter is still positive (ignoring the insignificant effects for both the subsample and joint Management in border demarkating rivers). Trade openness shows the expected positive impact on cooperation, but only statistically significantly so in case of water quantity and for border crossing rivers in general. Affinity is predominantly positive, and statistically significantly so for both water quality and water quantity in border demarkating rivers and across issues in case of border crossing rivers, but insignificant and negative for the water quality subsample. Whereas the coefficient on ratification of environmental treaties is positive across issues (although only statistically significantly so for water quantity and joint management and in case of border crossing rivers), the results regarding the EU membership dummy are rather mixed.

With respect to basin specific control variables, we observe predominantly positive coefficients. With the basinsize, the number of riparians and population density in a basin all being positive and highly statistically significant, the expectation that more important basins invoke more intergovernmental cooperation is supported. In line with Hamner (2009), scarcity exhibits a positive effect for both water quality and water quantity in border demarkating rivers, but is negative and statistically insignificant for joint management and negative and statistically significant in case of upstream-downstream settings. In line with the theoretical distinction between public goods and common pool goods, we observe less cooperation in mixed rivers when it comes to water quality and more cooperation in case of water quantity. Further, we see an ambiguous effect of sharing other rivers with the opposite flow direction when it comes to weaken power asymmetries in border crossing rivers: whereas sharing "mixed" rivers leads to more cooperation, sharing other rivers with clear up- and downstream country is predicted to lead to less cooperation.

As to the interdependencies, both the basin- and the dyad-spatial lags are estimated to be positive and statistically significantly so for all issues in border demarkating rivers (only the dyad spatial lag for the water quality subsample is negative). The coefficient on the basin spatial lag, however, is statistically significant and negative for border crossing rivers. Table 4 exemplarily[22] shows the estimated interdependence on interactions regarding water quality in 2004 (i.e. $\hat{\boldsymbol{W}} = \hat{\rho}_b \mathbf{W}^b \mathbf{y} + \hat{\rho_d} \mathbf{W}^d$) for some selected country-basins. We observe that, for instance, the behaviour of the Central African Republic and Tanzania (or Uganda and Rwanda) towards the Congo is positively related to their behaviour towards the Nile. Similar patterns apply for Tanzania and Zambia on the Zambezi and the Congo basin. Table 4 further indicates positive interdependencies within basins. E.g. the behaviour of the Central African Republic and Tanzania on the Congo is positively related to the one of other riparians. However, these links are not statistically significant.

Given that the regression coefficients in tables 3 to 8 only show the pre-dynamic impetuses (Hays et al. 2009, 13), I have calculated steady-state spatiotemporal effects and estimated the long-run-effects of hypothetical permanent shocks for selected samples and counterfactuals. For the model at hand, the long-run steady state is obtained by recursively solving expression 2.

$$\begin{aligned} \mathbf{y_t} &= \rho_b \mathbf{W}^b \mathbf{y_t} + \rho_\mathbf{d} \mathbf{W^d} \mathbf{y_t} + \phi \mathbf{y_{t-1}} + \mathbf{X_t}\boldsymbol{\beta} + \boldsymbol{\epsilon_t}, \\ &= \left[\mathbf{I_N} - \rho_\mathbf{b} \mathbf{W^b} - \rho_\mathbf{d} \mathbf{W^d} - \phi \mathbf{I_N}\right]^{-1} (\mathbf{X_t}\boldsymbol{\beta} + \boldsymbol{\epsilon_t}), \end{aligned}$$

where I again follow the notation in Hays et al. (2009) and adjust their equations[23] to the analysis at hand. Table 5 illustrates the effect of a hypothetical increase in the bounded cooperation score (on water quality) of Tanzania and Zambia on the Congo basin in 2004 of .5 , where all other variables (and the spatial weights) are held at their 2004 levels. To enhance readability, table 5 only shows the effects on selected basin-dyads (the same as those presented in table 4). Starting with the first row, we observe that for basin-dyads that are obviously not linked to the "shocked" basin-dyad (neither via co-riparianship, nor co-dyadship), the post-shock steady state is estimated to be exactly equivalent to the pre-shock steady state. For dyads such as Uganda and Rwanda on the Congo basin, in contrast, the post-shock steady state is greater than the pre-shock steady state due to the fact that this dyad is linked to Tanzania and Zambia via the Congo basin. Dyadic interdependencies become apparent when considering the difference in pre- and post-shock steady states for Zambezi riparians: the effect on Tanzania and Zambia in this basin is obviously the largest, but even country pairs not including either of the "shocked" countries, such as Malawi and Angola, experience an upward shift in the steady-state level of cooperation through indirect ties. The network effects go as far as inducing higher post-shock steady states for basins on which only one of the shocked country is riparian and thus interacting with other countries, such as Tanzania and Mozambique on the Ruvuma basin. Finally, we can see that the shock to Tanzania and Zambia on the Congo is slightly decreased through feedbacks within the network: although the shock itself was of .5 in magnitude, the post-shock steady state is .47 higher than the pre-shock steady state.

Regarding the effect of severity on countries' cooperation levels (H3), the results presented in table 7 show different effects depending on the severity indicator applied. This becomes especially apparent when considering figures **??** to **??** depicting the effect of salience for different levels of democracy. We observe clear support for H3 when operationalizing severity by water withdrawal: the effect of severity is negative in autocracies and positive in democracies. The effect is reversed and statistically insignificant when severity is proxied by the dependency ratio, or - as in the case of water quality- with population density. In all three cases, the coefficients displayed in table 7 are rather small. With respect to water quality, the counter- intuitive result might however be largely driven by events taking place on the Nile and the Danube. Given that most events take place in these two basins, I have rerun all models excluding both the Nile and the Danube (section 4.1). Whereas the most of the main results pertain, the interaction of democracy and salience in case of water quality is reversed in sign and also becomes statistically significant.

[22] Reporting all estimated weights for all models (and (sub-)samples) estimated would probably lead to more confusion than insights. I have therefore chosen to exemplarily highlight some interdependency effects. Other estimated weights matrixes are available upon request. The same applies for steady states.

[23] Apart from the homophily term not included in this analysis, Hays et al. (2009) omit the ρ coefficients in equation (37), page 28

On the basin level, we again observe more cooperation in basins shared by more countries. Sharing border rivers or rivers with opposite flow direction with the same riparian has a largely positive effect. Apparently, whether the basin in question is border crossing or border demarkating is relevant only when it comes to water quality.

As for other hypotheses, there are positive spillover effects within basins, but negative ones within dyads for water quantity (positive for water quality).

As to hypothesis 4a, the first column of table 8 shows the effect of issue salience and its interaction with democracy on the level of cooperation in a river sharing dyad. Especially for medium levels of salience, we do not only see a clear positive effect, but also (figure 10) that –as expected– the higher the level of democracy, the larger the positive effect of medium levels of salience compared to the baseline category of no salience. This lends preliminary support to hypothesis 4a.

Turning to hypothesis 4b, there is a clear positive effect of the transformed salience measure. This lends support to the hypothesis, that in upstream-downstream settings, democratic governments resort to more extreme actions in terms of their cooperativeness and conflictiveness when salience in high. This effects pertains independent on whether or not the Nile and Danube basins are included in the sample. The effect of most control variables is either comparable to the ones presented above or statistically insignificant, with the effect of sharing a river that flows in the opposite direction again showing the expected positive effect on cooperation levels.

4.1 Robustness Checks

I have checked the robustness of the results presented in the previous section in various ways. In order to track whether the effect of democracy depends on its operationalization, I have used different specifications of democracy, namely the polity IV score and its squared term, instead of Bueno de Mesquita's W. The main results pertain, although the coefficient on democracy and it's squared term become statistically insignificant for some samples.

Further, I have used indirect rather than direct trade and IGO links. There is no substantial change in any of the models presented. Also, the inclusion of dyadic FDI measures does not change the main results and the coefficient on FDI as such is statistically insignificant throughout all model specifications, (sub-)samples and issues under consideration.

In addition, one might claim that the transformation of the dependent variable along the lines of Crescenzi & Enterline (2001) might drive certain results. I have therefore rerun all models including a) a moving average of conflict- and cooperation intensities, b) exponential smoothing, and c) the "raw" conflict and cooperation score rather than the current transformation. Again, most of the results pertain, although trade dependency for water quantity in the whole sample (table 7) becomes statistically significant when using exponential smoothing and several basin specific coefficients change for the same specification regarding water quantity.

Given that a very high fraction of all events coded actually pertain to either the Nile or Danube basins, I have rerun the models excluding these two basins. With respect to water quality in the whole sample (table 7), the coefficients on basinsize, population density and the democracy severity interaction change sign. It thus appears that the former results were driven by these two large basins rather than applying to the entire sample. Further, the effect of democracy turns insignificant in case of border crossing rivers. The interaction of the upstream country's affectedness and its democracy score, however, qualitatively stays the same, such that the result of interest does not change. For all remaining specifications, no substantial change is observed when dropping these two basins.

5 Conclusion

The aim of this paper is to empirically analyse Kantian peace arguments, namely the context dependency of cooperation and conflict over shared resources. In particular, I highlight the impact of democracy and interlinkages on the degree of cooperativeness/conflictiveness of country-pairs interactions over shared water resources.

Preliminary results show that the hypothesised positive effect of democracy empirically holds, although the relationship between democracy and cooperation over shared resources appears to be non-linear. That is, the positive relationship between democracy and cooperation is only observed until a certain threshold is reached, whereupon the effect is dampened. Additionally, interlinkages proxied by joint IGO membership and trade dependency positively affect a country pairs' relationship in terms of cooperation over joint freshwater resources, thus lending support to classical kantian peace arguments. In the theoretical framework, I argue that crucial elements of the relationship between regime type (democracy versus autocracy) and cooperation over shared resources are both the salience and the severity of transboundary environmental problems. On the one hand, severity increases abatement costs and thus reduces governments' incentives to react. On the other hand, salience might encourage democratic governments to take action in order to avoid electoral punishment. Both concepts were expected to be highly correlated in democratic regimes, where citizens have easy access to information and thus become aware of environmental problems. In autocratic regimes, in contrast, even very severe environmental problems might not be afflicted with salience, since citizens are simply not informed about the issue. In addition, even if public awareness was high, autocratic leaders have less incentives to respond to their citizens' demands, since these politicians are relatively independent of their citizens' loyalty. Consequently, autocratic governments are expected to be reluctant to react to severe problems, whereas democratic leaders are expected to take action as long as the salience of the problem is high. Empirically, there is a clear link between issue salience and cooperation/conflict over shared water resources in democracies. As expected, cooperation levels are higher in border demarkating rivers when salience is high and action becomes more extreme (both in terms of cooperation and conflict) in upstream-downstream basins.

Due to the fact that some of the models are still running, part of the current results are to be seen as preliminary and will be revised soon. The current results support the expectation that Kantian peace arguments are applicable in the context of shared resources, but the effect of democracy and interlinkages depends on context factors such as geography.

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A Data Sources

Table 1: *Independent and control Variables*

	Variable	Description	Source
H1	winng coalit	size of winning coalition	Bueno de Mesquita: The Logic of Political Survival Data Source; recoded using polity data by Gleditsch (2008)
	democr	polity IV	Marshall & Jaggers (2002), Gleditsch (2008)
H2	# joint IGO	# joint membership in IGOs	Pevehouse et al. (2004)
	3rd IGO	3rd party IGO links	Dorussen & Ward (2008)
	trade dep	dyadic trade dependency (ratio of the sum of exports and imports of country i with country j to the total sum of exports and imports of country i)	Gleditsch (2006); Heston et al. (2006)
	3rd trade	3rd party trade links	Dorussen & Ward (2005)
H3	severity	population density in basin area	LandScan `http://www.ornl.gov/sci/landscan/`
		scarcity (basin-level)	based on Mitchell (2004)
		dependency ratio	Gleick (1998–2009)
		total water withdrawal	Gleick (1998–2009)
H4	salience sal1 (low), sal2 (medium), sal3 (high); salr: recoded salience measure	salience of river issue	own coding
Control Variables			
	ln_open	trade openness, ratio of exports+imports to gdp	Gleditsch (2006); Heston (2006)
	ln_gdpc	GDP/ capita	Heston (2006)
	EU	EU membership	`www.europa.eu.int`
	env treaty rat	ratification of multilateral environmental agreements	(Mitchell 2002-2008), CIESIN: `http://sedac.ciesin.columbia.edu/entri/`
	source neutrality	neutrality of the media source (if unavailable: press freedom in country that issued media article)	World News Connection: `http://wnc.fedworld.gov/`, Freedomhouse: `http://www.freedomhouse.org/`
	affinity	similarity of UN voting patterns in dyad	Gartzke and Jo (2002)
	river type	Upstream/downstream, border demarcating river	Toset et al. (2000)
	basin size	size of basin in each country	Toset et al. (2000)

B Data Illustrations

In the following, I briefly illustrate the data used for constructing the dependent variable.

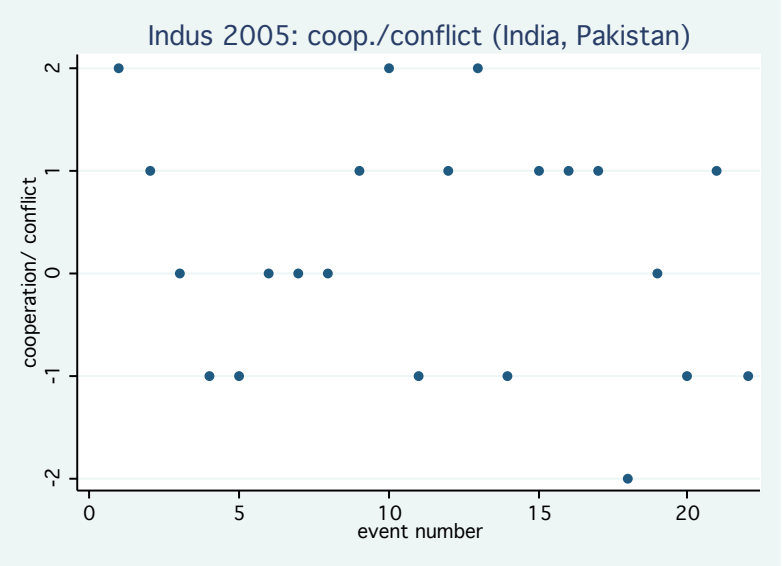

Figure 1: *Indus 2005, cooperation conflict score India Pakistan*

Figure 1 shows the cooperativeness/ conflictiveness of interactions between India and Pakistan in 2005 regarding the Indus basin. We observe quite some variation in terms of the degree of cooperativeness/ conflictiveness. Looking at the event descriptions in table 2 reveals that basically all of these interactions refer to an Indian dam project disliked by Pakistan authorities. The information displayed in table 2 is meant to illustrate how the event data described in section 3.1.1 is coded.

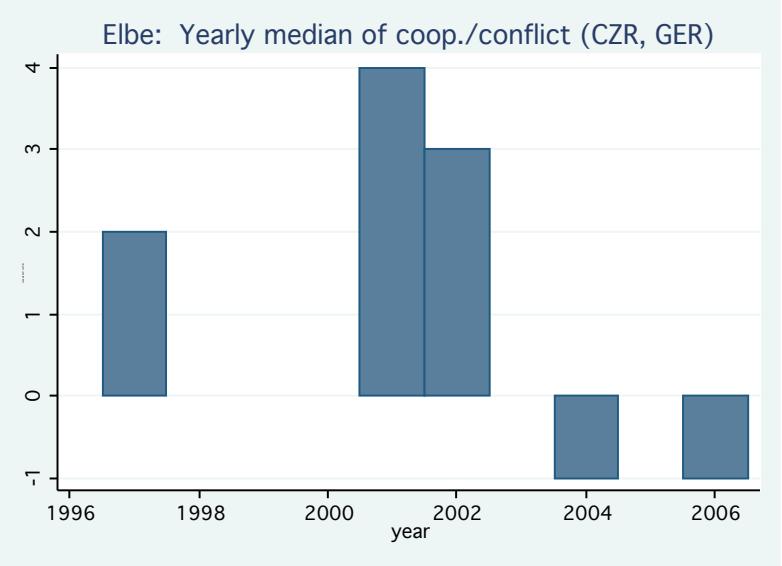

Figure 2: *Elbe, median cooperation conflict scores Germany, Czech Republic*

Whereas figure 1 illustrates the degree of cooperation and conflict of different events in a single year, figure 2 shows yearly aggregated data for the interaction between Germany and the Czech Republic over the entire period of investigation. Apart from some conflictive events in 2004 and 2006, respectively (unwanted dam projects and cyanide pollution), interactions between the two countries are very cooperative. For instance, in 2001, Germany gave a considerable amount of money for the construction of a sewage pipeline and a central sewage station in the Czech Republic (this event drives the height of the bar in the middle of figure 2).

Figure 3 shows the raw cooperation/conflict scores (dots) and the measure of the degree of cooperation/conflict in interstate relationship after applying transformation 1 (line) for the interactions

Table 2: *Cooperative/ Conflictive events between India and Pakistan, Indus, 2005*

date	event	category	coop/ confl
8/5/2005	India was ready to redesign the Kishanganga hydro power project to obviate Pakistan's reservations.	expressing willingness to come to an agreement	2
11/5/2005	Indian water officials held three-day talks with their Pakistani counterparts to iron out differences over Kishenganga hydro power project in Jammu and Kashmir, but failed to achieve a major breakthrough.	visit by lower officials for talks on joint water issues	1
11/5/2005	Shah said: "Pakistan will not become a party to delay the resolution of Kishanganga dam issue. If India is interested in lingering on the issue, they should suspend the construction work first. We will be ready to hold talks continuously till the final resolution"	rhetorical statements	0
12/5/2005	Talks on the Kishanganga dam project have failed	failure to come to reach agreement in dispute settlement attempt	-1
12/5/2005	India has refused to stop work on the project, although both countries have declared they will continue their dialogue	refusing to accept compromise/ solution to dispute proposed by other country	-1
12/5/2005	We say our government should talk to India	rhetorical statements	0
12/5/2005	We say both countries should move ahead towards a mutual resolution of the problems in order to open ways for development	rhetorical statements	0
12/5/2005	""It is the need of the hour that India should abide by the Indus Basin Treaty and give due importance to Pakistan's standpoint so that the issue can be settled down by consensus"	rhetorical statements	0
1/6/2005	Indian and Pakistani water officials have begun talks on the Kishenganga water project in New Delhi	meeting of high officials discussing joint water issues	1
1/6/2005	India's water commissioner says that they have another two days to discuss each and every issue comprehensively and that the objective of the Kishenganga project is to arrive at a design which is acceptable to both the sides	expressing willingness to come to an agreement	2
1/6/2005	Pakistan's Indus Water Commissioner says that they have uses downstream of this river and that if water is diverted, their uses will be harmed	mild verbal expressions displaying discord in interaction	-1
2/6/2005	Talks between India and Pakistan to resolve differences on the Kishenganga hydro-power project remained inconclusive.	minor official exchanges, talks or policy expressions	1
29/6/2005	India and Pakistan reported "tangible and good progress" and "better understanding" at the secretary-level talks on Wullar Barrage-Tulbul Navigation Project in Jammu and Kashmir and agreed to continue discussions to resolve the differences on it	expressing willingness to come to an agreement	2
6/7/2005	Pakistan has asked India to stop work on the Wullar Barrage because it is a violation of the Indus Waters Treaty	proposing unwanted dam or other flow regulation	-1
8/8/2005	Pakistani experts visit site of Kishanganga Dam project which Islamabad believes may breach Indus Water Treaty	visit by lower officials for talks on joint water issues	1
8/8/2005	talks in New Delhi	meeting of high officials discussing joint water issues	1
9/8/2005	Pakistan-India talks begin in New Delhi on Kishanganga Dam project which Islamabad believes may breach Indus Water Treaty	meeting of high officials discussing joint water issues	1
13/8/2005	Pakistan Indus Basin Commission member Siddiqi said that official talks between India and Pakistan at the Indus Basin Commission level could be considered as having failed because India had not been ready to follow the Indus Basin Treaty for the past 12 years	making threatening demands and accusations	-2
13/8/2005	Talking about Pakistan's repose over the Indian wish to divert Neelum River, Siddiqi said India could not divert Neelum River at any point under the Indus Basin Treaty	rhetorical statements	0
13/8/2005	Failure of dialogue between the Indian and Pakistani Indus Basin Commissions is not a new issue, as a three-day meeting between the Indus Basin commissioners of both countries to resolve Pakistan's objections over the Kishanganga project had already ended without any conclusion on 10 May, 2005, because Indian authorities had failed to provide relevant information	failure to come to reach agreement in dispute settlement attempt	-1
13/8/2005	Pakistani Indus Basin Commissioner Ali Shah is still in New Delhi to sign a joint declaration over the dialogue process between both countries	meeting of high officials discussing joint water issues	1
14/8/2005	Pakistan has formally announced that talks with India on the Kishanganga dam project under the Indus Basin Treaty have failed	failure to come to reach agreement in dispute settlement attempt	-1

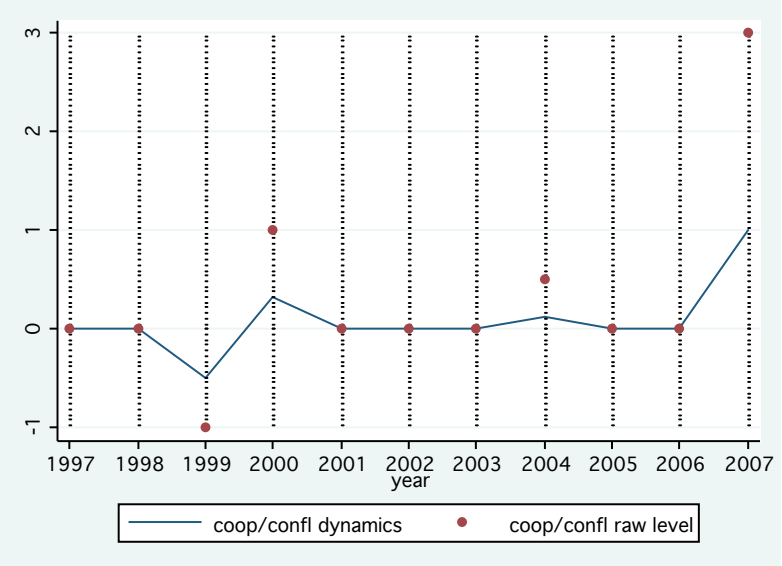

Figure 3: *Interaction Hungary Croatia, Drava*

between Hungary and Croatia on the Drava. We observe that both the conflictive and the cooperative events in 1999 and 2000 only slightly perturb the perceived relationships between the two countries, given that, previously, their interactions were rather neutral. Even the very positive event in 2007 (score of 3) only leads to an increase of the interaction level to 1, given the long neutral history.

C Results

Table 3: *Border demarkating rivers, by issue type*

	Water Quality		Water Quantity	Joint Management
	full sample	subsample		
constant	-0.767	-0.061	0.105	-0.060
	(.000)***	(.112)	(.000)***	(.087)
lag dep var	-0.055	-0.865	-0.315	-0.017
	(.020)***	(.027)***	(.000)***	(.012)
winng coalit	0.141	-0.014	0.023	-0.057
	(.000)***	(.126)	(.000)***	(.039)
winng coalit^2	-0.062	-0.021	-0.031	0.069
	(.001)***	(0.05)	(.000)***	(.041)*
# joint IGO	0.000	0.000	0.000	0.000
	(.000)*	(.000)	(.000)***	(.000)
trade dep	0.000	-2.018	0.001	0.000
	(.000)	(1.607)	(.000)***	(.000)
ln_open	0.000	0.000	0.001	0.001
	(.001)	(.001)	(.000)***	(.001)
ln_gdpc	0.003	0.001	-0.003	0.012
	(.000)***	(.003)	(.000)***	(.004)***
diff ln_gdpc	0.000	0.000	0.000	0.000
	(.000)	(.001)	(.000)***	(.001)
env treaty rat	0.000	0.000	0.000	0.000
	(.000)	(.000)	(.000)***	(.000)**
EUdj	-0.009	-0.005	-0.019	0.013
	(.011)	(.007)	(.000)***	(.015)
neuf1	0.197	0.249	0.178	0.243
	(.023)***	(.023)***	(.000)***	(.015)***
neuf2	0.283	0.362	0.265	0.133
	(.028)***	(.020)***	(.000)***	(.020)***
s2unii	0.059	-0.053	0.036	0.005
	(.000)***	(.045)	(.000)***	(.034)
ln_gdp	0.006	-0.002	-0.001	0.003
	(.000)***	(.003)	(.000)***	(.004)
diff ln_gdp	0.005	0.001	0.010	0.000
	(.000)***	(.002)	(.000)***	(.002)
av_per501		-0.016		
		(.016)		
grdem		0.012		
		(.021)		
depdem			-0.001	
			(.000)***	
depratio			0.000	
			(.000)***	
basinsize	0.000	0.000	-0.098	0.000
	(.000)***	(.000)***	(.000)***	(.000)***
rivsh	0.020	0.006	0.001	0.009
	(.001)***	(.002)***	(.000)***	(.001)***
popb	0.000	0.000	0.006	0.000
	(.000)**	(.000)***	(.000)***	(.000)***
dryj	0.000	0.000	0.006	-0.077
	(.000)***	(.000)	(.000)***	(.062)
mix	-0.023	-0.025	0.006	-0.039
	(.005)***	(.010)**	(.000)***	(.050)
basin spat lag	0.055	0.854	0.035	0.171
	(.042)	(.049)***	(.000)***	(.024)***
dyad spat lag	0.187	-0.331	0.139	-0.156
	(.027)***	(.037)***	(.000)***	(.019)***
σ	0.095	0.052	0.051	0.128
	(.000)***	(.000)***	(.000)***	(.000)***
N	3892	1175	3892	3892

all regressions include country fixed effects

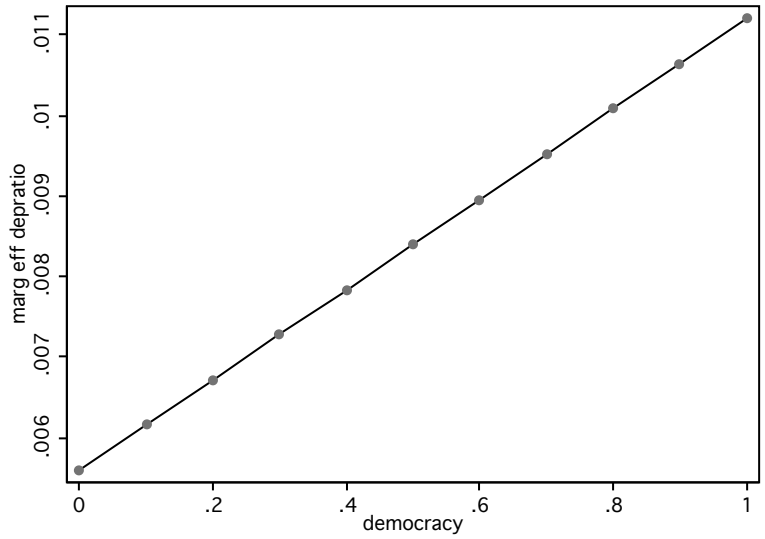

Figure 4: *H1, water quantity marginal effect dependency ratio*

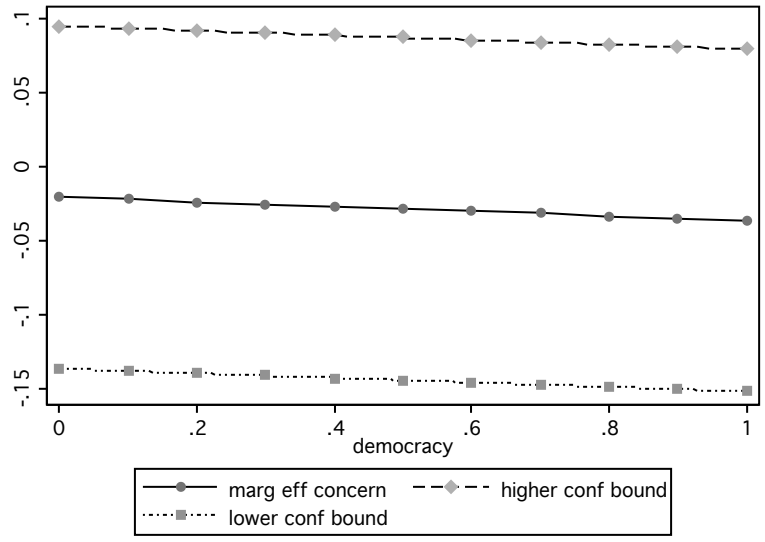

Figure 5: *H1, water quality marginal effect citizens' concern*

Table 4: *Estimated Interdependence in 2004 (water quality), selected country-basins*

country1	country2	basin	Finland Norway Tana	Central-African-Republic Tanzania Nile	Uganda Rwanda Nile	Central-African-Republic Tanzania Congo	Uganda Rwanda Congo	Tanzania Zambia Congo	Tanzania Namibia Congo	Zambia Zimbabwe Congo	Zambia Namibia Congo	Malawi Namibia Congo	Malawi Botswana Congo	Namibia Botswana Congo	Tanzania Zambia Zambezi	Tanzania Namibia Zambezi	Zambia Zimbabwe Zambezi	Zambia Namibia Zambezi	Malawi Namibia Zambezi	Tanzania Mozambique Ruvuma
Finland	Norway	Tana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central-African-Republic	Tanzania	Nile	0	0	0.00017	0.00888*	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uganda	Rwanda	Nile	0	0.00017	0	0	0.00888*	0	0	0	0	0	0	0	0	0	0	0	0	0
Central-African-Republic	Tanzania	Congo	0	0.00888*	0	0	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0	0	0	0	0	0
Uganda	Rwanda	Congo	0	0	0.00888*	0.00009	0	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0	0	0	0	0	0
Tanzania	Zambia	Congo	0	0	0	0.00009	0.00009	0	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00888*	0	0	0	0	0
Tanzania	Namibia	Congo	0	0	0	0.00009	0.00009	0.00009	0	0.00009	0.00009	0.00009	0.00009	0.00009	0	0.01696*	0	0	0	0
Zambia	Zimbabwe	Congo	0	0	0	0.00009	0.00009	0.00009	0.00009	0	0.00009	0.00009	0.00009	0.00009	0	0	0.01696*	0	0	0
Zambia	Namibia	Congo	0	0	0	0.00009	0.00009	0.00009	0.00009	0.00009	0	0.00009	0.00009	0.00009	0	0	0	0.01696*	0	0
Malawi	Namibia	Congo	0	0	0	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0	0.00009	0.00009	0	0	0	0	0.01696*	0
Malawi	Botswana	Congo	0	0	0	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0	0.00009	0	0	0	0	0	0
Tanzania	Zambia	Zambezi	0	0	0	0	0	0.00888*	0	0	0	0	0	0	0	0.00025	0.00025	0.00025	0.00025	0
Tanzania	Namibia	Zambezi	0	0	0	0	0	0	0.01696*	0	0	0	0	0	0.00025	0	0.00025	0.00025	0.00025	0
Zambia	Zimbabwe	Zambezi	0	0	0	0	0	0	0	0.01696*	0	0	0	0	0.00025	0.00025	0	0.00025	0.00025	0
Zambia	Namibia	Zambezi	0	0	0	0	0	0	0	0	0.01696*	0	0	0	0.00025	0.00025	0.00025	0	0.00025	0
Malawi	Namibia	Zambezi	0	0	0	0	0	0	0	0	0	0.01696*	0	0	0.00025	0.00025	0.00025	0.00025	0	0
Tanzania	Mozambique	Ruvuma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All estimated weights marked with * statistically significant ($p \leq 0.01$).

Table 5: *Steady State, water quality*

country1	**country2**	**basin**	**pre-shock steady state**	**post-shock steady state**	**difference**
Finland	Norway	Tana	-0.002849	-0.002849	0
Central African Republic	Tanzania	Nile	-0.033369	-0.033368	0
Uganda	Rwanda	Nile	-0.002216	-0.002216	0
Central African Republic	Tanzania	Congo	0.113650	0.113690	0.000040
Uganda	Rwanda	Congo	0.144810	0.144850	0.000040
Tanzania	Zambia	Congo	0.206680	0.680520	0.473830
Tanzania	Namibia	Congo	0.254660	0.254700	0.000040
Zambia	Zimbabwe	Congo	0.280900	0.280940	0.000040
Zambia	Namibia	Congo	0.327060	0.327100	0.000040
Malawi	Namibia	Congo	0.315120	0.315160	0.000040
Malawi	Botswana	Congo	0.307800	0.307840	0.000040
Tanzania	Zambia	Zambezi	0.034766	0.038754	0.003988
Tanzania	Namibia	Zambezi	0.105070	0.105070	0.000002
Zambia	Zimbabwe	Zambezi	0.152340	0.152350	0.000002
Zambia	Namibia	Zambezi	0.198500	0.198500	0.000002
Malawi	Namibia	Zambezi	0.349440	0.349440	0.000002
Tanzania	Mozambique	Ruvuma	0.023569	0.023570	0.000001

.5 shock to Tanzania Zambia Congo in 2004

Table 6: *Border crossing rivers*

	Coeff
constant	0.019
	(.000)***
lag dep var	0.726
	(.000)***
winng coal	-0.062
	(.000)***
winng coal^2	0.034
	(.000)***
basinsizeupstrn	0.024
	(.000)***
dem*upsize	0.010
	(.000)***
IGO	0.000
	(.000)***
trade dep	0.000
	(.000)***
ln_open	0.001
	(.000)***
ln_gdpc	-0.001
	(.000)***
diff ln_gdpc	0.000
	(.000)***
env treaty rat	0.000
	(.000)***
EU	-0.050
	(.000)***
neuf1	0.073
	(.001)***
neuf2	0.073
	(.000)***
affinity	0.000
	(.000)***
ln_gdp	0.001
	(.000)***
diff ln_gdp	0.001
	(.000)***
basinsize	0.195
	(.000)***
# riparians	0.001
	(.000)***
popb	8.301
	(.000)***
scarcity	-0.439
	(.000)***
rivmix	0.005
	(.000)***
rivdir	-0.002
	(.000)***
basin spat lag	-0.038
	(.000)***
dyad spat lag	0.236
	(.000)***
σ	45.026
	(.000)***
N	7955

regression includes country fixed effects

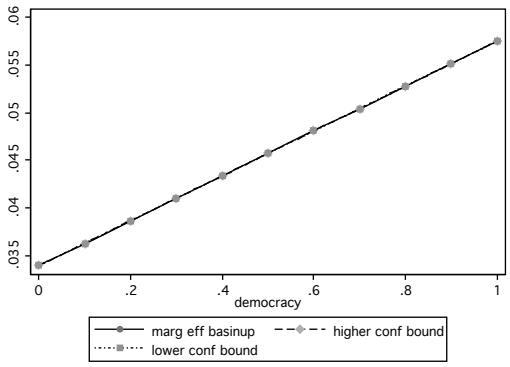

Figure 6: *Marginal effect basinsize for different levels of democracy*

Table 7: *H3 (severity) by issue type*

	water quantity		Water Quality
Constant	-0.008	-0.008	-0.003
	(0.013)	(0.013)	(0.015)
ldep	0.857	0.855	0.663
	(0.006)***	(0.006)***	(0.008)***
winng coalit	0.006	0.010	0.039
	(0.009)	(0.009)	(0.011)***
winng coalit^2	-0.024	-0.021	-0.009
	(0.009)***	(0.009)**	(0.011)
# joint IGO	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
trade dep	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)***
ln trade openness	0.000	0.000	0.001
	(0.000)**	(0.000)**	(0.000)***
ln_gdpc	-0.000	-0.001	-0.000
	(0.001)	(0.001)	(0.001)
ln_gdpcd	-0.000	-0.000	0.000
	(0.000)**	(0.000)*	(0.000)
env treaty rat	0.000	0.000	-0.000
	(0.000)***	(0.000)***	(0.000)
EU	-0.006	-0.007	0.002
	(0.003)**	(0.003)**	(0.004)
gov p	0.118	0.117	0.130
	(0.006)***	(0.006)***	(0.011)***
partly	0.140	0.140	0.259
	(0.007)***	(0.007)***	(0.010)***
affinity	0.017	0.014	0.010
	(0.004)***	(0.004)***	(0.005)*
ln_gdp	-0.001	-0.000	-0.002
	(0.001)	(0.001)	(0.001)*
ln_gdpd	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
basinsizen	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)***
# riparians	0.000	0.000	0.002
	(0.000)	(0.000)	(0.000)***
Total Freshwater Withdrawal (km3/yr)	-0.000	-0.000	
	(0.000)***	(0.000)***	
water dependency	0.000	0.000	
	(0.000)	(0.000)***	
pop density			0.000
			(0.000)
dem*sev	0.000	-0.000	-0.000
	(0.000)***	(0.000)**	(0.000)
scarcity	0.000	0.000	
	(0.000)	(0.000)	
rivmix	0.003	0.003	0.007
	(0.002)*	(0.002)*	(0.002)***
rivdir	0.002	0.002	0.005
	(0.002)	(0.002)	(0.002)***
updown	-0.002	-0.002	-0.007
	(0.001)	(0.001)	(0.002)***
dyad spat lag	-0.017	-0.018	0.067
	(0.010)*	(0.010)*	(0.009)***
basin spat lag	0.126	0.125	0.582
	(0.013)***	(0.013)***	(0.010)***
Sigma	.06	.06	.06
N	11847	11847	11834

all regressions include country fixed effects
standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

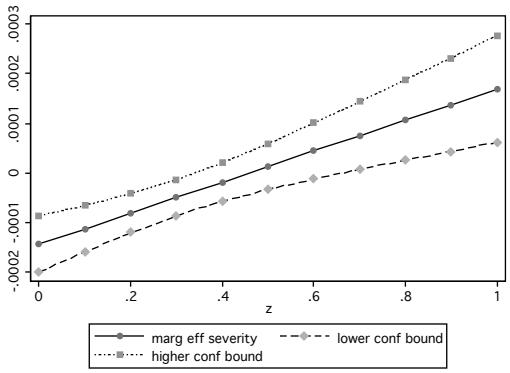

Figure 7: *Marginal effect severity (total withdrawal) for different levels of democracy*

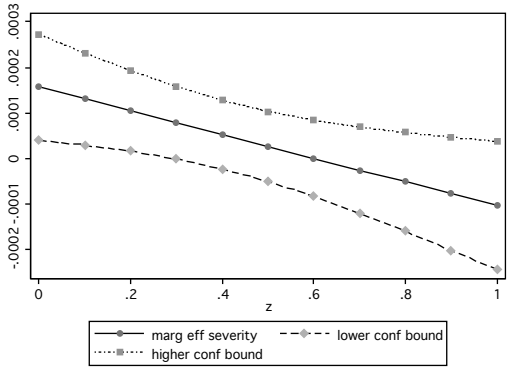

Figure 8: *Marginal effect severity (dependency ratio) for different levels of democracy*

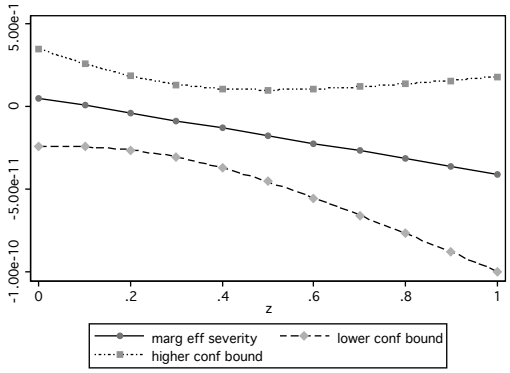

Figure 9: *Marginal effect severity (population density) for different levels of democracy*

Table 8: *H4 (salience)*

	H4a border demarkating	H4b border crossing
constant	-0.598	-0.163
	(.000)***	(0.091)*
lag dep var	.476	0.657
	(.000)***	(0.012)***
salr		0.166
		(0.007)***
winng coalit	0.105	
	(.000)***	
winng coalit^2	-0.085	
	(.000)***	
low salience	0.477	
	(.000)***	
medium salience	0.325	
	(.000)***	
high salience	-0.100	
	(.000)***	
low sal*dem	-0.188	
	(.000)***	
med sal*dem	0.069	
	(.000)***	
high sal*dem	0.000	
	(.000)***	
# joint IGO	0.000	0.000
	(.000)***	(0.000)
trade dep	0.000	0.000
	(.000)**	(0.000)
ln_open	0.000	0.002
	(.000)***	(0.001)***
ln_gdpc	0.006	-0.003
	(.000)***	(0.005)
diff ln_gdpc	0.000	0.000
	(.000)***	(0.001)
env treaty rat	0.000	0.000
	(.000)***	(0.000)
EU	0.016	-0.021
	(.000)***	(0.009)**
press freedm	0.116	-0.045
	(.000)***	(0.011)***
affinity	0.121	0.035
	(.000)***	(0.022)
ln_gdp	0.002	0.004
	(.000)***	(0.004)
diff ln_gdp	0.004	0.003
	(.000)***	(0.002)
basinsize	0.001	0.000
	(.000)***	(0.000)
scarcity	-0.001	0.000
	(.000)***	(0.000)***
upstr basinsize		0.000
		(0.000)
border rivers		0.005
		(0.006)
riv opp flow direct		0.011
		(0.006)*
mix	-0.005	
	(.000)***	
basin spat lag	0.040	0.114
	(.000)***	(0.023)***
dyad spat lag	0.040	-0.198
	(.000)***	(0.047)***
σ	18.434	0.164
	(.000)***	(0.094)*
N	2401	3892
country fe	no	yes

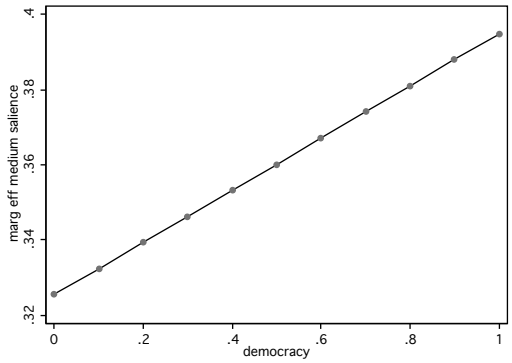

Figure 10: *Medium salience, enhanced by democracy*