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WATER AS A CURSE?

A quantitative examination of the link between water resources and interstate conflict

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Abstract

The phenomenon of the resource curse links the abundance of natural resources to higher levels of conflict occurrence. Until now, most literature merely focuses on non-renewable resources such as diamonds or gold. This paper sheds the light on water as a renewable resource and takes a new perspective arguing that water abundance can also be linked to conflict occurrence. The main argument for water to be a curse is based on the expectation that the commercialization of water resources can lead through the effects of greed or grievances to interstate clashes. The quantitative time-series cross-section analysis focuses on shared water basins and examines their link to low-level militarized interstate disputes (MID). Multivariate logistic regressions, interaction terms and marginal effects show that larger water basins are associated with a lower conflict risk which means that the expectation of a water curse cannot be confirmed. The results for greed and grievance as determinants of conflict show that greed does in fact increase the conflict risk, but the effect is independent from water abundance. In contrast, grievances turn out to be a conflict-decreasing factor, also when set in relation with water abundance. The results strengthen previous findings suggesting that scarcer water resources are a conflict-contributing factor. However, even though a curse cannot be confirmed at this point, strong improvements in the development of indicators are needed before ruling out the possibility of a water curse.

Keywords: resource curse, water abundance, interstate conflict, greed, grievances

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1. Introduction

Natural resources were long perceived to be a crucial possibility for countries to achieve higher levels of economic development. However, it has been shown that most resource-abundant countries struggle to achieve sustained economic growth and often have very low levels of their Gross Domestic Product (GDP) per capita. Sachs & Warner (2001) as well as Auty (2004) coined this phenomenon as the *resource curse.* But not only natural resources seem to be linked to economic development, researchers also established the link between resource abundance and an increased conflict risk. The most widely known are cases such as Angola or Sierra Leone where rebels used natural resources to finance their conflict activities.

Several explanations for the resource curse exist. One common explanation is that the profitability of natural resources makes it worth for rebels to exploit them and appropriate the benefits for themselves. Greedy exploitation used to finance rebel activities thereby hampers the respective countries' economic achievements and fosters conflict occurrence and persistence. Another prevalent explanation is that an extensive reliance on the revenues from natural resources leads to a lack of diversification in the national economy. In consequence, economic growth is unsustainable and once the resource revenues decline, there are no alternatives for the economy to sustain itself (Collier/Hoeffler 2004; De Soysa/Neumayer 2007; Humphreys et al. 2007).

When discussing the resource curse, most researchers focus on those types of natural resources that are small as well as easy to exploit, trade, and transport such as gold, diamonds, or coltan. The fact that their value is easily taken advantage of is supposed to contribute to such resources' exploitation and act as a triggering and sustaining factor of conflict (Bannon/Collier 2003). While oil does not share all of the aforementioned characteristics, it has nevertheless been shown to have a conflict-inducing character (Ross 2004). The large majority of the research on the resource curse focuses only on those non-renewable resources.

This paper shifts the focus in the resource curse debate to water as a crucial renewable resource and its link to conflict. Given the impacts of climate change, water is primarily examined in the context of scarcity and the question how the lack of availability increases conflict risks. This prevalent focus has two main weaknesses: first, the link between water scarcity and conflict lacks substantial evidence since the expectation of "water wars" has so far not come true; second, the expectation of conflicts due to water scarcity is largely based on distributional problems which can also exist when water is abundant.

A hypothetical water curse is based on Gleditsch et al. (2006) who conducted quantitative research on interstate conflict among river-sharing countries, mainly testing what characteristics in a river-sharing dyad contribute to higher conflict likelihood. Among others, they controlled for the abundance of water using a variable on the size of water basins. The findings show, that the basin size seems to have a positive effect on conflict which could hint towards a possible water curse.

This paper therefore seeks to answer the following question: **Is there a water resource curse? That is, is there an association between larger water resources and a higher conflict risk?** The main argument is that not only non-renewable resources but also water abundance can lead to a curse. While water may not have as obvious lootable characteristics as diamonds or gold do, it does entail other monetary benefits. For instance, its exploitation can lead to benefits in terms of irrigation, electricity generation and navigation which is why controlling water resources can also be profitable. The exploitation of water on the one hand but also closely linked inequalities in terms of access and monetary benefits on the other hand are therefore expected to increase the conflict risk.

In order to answer this research question, a quantitative analysis will be conducted. Particularly, it will be examined how the size of shared water basins – a basin shared by at least two countries – is linked to the occurrence of conflict. Conflict will be measured as militarized interstate dispute (MID), which captures low-level conflict with a minimum threshold of one fatality. The choice of these variables will be explained in the methodological part of the paper. The research aims to open the black box of the resource curse and shed light on water as a renewable resource that has so far been widely neglected in this context. The paper thereby moves on from the narrow focus on water scarcity to the implications of water abundance. Furthermore, as most research in terms of the resource curse as well as water scarcity focuses on intrastate conflict, the interstate dimension contributes to filling a further gap. The focus on interstate conflict in relation to water abundance is chosen because most water resources are shared among several nations which means that water basins are a highly crucial interstate matter not limited to intrastate concerns. Each of the 263 international basins across the world is shared by two up to 18 different countries (UNDESA/UN Water 2014). This paper thus seeks to highlight the importance of water to interstate disputes. The topic is further highly relevant for the scientific as well as policy debate since it contributes to the debate about water policies on the one hand and has the potential to shed light on a risk-contributing factor that has so far been neglected: water abundance.

The analysis will proceed as follows: First, a literature review will present existing research on the resource curse on the one hand, as well as the link between water and conflict on the other hand. Based on this literature review, the paper's theoretical argument and hypotheses will be developed. Following the methodological part, which explains the method, data, and choice as well as operationalization of the variables, the empirical analysis will be conducted. A logistic regression followed by several robustness checks and its associated discussion is expected to help answer the research question. The conclusion will summarize the findings and suggest further research in this area.

2. Literature Review

This chapter will provide an overview of the current literature on the resource curse in general but also the link between water and conflict in particular. Following a critical discussion of the literature, the two topics will be combined in order to develop the theoretical framework.

2.1 The Resource Curse

The resource curse mainly establishes two links: on the one hand, researchers claim an association of natural resource abundance with low economic development. On the other hand, natural resource abundance is also argued to be linked to conflict.

2.1.1 Natural Resources and Economic Development

Sachs and Warner (1995) first introduced the concept of the natural resource curse based on the observation that countries with larger amounts of natural resources and an increased share of resource revenue exports in GDP tend to display lower levels of economic growth. This observation is described to be a curse as one would generally expect that natural resource abundance enables a country to benefit from their advantage: An increased amount of natural resources entails economic opportunities and increases external demand generating revenues for national investments. However, since the 1970s, most resource-rich nations were not able to generate economic growth (Sachs/Warner 2001, 837).

The main mechanism supposedly linking natural resource abundance with lower economic growth is the Dutch Disease. An overvalued exchange rate in consequence of the sudden increase in natural resource exports renders other national exports uncompetitive on the international market and suppresses local production through cheaply acquired international products (The Economist 2014). This often leads to a decrease in manufacturing and entrepreneurial activities (Humphreys et al. 2007, 6; Ross 2007; Sachs/Warner 2001, 835). A further explanation is resource-rich countries' overreliance on natural resource revenues creating a lack of investment in other sectors and in turn the inability to diversify the national economy. Thus, resource-abundant countries mostly fail to use their resource endowments strategically for the creation of long-term growth, ignoring the fact that natural resource stocks will be exhausted at some point (Humphreys et al. 2007, 8ff.). Besides those economic consequences, gains from natural resource extraction also create opportunities for corruption among those controlling the resources – often the elites (ibid., 11f.).

Empirically, Sachs and Warner (2001, 828) find that countries are either resource-rich or highly ranked in terms of economic development, that is high levels of GDP. Examples are the Gulf States or Nigeria that are wealthy in terms of economic resources but keep having low levels of GDP. However, those findings neglect famous examples such as Norway in the industrialized world or Botswana in the developing world. Norway has large natural resource endowments and is nevertheless a highly developed country with a high level of GDP. Botswana was able to convert its natural resource endowment into successful economic development mainly through the implementation of effective resource governance (Bannon/Collier 2003, 11; Basedau/Lay 2009, 760). Therefore, the resource curse is clearly not ultimate and can be escaped, although one has to recognize that this tends to be rarely the case.

2.1.2 The Resource-Conflict-Nexus

Besides the link to weak economic performance, resource abundance is also argued to be linked to increased conflict risk. Most researchers agree that easily lootable resources that are small, easy to transport, and of high value are most conflict-inducing. This mostly applies to diamonds, minerals, gold or drugs (Bannon/Collier 2003, 5). When it comes to the mechanism linking abundance and conflict, greed and grievance are the predominant explanatory concepts (Collier/Hoeffler 2004). While conflict due to greed can be ascribed to certain groups aspiring for political and monetary power by using their country's natural resources for their own profit, conflict due to grievances is based on social and political injustice.

Greed

If a group anticipates monetary benefits associated with the exploitation of a certain natural resource, greed constitutes the motivation for insurgency and the engagement in conflict. Uprising groups seek to gain control of the resource and enforce the group's preferences in political and economic life, looting natural resources for their own financial gain. In this context, natural resources provide the necessary opportunity for conflict as their revenues are used to finance conflict activities (Collier/Hoeffler 2004, 563f.; De Soysa/Neumayer 2007, 4).

The concept of greed is based on a simple utility function: if a certain group of actors calculates that the expected benefits of conflict exceed the costs, they will most likely engage in conflict (Collier/Hoeffler 1998, 564). Pure economic calculations can therefore often – at least to some extent – explain the occurrence of conflicts. Natural resources and their monetary benefits can influence this cost-benefit calculation in several ways. First, they decrease the costs of conflict by serving as a financial means for conflict activities (conflict as business activity). Second, they increase possible benefits if control over the resources can be gained and the respective party can keep realizing profits after the conflict (conflict as a future investment). This is mostly the case for resources of high value that can generate large incomes (Collier et al. 2004, 254f.). Other factors influencing the cost-benefit calculations are, for instance, a well-organized and resourceful elite and military because they increase the costs of conflict as one must expect conflict to endure longer. If the level of income is relatively high, costs of conflict tend to increase since living conditions could worsen throughout and in the aftermath of the fighting (Collier/Hoeffler 1998, 565). Among the most famous examples for conflicts dominated by greed and looting rebel activities are Sierra Leone and Angola where rebel groups used diamond sites to finance their atrocities during conflict (Le Billon 2001, 562).

Grievances

Grievances, on the other hand, emerge when population groups feel highly marginalized or treated unequally, for instance due to social or ethnic clashes in the society, or the abuse of political rights. If grievances are strong enough, some groups may risk civil conflict in order to improve their situation (Collier/Hoeffler 2004, 563f.). In relation to natural resources, grievances are most likely to occur due to problems of unequal access and allocation. Only if a party does not feel like it benefits adequately (be it in monetary or other terms) grievances are likely to arise. But also the consequences of the Dutch Disease palpable by an increased unemployment and lower incomes, increasing inequality, or the discrimination against resource-scarce regions can reinforce grievances and contribute to violent movements (Humphreys 2005, 510ff.; Ross 2007, 238).

The State Capacity Model

A further mechanism explaining the association between natural resource abundance and conflict occurrence is the state capacity model. In general, one distinguishes between three ways how natural resource abundance contributes to conflict through a weaker state. First, large resource revenues can foster corruption among the elites trying to use the money to their own advantage (Ross 2003, 24). Second, resource-abundant governments are likely to be unaccountable because they do not have to tax their citizens given the natural resource revenues. In consequence, bureaucratic institutions are not highly developed and the government is unable to resolve possible grievances among the population (Humphreys 2005, 512). Third, given the tendency to have a weak bureaucratic body resource-abundant states fail to ensure the provision of public goods for their citizens as well as the peaceful settlement and avoidance of conflict (De Soysa/Neumayer 2007, 2; Le Billon 2001, 563; Ross 2003, 25).

Findings

Researchers generally agree on the existence of the link between resource abundance and conflict, but they disagree when it comes to conflict characteristics, the type of resource and the mechanism linking the two. Collier and Hoeffler (2004) use a dataset covering the period from 1960 to 1999 trying to proxy greed and grievance in order to find out which of the two matters most for civil conflict occurrence. The share of primary commodity exports of the country's GDP approximates the financial opportunities resource exploitation entails and is therefore one of the indicators for greed (ibid., 565). The possible costs of conflict are proxied, among others, with the average income per capita (ibid., 569). Ethnic fractionalization, the level of democracy and economic inequality are used as indicators for grievances. The results show that the greed proxies perform a lot better in explaining civil conflict occurrence than the grievance indicators do. If grievance is to be an explaining predictor, it would only be so due to its indirect link to economic variables (ibid., 589).

One of the main weaknesses in Collier and Hoeffler's research is the fact that greed is mainly captured with the share of primary commodity exports of GDP. This measurement is highly insufficient as numbers on several resources such as diamonds either barely exist or do not include dark figures. Moreover, the export details do not give a real idea of how easily rebels will be able to control a resource and to appropriate all of the benefits to themselves. De Soysa (2000, 122) further points out that the export figure does not give real information about the actual availability but barely the simple quantity of the resource.

Other researchers disagree with Collier and Hoeffler's claim of greed being the dominant predictor of conflict. When using a variable for production and stock levels of different natural resources instead of the primary commodity export measure, conflict occurrence turns out to be largely predicted by levels of resource production in the past (Humphreys 2005, 508). This controverts the greed argument which is based on future-oriented cost-benefit-calculations but not past conditions of resource endowments when calculating conflict risk. Other research shows that it is not resource wealth per se but those resources used for energy generation that are associated with conflict risk (De Soysa and Neumayer 2007, 3). Le Billon (2001, 580) appropriately brings to the point that one should not label conflicts as resource wars purely defined by greedy actors but to keep the key implications in mind that political and economic contextual factors can have on the overall conditions in a country as well as on the course of events.

As for the resource type, several researchers claim that diffuse resources such as drugs or alluvial diamonds that are hard for the authorities to control and therefore easier for uprising groups to exploit and commercialize, have stronger links to conflict occurrence (Bannon/Collier 2003, 5). Moreover, almost without exception it is non-renewable resources that are argued to be linked to increased conflict likelihood. The link of renewable resource endowments to conflict risk is either not examined or is argued to be non-existent (Le Billon 2001, 565). What authors generally do agree on is that small, high-value resources that are easy to transport are most likely to be exploited and conflict-inducing because it is less complicated to make profits with them (Bannon/Collier 2003, 5). Oil is widely agreed to have a peculiar role as it seems to create a higher conflict risk – especially for secessionist conflict – than other resource types (Bannon/Collier 2003, 5; Collier/Hoeffler 1998, 564; Ross 2004, 337).

When presenting the different arguments and findings in relation to the resource curse, one can notice that some results are very divergent. This is mainly due to some of the authors' methodological choices. First, they use different datasets that cover different cases and time periods. Different samples can lead to different findings and conclusions. As for the most common dependent variable, the occurrence of conflict, researchers choose different definitions. For instance, some use a threshold of 1000 deaths per year to code violent activities as conflict, others only require 25 deaths in a conflict year. The latter increases the number of observations showing conflicts which can influence the significance of results. As for the natural resources, some measure abundance in pure availability per capita, others measure dependence according to the share of exports of GDP. While some may differentiate between different types of resources, for instance, mineral or energy rents (De Soysa/Neumayer 2007), others use simple shares of all primary commodity exports of GDP (Collier/Hoeffler 2004). Further differences can stem from coding decisions, for instance, if only the year that a conflict first occurs is coded as a conflict year or all the years that it lasts; or how one deals with missing data, for instance, if missing cases are simply dropped or deleted listwise (Ross 2004, 347f.).

In sum, opinions and results about the link between resource abundance and conflict diverge. While Collier and Hoeffler (2004) are convinced that resource abundance is linked to the risk of civil war and that this link can be traced back to greed not grievances, Fearon (2005) as well as Humphreys (2005) find stronger support for the state capacity model and stress the importance of quality of government. What authors largely do agree on is the particular role of oil which has repeatedly proven to be extremely hazardous and likely to induce secessionist conflict. Apart from that, results on the type of resource that matters most as well as the characteristics of the conflict differ from each other. Most of the research on the resource curse focuses on intrastate violence. However, water abundance is exactly because of the international dimension of water expected to have comparable effects for interstate disputes. How exactly this is expected to work is developed in the context of the theoretical argument section.

2.2 Water and Conflict

Renewable resources are considered to be those "energy resources and technologies whose common characteristic is that they are non-depletable or naturally replenishable." (Armstrong/Hamrin 2013). Due to this characteristic, renewable resources are perceived to have a clear advantage compared to non-renewable resources since the latter are increasingly exhausted due to modern consumption patterns and population pressure. Water's availability is highly debated as climate change, pollution, human activities and its variability across the globe often challenge its renewable character. Thus, the renewability of water is highly dependent on a careful and sustainable use and management. Besides its absoluteness for human life, water contains a lot of potential for renewable energy production (Green Facts 2016). This section gives an overview of the existing literature on the link between water and conflict and explains why the strong focus on scarcity is insufficient and neglects several crucial commonalities that resource scarcity and abundance entail.

2.2.1 Scarcity and Conflict

Researchers predominantly focus on the consequences of climate change and the growth of the global population which increasingly threaten the availability of water. Among all renewable energy sources, water has even been defined to be the most conflict-prone one (Gleditsch et al. 2006, 363). Nevertheless, the often proclaimed prediction of future "water wars" as a consequence of water scarcity has so far not come true (Homer-Dixon 1994; Klare 2001; Swain/Krampe 2011; Wolf 1998).

Those conflict forecasts are based on a neo-malthusian view, which assumes that all natural resources' availability is restricted and delimits the possibilities of population growth and consumption. Once those limits are surpassed the society is expected to be confronted with socioeconomic failure and violent conflict. Developing countries are supposed to be most affected by those consequences since they do not possess the abilities to adequately adapt to environmental stress. They lack proper human and financial capital as well as technologies and on top of that often face political and economic instability (Homer-Dixon 1999, 4f.). While this view may regard the environmental stresses that the global society is facing nowadays and in the future, it excessively focuses on the mere availability of resources and does not take into account any institutional or political features that could influence the situation.

In contrast, economic optimists do not accept natural resource limits as bound but argue that societies can react and adapt to those limits with the right mechanisms and institutions. One of those institutions is the market which is supposed to set incentives for societies to change consumption patterns, substitute resources and use technological innovations in order to adapt to the naturally defined limits (ibid., 25). A further point of view in the debate is represented by the distributionists, arguing that it is not the resource availability per se but an unequal and poor distribution that can contribute to both scarcity and conflict occurrence (ibid., 35).

2.2.2 Empirical Evidence on Water and Conflict

Scarcity is argued to be linked to several kinds of conflict and researchers do overall agree that scarcity itself is "neither a necessary nor sufficient cause of conflict", but that a combination of different contextual factors causes resource-related conflicts (Böhmelt et al. 2014, 343; Homer-Dixon 1999, 7). First, two countries that share a river are at higher risk to engage in violent conflict than two countries that do not share a river. And the more rivers are shared between the respective countries, the higher the conflict likeliness (Furlong et al. 2006; Gleditsch et al. 2006; Toset et al. 2000). Second, if the river-sharing countries are contiguous, conflict likeliness also increases (Furlong et al. 2006, 80). Physical proximity provides more opportunities to engage in conflict compared to a situation where other countries lie between the basin-sharing countries. Third, shared rivers whose stakeholder countries have an upstream-downstream relationship tend to be more conflict-prone, especially if one of the countries is either highly reliant on that river's water or if the upstream country exerts its authority over the downstream partner (Brochmann/Gleditsch 2012a, 525f.; Homer-Dixon 1999, 139).

Fourth, empirical findings further indicate that cooperation is actually more common than conflict over water (Wolf 1998; Gleditsch et al. 2006). Across the globe, a large number of river management agreements between basin-sharing countries have been signed, such as the Mekong River Commission or the Nile Basin Initiative that support the participating countries in settling river-related matters in a peaceful manner. Empirical evidence has further shown that the right institutions can be highly crucial in this context since they provide the possibility to improve the distribution of resources and thereby make sure to either prevent or alleviate possible grievances (Gizelis/Wooden 2010, 451). This importance of institutions clarifies the notion that resources and a possible resource curse are not merely economic but also political matters and that even when competing for resources the involved countries are able to find shared interests that makes them favor cooperation over conflict. If interstate conflict over water happens anyway, the conflicts are mostly low-level conflicts and still no real "water wars" as they had been predicted (Bernauer et al. 2012).

2.2.2 Scarcity versus Abundance

The extreme focus on water scarcity in most of the literature researching the link between water and conflict entails several limitations. First and foremost, scarcity and abundance cannot be quite separated per se but are relative terms, as one actor's abundant availability of a resource often comes with scarcity for another one – no matter if those are actors within the same state or in different states. Thus, instead of framing resources in terms of mere scarcity or abundance, one has to take a closer look at factors such as the distribution of the resource, the dependence on it as well as the access to it. Especially in relation to water, the vital and non-substitutable characteristic of water changes the nature of conflict since every actor is dependent on water to some extent which is why it is of high value to everyone – not only in monetary terms. Furthermore, every stakeholder is aware that water availability is fixed; hence, even when water is abundant competition can be strong (Tir/Stinnett 2011, 610). In the case of Sudan, for instance, Selby and Hoffmann (2014, 363) find that it was mostly water abundance not scarcity linked to conflict. Yet, the association between the two is mainly determined by other factors such as the relative value of water – economically and politically – as well as dynamics in the political economy linked to the resource, not its pure availability. The case of Sudan shows that rebel groups have indeed tried to capture the water resources for their own profit and that water has become a strategic asset during conflict (Selby/Hoffmann 2014, 466).

Causes of resource scarcity are mostly divided into supply- and demand-induced factors (Homer-Dixon 1999, 15). The former arise if environmental degradation limits the supply of a certain resource while the latter can develop due to demographic changes. But it is often neglected that especially demand-side factors can also create competition if a resource is abundant. In relation to water, acceleration in demand can be created by increased agricultural productivity in order to increase economic incomes, a high population density given the opportunities of employment in the area, or economic development stimulated by energy production or changing consumption patterns (Böhmelt et al. 2014, 338f.).

It is often argued that social consequences of water scarcity will lead to grievances among the population due to its impact on people's livelihood and competition over the resource which in turn is likely to increase conflict likelihood (Gizelis/Wooden 2010, 444ff.). Social impacts may be highly severe if a resource is scarce especially in terms of food security. However, when resources are abundant, their exploitation brings also broad socioeconomic consequences with it that are likely to lead to grievances and violence. People's livelihoods are often destroyed, rich soils overused and exploited, and local people have to be relocated. Research has shown that relocation increases conflict likeliness between the relocated people and their new area's population (Homer-Dixon 1999, 141). Grievances among the population that arise as a consequence of unequal profit of water and due to the social implications the commercial use of water entails, can therefore contribute to conflict resources just as much when the resource is abundant.

Problems of unequal access to and benefits from available resource are mostly set in relation to scarce resources (Homer-Dixon 1999, 15). Yet, the same conflicts can and do come up if a resource is abundant – may this be due to monetary value (ex. diamonds) or value in terms of an improvement of living conditions (ex. agriculture for food security) that people want to make their own. Additionally, some researchers even query whether water is scarce or not. On a global scale, water is plenty but its distribution and supply-and-demand structures put some regions at an extreme disadvantage in terms of availability of and access to water (Furlong et al. 2006, 84; Selby/Hoffmann 2014, 364).

Empirically, Gleditsch et al. (2006) do not examine the sole effect of water abundance on dyadic conflict but use the river basin size as one of their control variables. The results do indicate that the water basin size is positively associated with interstate conflict likelihood. One of the reasons for this is the increased number of stakeholders in larger water basins that are likely to clash when trying to establish co-management mechanisms (Sneddon 2002). Hendrix and Glaser (2007) did not test for shared rivers but for the availability of freshwater resources and found that an increased amount of freshwater resources per capita does in fact increase conflict risk. That is, even when it is not about shared basins, more water seems to contribute to conflict.

3. Modeling the Link: Water Abundance and Interstate Conflict

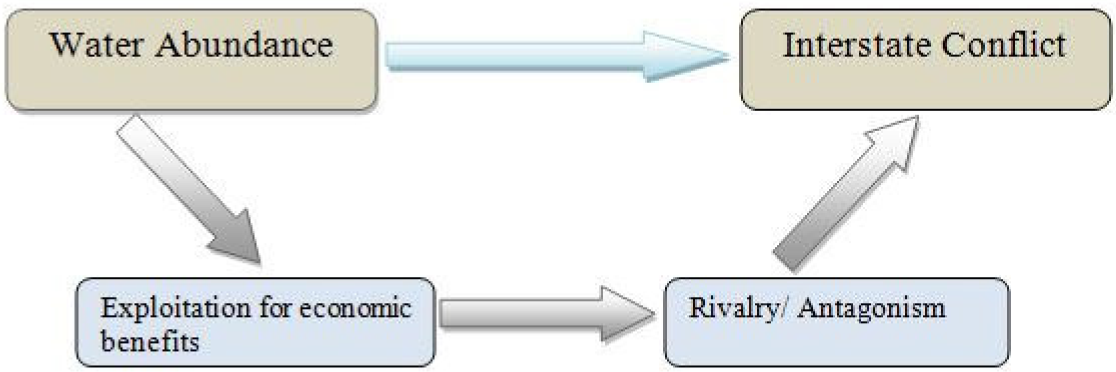
As the last section already indicates, water scarcity is not the only possible circumstance expected to increase conflict likelihood. This paper's main argument is that larger water basins shared among two countries – a country dyad - can increase the conflict likelihood. This water curse is mainly expected to occur due to an increasing demand for water that emerges with its abundance as people realize the possibilities that water abundance entails – be it for production or consumption purposes. Each country is expected to want to secure its access to the water and its monetary benefits – especially given possible future water pressures. The emerging tensions between the dyad countries concerning access and allocation of the resource is therefore expected to contribute to conflict occurrence. Moreover, larger water basins do usually involve a larger number of stakeholders whose interests are likely to clash and end in conflict. Due to the fact that water basins are shared between several countries and that water resources cannot like most other resources be divided according to national borders, the occurring dispute is expected to be of an interstate character.

Hypothesis 1: Larger shared water resources increase the likelihood of interstate conflict.

In order to capture the possible mechanisms linking water abundance and conflict, two main arguments are used to establish the link – greed and grievances. It is important to point out, that the focus does not lie on choosing one mechanism over the other but simply to find out if results do indicate which mechanism may explain the link between water abundance and conflict – if there is one to find.

As for greed, water is usually not assumed to have the same lootable characteristics as diamonds or gold and therefore considered to be of less monetary value. But due to lacking substitutes and water's absoluteness for human life, this paper bases its examination on the assumption that water is also highly valuable. For instance, abundant water basins contain potential for low-priced hydrological power which can be an incentive to exploit water resources – especially in developing countries where energy and electricity are often scarce. Moreover, abundant water resources entail more capacities for irrigation schemes which give incentive to increase agricultural productivity using the water resources. Further monetary value comes with the navigational capacities larger river basins contain, and abundant species of fishes which can constitute local incomes and therefore be worth to capture (Brochmann/Gleditsch 2012a, 520; Gleditsch et al. 2006, 379). All of those advantages may not be a pure and direct monetary benefit in the shortest term, but they still do increase the demand for water and represent a commercialization of water resources.

Graph 1: Greed linking water abundance and interstate conflict occurrence



The exploitation of those advantages in order to secure the monetary benefits is expected to lead to an increasing rivalry between two basin-sharing countries and can in turn lead to interstate disputes (Graph 1). Since the monetary value of water is difficult to capture and constitutes itself an entire scientific debate (Boucher 2014; Grygoruk et al. 2013), hypotheses that indicate greedy motivations in conflict will be tested. First, it has been argued that resource abundance is less likely to be linked to conflict if the respective countries have a relatively high level of income as the costs of conflict will probably increase. In contrast, for countries with lower income levels conflict costs are relatively low as there is not much to lose (Collier/Hoeffler 2004, 569). If a country-dyad is a "poorer" dyad in terms of GDP per capita, it is therefore likely that the poorer country of the two can gain – or at least not lose – by engaging in conflict over water. Hence, greedy expectations of a conflict can motivate interstate violence. Since a dyad consists of two different GDP per capita, the hypothesis will focus on the poorer of the two.

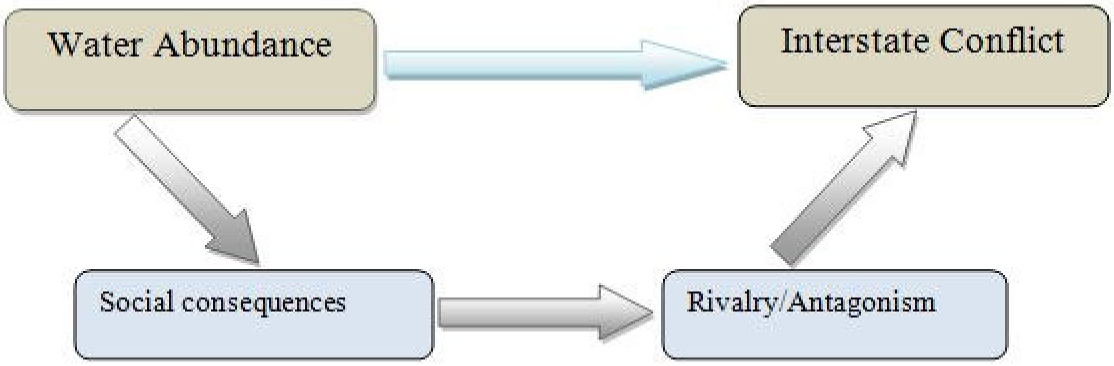
Hypothesis 2: A larger GDP per capita of the dyad's less wealthy country decreases the likelihood of interstate conflict.

If a river-sharing dyad finds itself in an upstream-downstream relationship, peace is only possible if both countries manage to act in a cooperative way. But an upstream-downstream relationship can set incentives for both parties to act greedy which in turn is likely to increase conflict likelihood. The upstream country could exert its authority and try to increase its own benefits through the exploitation of the water resources, for instance through dam construction or the use of hydropower. The usually disadvantaged downstream country could risk conflict in order to secure its own access to water and benefits from its commercialization. An example for this relationship is the Syr Darya basin: Kyrgyzstan is the upstream state, wanting to store water during the warmer periods in the spring and use it for electricity generation during the winter. The downstream states Uzbekistan and Kazakhstan though need enough water for cultivation during the spring and summer while in the winter they need less water due to flood risks (Bernauer/Siegfried 2012, 231f.).

Hypothesis 3: An upstream-downstream relationship between two basin-sharing countries increases the likelihood of interstate conflict.

Besides this possible link through a greed-mechanism, abundant water resources and their use do also have wide social consequences that can increase grievances and therefore contribute to conflict risk among a river-sharing dyad (Graph 2). The construction of dams and expansion of irrigation plants have severe consequences for the locals' lives as they do take people's livelihoods since those in rural areas close to rivers often earn their money as pastoralists or fishers. For instance, dams and irrigation systems destroy migration routes for cattle and force locals to be relocated (Selby/Hoffmann 2014, 366). Following the construction of dams and installation of hydropower or irrigation schemes, many parts surrounding river basins become uninhabitable. When relocated, it has been shown that clashes between the relocated ones and the population in the new areas are likely (Homer-Dixon 1999, 141). Environmental pollution and degradation caused by the commercialization of water can further stimulate grievances in the affected regions (Humphreys et al. 2007, 13).

Graph 2: Grievances linking water abundance and interstate conflict occurrence



Grievances will become an important factor not only for intrastate but also for interstate disputes if social consequences for one state are different than for another one – which is very likely – especially due to the transboundary character of rivers. In order to capture the impact of grievances, two hypotheses will be tested. First, if a country-dyad presents a high level of economic inequality, it is very likely that the poorer country feels disadvantaged and therefore inclined to risk conflict as the risk to worsen conditions through violence is perceived to be low.

Hypothesis 4: A higher difference in the levels of income between two basin-sharing countries increases the likelihood of interstate conflict.

Second, ethnic fractionalization has been shown to be an indicator of possible clashes of interest (Collier/Hoeffler 2004, 571ff.). The more diverging the countries in a river-sharing dyad are in terms of ethnicity, the more likely it is that interests will clash and conflict will occur.

Hypothesis 5: A higher degree of ethnic fractionalization between two basin-sharing countries increases the likelihood of interstate conflict.

4. Research Design

Before conducting the quantitative analysis, the research design will be presented. In the first section, the operationalization and measurement of the models' variables will be discussed. The second part depicts the method and the dataset used in the analysis.

4.1 Operationalization and Measurement

Dependent Variable: Militarized Interstate Dispute

The phenomenon researched in this paper is the occurrence of interstate conflict. The dependent variable is captured by the occurrence of militarized interstate disputes (MID) with a minimum fatality of one (*fmid)*. Any clash between two states or more that causes at least one death is considered to be a fatal MID. The variable is measured on a dichotomous level (1= MID onset, 0 = no MID onset). It captures the onset of MIDs which is why the duration and persistence of conflicts are not taken into account. If an interstate conflict involves more than two states, the conflict is recorded for each of the participating dyads.

The death-threshold is a lot lower than it is in the case of civil conflicts (one versus 25 or 1000). Interstate conflict has become a much rarer phenomenon and if it occurs, it is mainly a conflict of low violence. In this case, interstate conflict has been chosen over intrastate conflict as the dependent variable for several reasons. First, a large majority of the literature on the resource curse does focus on the link between water and intrastate conflict (Böhmelt et al. 2014, 338). But when analyzing water resources in terms of rivers or water basins, a local approach does not take the transboundary dimension of water into account: the UN lists 263 transboundary lake and river basins, that are mostly shared between but up to 11 or even 18 countries (Danube river) (UNDESA/UN Water 2014). Water abundance and its link to conflict therefore have a clear international dimension which needs to be analyzed. Thus, this choice does contribute to closing a gap in the existing literature.

Furthermore, even when analyzing local clashes, those are very likely not to be limited to one state – especially in the case of international rivers running along the border of two different states. Even though conflict or violence may first arise on a local level, it becomes international as soon as local groups from two different states are involved. Using the interstate conflict variable further reflects a mere technical choice, since this paper is based on Gledtisch et al. (2006) and Brochmann and Gleditsch (2012a) who also used the fatal MID variable in their analyses claiming that largely violent conflicts over individual rivers might not occur that often but that “a large shared river basin provides a resource worth fighting for”

(Gleditsch et al. 2006, 373). Fatal MIDs are chosen over simple non-deadly MIDs because an even lower barrier (no fatality at all) for conflict could entail an attention bias. Non-fatal MIDs are much more complicated to report which is why the variable could easily overstate or understate non-fatal violence. Furthermore, the exact starting and end point of non-fatal MIDs often remain unclear (Toset et al. 2000, 984).

Independent Variable: Water Basin Size

The main explanatory variable for the occurrence of interstate conflict is the abundance of water. For this analysis it is captured by the water basin size in sqkm *(lnbasinsize)*, a time-invariant variable measured on a continuous level. A water basin is “a topographically delineated area drained by a stream system”; including “all lands that drain through […] rivers and their tributaries into the ocean”. Examples are the Mississippi River Basin, the Amazon River Basin or the Congo River Basin (Brooks et al. 2013, xv). As explained in the theoretical argument, this variable is expected to have a positive effect on the occurrence of conflict, that is, increase the likelihood of fatal MIDs.

The water basin variable matches well with the phenomenon of interstate disputes and basins’ international dimension. Analyzing intrastate conflict with the water basin as the explanatory variable would not live up to the broad and international nature of water basins. Nevertheless, this choice of variable has mainly been determined by the availability of data and the choice of several researchers (Gleditsch et al. 2006; Brochmann/Gleditsch 2012a). It is therefore crucial to acknowledge that this variable has several weaknesses. For instance, the pure size in sqkm unfortunately does not capture the actual availability of water since it does not give a measurable idea of the capacity the resource provides for commercialization of water. In contrast to other resources, the measurement of water can also not be captured in terms of exports of GDP since water usually is not exported but used for national purposes. The variable therefore does not actually measure how much of the water resource stocks are used for commercial purposes. To have a slightly more expressive indicator, per capita measures that give an idea about the availability of water in relation to the size of population would have been preferred for the data. Despite its limitations, the size of the river basin gives an idea about the water resources’ vast extent that bring along an increased number of shareholders and interests. It also reflects distributional conflicts that come up with an increasing river basin size. Nevertheless, it does constitute a low common denominator which has to be kept in mind during the interpretation of the analysis’ results.

Variables indicating Greed and Grievances

Level of income: In order to test the first hypothesis proxying the impact of greed on interstate conflict (Hypothesis 2), the level of income has to be measured. The level of income of the poorer country in the dyad is expected to be crucial since it is likely to be a motivation for greedy behavior based on the observation that lower levels of income are an important explanatory factor of conflict as opposed to high levels of income (Raleigh/Urdal 2007, 691). The variable *lnsmlgdpc* measures on a continuous level the real GDP per capita in the smaller economy of the dyad in thousand USD. The real GDP per capita is chosen over a simple GDP per capita measure because it is clear of inflation rates, which makes a comparison of the numbers over time possible. In congruence with the hypothesis, higher scores of *lnsmlgdpc* are expected to be associated with decreased conflict likelihood.

Upstream-downstream relationship: As for the third hypothesis, this paper argues that an upstream-downstream relationship between two countries stimulates greedy behavior contributing to conflict risk. In order to capture this type of relationship, a dichotomous variable (*updown)* is used (1= upstream/downstream relationship, 0= no upstream/downstream relationship). It is important to note that an upstream-downstream relationship can lead to greedy behavior of both – the upstream and the downstream state – since in different settings each of the states can be the hegemon. For example, in the case of the Aral Sea Basin in Central Asia, the upstream state Kyrgyzstan holds back water during the summer season in order to use it for electricity generation during the winter. Downstream states Uzbekistan and Kazakstan, needing most water during the summer to grow their harvest are dependent on the upstream state's goodwill. On the other hand, along the Nile, Egypt is the downstream state but also the hegemon in the basin due to its military and economic power as well as its ability to store most of the water (Bernauer/Siegfried 2012, 231f.). Upstream countries' access to the water resources is therefore restricted by Egypt's behavior and the quantities of water it decides to store as well as its goodwill given the regional power it possesses.

Difference in GDP per capita: In order to examine possible impacts of grievances, Hypothesis 4 focuses on the economic inequality between the countries involved in a fatal MID. The difference in real GDP per capita of the two countries in a dyad has been chosen as the indicator for this type of inequality. As for now, real GDP per capita is the number that covers most countries in the world, giving an idea about the respective level of economic development. The variable (*lngdpc_diff)* is measured on a continuous level. Increasing scores are expected to lead to higher scores in MID occurrence.

Ethnic fractionalization: Hypothesis 5 expects for a higher degree of ethnic fractionalization to increase conflict likelihood. Previous research has shown that the composition of ethnic groups can be a crucial conflict determinant. Collier and Hoeffler (2002) argued that the dominance of an ethnic group can increase conflict likelihood. They further state that an ethnically diverse society can contribute to ethnic hatred and in turn lead to conflict (Collier/Hoeffler 2004, 571).

Ethnic fractionalization is an indicator for disparities in language and race that can lead to clashing interests between population groups. Fractionalization stands for the "probability that two randomly selected people from a given country will not share a certain characteristic" (Teorell et al. 2015, 65). The original variable from the Quality of Government dataset is measured on a range from 1 to 10, with higher numbers indicating a higher degree of fractionalization. As for now, the variable was mostly used when examining local or national phenomena. In order to convert it to a dyadic measure appropriate for this paper, a dyad's fractionalization average ($ethn_{ave} = \frac{fractionalization\ state\ A + fractionalization\ state\ B}{2}$) has been calculated in order to indicate how ethnically diverse a country dyad is (*ethn_ave).* A higher ethnic fractionalization score is expected to increase conflict likelihood as the different population groups' interests are more likely to clash opposed to ethnically similar population groups.

Further Control Variables

In order to control for the influence of other possible variables on the level of conflict likelihood, the following control variables have been chosen.

Regime type: The political regime of a country has often been set in relation to its conflict proneness. Democratic peace theory argues that democratic states do not fight each other, meaning that democratic dyads should present a lower level of conflict risk. In contrast, dyads consisting of unconsolidated regimes that are neither democratic nor autocratic are expected to be especially conflict-prone and less able to cooperate (Böhmelt et al. 2014, 340ff.; Gleditsch et al. 2006, 371; Hegre et al. 2001; Tir/Stinnett 2011, 621). In order to control for the regime type's influence, two dummy variables capturing the respective constellation in a country dyad are used: *twodemoc* indicates that both countries in the dyad are democratic (1=two democracies; 0=not two democracies). In contrast, *unconsol* (from unconsolidated) indicates that the regimes in a dyad are not settled and can neither be assigned to be democratic nor autocratic (1= unconsolidated, 0= not unconsolidated). The classification of the countries to be autocratic or democratic has been made according to the countries' Polity IV score measuring the establishment of civil liberties and checks and balances.

IGO membership: When it comes to transboundary water issues and conflict, it is expected to be crucial whether the involved countries do have an established cooperation mechanism. As mentioned in the literature review, cooperation over water tends to be more likely than conflict. Hence, the presence of an institutional arrangement can be crucial for whether disputes over water quantities do end in interstate conflict or if matters are settled in a peaceful manner (Bernauer/Böhmelt 2014, 119; Tir/Stinnett 2012, 212). Institutions can form a mechanism of resource allocation and address or prevent grievances caused by unequal access (Brochmann/Gleditsch 2012a, 521; Gizelis/Wooden 2010, 444). Unfortunately, no data that captures the existence of a cooperation mechanism within a certain country dyad is available. In order to proxy the cooperation abilities of the involved countries, the variable for Intergovernmental Organization (IGO) membership, *lntotal_ig*, will be used. It captures the number of IGOs in which both countries of a dyad are members on a discrete level of measurement. Being a member of the same IGOs indicates overlapping interests and closer relationships, both of which do increase the costs of fighting each other and can be an incentive for cooperation. The higher the number of shared IGO memberships, the lower is conflict likelihood expected to be.

Contiguity: Given the costs and benefits before engaging in conflict, physical proximity is likely to increase the risk of fatal MIDs because it constitutes a better opportunity and lower costs opposed to countries being further apart from each other. *Contiguity* is measured on a dichotomous level (1=contiguity, 2= no contiguity). In this sample, the number of different dyads analyzed does vary across the years, but on average there are about 320 different dyads (each reported for several years) out of which on average about 45% are contiguous.

Peace History: With an increasing amount of years that countries have not engaged in conflict against each other, it is usually argued that the likelihood of a new conflict between the two to occur decreases. Peace history (*peacehis2)* is measured on a continuous level of measurement, capturing the number of previous years in the dyad without any MID occurrence or, alternatively, the amount of years since the younger of the countries has gained independence (Brochmann/Gleditsch 2012a, 523).[1]

Difference in Military Capability: Keeping in line with the argument of rational calculations before engaging in conflict, the military capability can also be an explanatory factor of MID occurrence. According to realists' balance of power theory, a dyad with equal military capabilities is less likely to have conflict than when the balance is more unequal. Thus, with an increasing difference in military capabilities, conflict likelihood is expected to increase. Military capability measures the percentage of world power a country possesses which depends on its military spending, amount of soldiers and further defense expenses. The variable *lncap_diff* captures the difference in military capability within a dyad.

Dyadic Trade: Slightly related to the shared membership in IGOs is trade within a dyad. Economic interdependence is likely to prevent countries from fighting each other due to the costs that would be linked to conflict, for instance through economic sanctions or stopping any trade relations. Oneal and Russett (1999) showed that countries with stronger trade relationships are less likely to engage in conflict with each other. Besides the costs that conflict would entail, economically interdependent countries have also been shown to have a higher level of trust in each other and demonstrate an increased willingness to surrender parts of their sovereignty for the sake of properly functioning international institutions (Tir/Stinnett 2011, 620). *Lndytrd* proxies a dyad's economic interdependence, measuring the trade between the respective countries in USD on a continuous level of measurement.

4.2 Methods and Data

Since this paper's theoretical argument is based on a suggestion made by Gleditsch et al. (2006) as well as Brochmann and Gleditsch (2012a), the replication dataset of the latter is used. As it is often the case in international relations analyses, the dataset comes in dyadic form, which means that the unit of analysis is not as usual a simple country-year but a dyad-year. A dyad refers to a certain pair of country; each country in the world builds a dyad with every single other country of the world. The dyadic dataset has a clear advantage compared to non-dyadic ones when examining international conflict: Non-dyadic datasets focusing on a certain country-year would not be able to analyze any conflict characteristics that go beyond

[1]For further explanation of the computation, Brochmann and Gleditsch (2012a, 526) add the following: "The variable is defined as –(2^(-years of peace)/α), where α is a half-life parameter. We choose α=2 as we assume the conflict increasing effect of a previous conflict to be halved every second year." (also see: Gleditsch et al. 2006, 371, fn.10).

those of the respective state. In contrast, the dyadic dataset enables to shed light on further relational variables that could have contributed to violence between two countries. However, due to the limited availability of other variables in a dyadic form, the amount of variables to choose among for this examination is quite limited.

In order to avoid an excessive number of observations (without any restrictions the dataset would have more than 600,000 observations) the analysis only takes into account politically relevant dyads, which usually includes "pairs of contiguous states and/or pairs of states including at least one major power" (Lemke/Reed 2001, 138). Since for this research the main criterion of inclusion is for two countries to share a water basin, only dyads within the same physical continent are included. Dyads that are completely separated by the ocean – even if this concerns a country pair with a major power like the United States – as well as single-island countries are dropped from the dataset (Brochmann/Gleditsch 2012a, 523). Furthermore, only those dyads that do share a water basin are kept in the dataset given this paper's research focus which leads to a sample of 33,349 observations.

The Shared River Basin dataset, which is what Brochmann and Gleditsch's analysis is based on, covers all river-sharing dyads worldwide from 1816 to 2007. In contrast to previous versions, for instance from Toset et al. (2000), this newer version covers a broader time period. Furthermore, it includes non-contiguous dyads, which allows controlling for the physical proximity of country pairs (Brochmann/Gleditsch 2012b, 1f.). The main predictor, the total basin size, originates from the Transboundary Freshwater Dispute Database (TFDD 2008). The dependent variable in the replication dataset, *fmid*, originally stems from the Correlates of War Project (COW 2012). All variables except for ethnic fractionalization are taken from Brochmann and Gleditsch's replication dataset. The ethnicity variable stems from the Quality of Government dataset (Teorell et al. 2015). Some of the variables show a skewed distribution which is why they have been log-transformed before the analysis in order to ensure a (roughly) normal distribution. The variables in question can be recognized with the beginnings of their labels being "ln" (*lnbasinsize, lnsmlgdpc, lncap_diff, lntotal_ig, lndytrd).*[2]

The sample covers all the reported basin-sharing dyads in the world and does not make any regionally or economically motivated selections in order to ensure the possibility to generalize the results. The timely availability of the control variables in the dataset limits the analyzed

[2]For further information on the original sources of the control variables, see the replication dataset from Brochmann/Gleditsch 2012a.

timeframe to 1885 to 2001 with gaps, meaning that it is dealt with an unbalanced panel. This research indicates a first glance on whether a water curse could exist on a global scale. In future research one can then focus on different spatial and temporal settings.

As the dyad-year unit of analysis already indicates, the dataset consists of time-series cross-section (TSCS) data. With the exception of the water basin size and ethnic fractionalization, all variables are time-variant. Opposed to a simple cross-sectional analysis, the use of panel data enables to take into account the changes over time in the data and does not only depict a sequence at a specific point in time. Moreover, it is possible to examine how the value of one predictor in the first year does influence the outcome in the following. TSCS further increases the number of observations in the sample which contributes to the generalizability of the empirical results (Stimson 1985, 916). Furthermore, given the low-probability of interstate conflict occurrence, TSCS data covers far more conflicts than only the analysis of one year or one dyad over time would. Despite its advantages, panel data does also increase the risk to violate one of the regression assumptions such as autocorrelation or heteroscedasticity which will be addressed in the context of reliability and validity checks.

The quantitative examination of the topic entails several advantages compared to a case study. Qualitative case studies often focus on conflictuous river-sharing cases in order to identify the triggers of violence. This approach is suited to understand the causalities underlying specific conflict cases. However, the approach does miss out to analyze those cases in which conflict has not occurred but which might have similar contextual conditions (Böhmelt et al. 2014, 338). Furthermore, a case study does not allow any generalization of the findings which is much more feasible in the case of a large-N-study, although it always has to be done with caution. Given the binary outcome variable in this research, a logistic regression will be the main method used. In contrast to an OLS regression it does not assume a linear relationship between the predictor and outcome variable but analyses the relationship of each independent variable with the logarithm of the outcome (Field 2013, Ch. 19.3[3]).

4.3 Descriptive Statistics

When dropping those cases from the dataset that are considered non-relevant dyads, the total number of observed dyad-years sums up to 33,349. Among those observations, only 697 experienced a fatal MID which is corresponds to 2.38% and confirms that a fatal MID to

[3] The exact references in Field 2013 have to be given with the chapter numbers as the available e-book does not indicate any page numbers.

occur is a low-probability event. The following table presents the number of observations, mean, standard deviation as well as minimum and maximum value for each of the variables used in the main analysis. One can note that the variables differ in their number of observations which is the reason for differing sample sizes in the regression models.

Table 1: Descriptive Statistics

Variable	Observations	Mean	S.D.	Min.	Max.
Interstate Conflict (fmid)	29,273	0. 24	0.15	0	1
Basin Size (lnbasinsize)	30,201	13.68	1.62	6.13	16.03
Small GDP per capita (lnsmlgdpc)	28,080	7.53	0.95	5.42	10.20
Upstream/downstream (updown)	30,201	0.43	0.50	0	1
Difference in GDP per capita (lngdpc__diff)	25,150	6.99	1.51	-3.91	10.11
Ethnic fractionalization (ethn_ave)	27,180	0.48	0.22	0.21	0.90
Regime type					
- Two democracies (twodemoc)	28,158	0.15	0.35	0	1
- Unconsolidated (unconsol)	28,158	0.31	0.46	0	1
Shared IGO membership (lntotal_ig)	19,747	3.30	0.66	0	4.67
Contiguity (contiguity)	30,201	0.52	0.50	0	1
Peace history (peacehis2)	28,101	-0.10	0.23	-1	-4.91e-18
Difference in military capability (lncap_diff)	29,555	-5,76	2.20	-13.82	-0.97
Dyad trade (lndytrd)	17,618	1.32	0.80	-7.72	2.55

5. Empirical Analysis

The empirical analysis will test whether water abundance is related to the occurrence of interstate conflict. Several robustness checks will be conducted in order to ensure that the results are generalizable and not only occurring due to the model specificities. The section further tests several interaction terms to find out how greed and grievance's link to conflict develops given different levels of water abundance. Marginsplots will depict some of the effects visually. All regression results will be presented in odd ratios.

5.1 Validity and Reliability

In order to be able to run a logistic regression with the data and make it a good fit to the model, several assumptions have to be fulfilled by the data. The Shapiro-Wilk test for normality suggests a non-*normal distribution of error terms* in the data which is a violation of one of the assumptions. However, due to the large number of observations in the sample, this violation can and will be ignored in the analysis (Field 2013, Ch. 8.3.2.1). Another assumption for logistic regression is no perfect *multicollinearity,* which requires that the independent variables are not highly correlated with each other. A correlation table shows that no predictors are correlated with a value higher than 0.80 which does not suggest any problems with multicollinearity. When checking VIF and tolerance values to make sure the assumption is not violated, the results confirm what the correlation table indicated: No multicollinearity is present in the data since none of the variables presents a VIF value higher than 5 or a tolerance value lower than 0.2.[4]

A further assumption that has to be met is for the data's error terms to show *no autocorrelation*, which means that the error terms have to be independent from each other (Field 2013, Ch. 8.3.2.1). When working with panel data this assumption is often violated as errors might be correlated temporally within the same unit, or two different unit's error terms can be correlated at the same point in time. The violation of this assumption leads to minimized standard errors in the results (Beck/Katz 1995, 636). A Wooldridge test for autocorrelation shows that autocorrelation is present in the data. In order to account for this violation, one of the models (Model 6) in the empirical analysis will use a one year lagged dependent variable *fmid_lagged.*

Homoscedasticity assumes that the variance of the error term across different independent variables in the data is constant. When analyzing TSCS data this variance often differs between the different analyzed units (Beck/Katz 1995, 636). The violation of this assumption is likely to inflate standard errors and hence reduces the model's effectiveness. Some heteroscedasticity will most likely always persist in TSCS data, but in order to account for some of it, an additional model will be run with robust standard errors. Thereby, it is assured that heteroscedasticity will not let non-significant values appear significant. Similarly to the remedy of heteroscedasticity, running a model with clustered, robust standard errors (Model 5) will also address a possibly violated *independence of observations* since those standard errors take into account that some of the observations within the same dyad may be related to each other (Tir/Stinnett 2012, 219). A further important test for the data is the detection of outliers, cases that highly differ from the main picture of the data and can therefore possibly influence the estimated coefficients in the results (Field 2013, Ch. 8.3.1.1). When testing for

[4] See Table 8 in the Appendix

outliers by running scatterplots of the calculated residuals and each independent variable, three dyads are found to be outliers: North Korea and South Korea; Moldova and Romania; and China and India[5]. In order to account for this problem, the analysis will be run with and without the outliers (Model 8). The use of several control variables in the models accounts for a possible *omitted variable bias.*

5.3 Main Analysis

Before running multivariate logistic regressions, the bivariate relation of each independent variable and the dependent variable has been assessed in Model 1 (see Table 2). Each of the independent variables turn out to be significant at least at a 10 percent level, which means, that the risk of wrongly assuming a significant effect between predictor and outcome is lower than ten percent. As for the main explanatory variable, the result shows that as the water basin size increases by one unit, the odds of a fatal MID occurring is 0.823 times lower which corresponds to a 17.7% decrease of the odds of a fatal MID occurrence. The direction of the result is surprising as the main expectation of the theoretical argument was for larger water basins to increase not decrease the conflict likelihood.

Both independent variables indicating greed, the dyad's smaller GDP per capita and an upstream/downstream-relationship do significantly influence the likelihood of MID occurrence. With every unit increase in the poorer country's GDP per capita, the odds of MID occurring are 25.6% less. The result further confirms the risk-contributing character of an upstream/downstream relationship within a river-sharing dyad on the bivariate level given that the odds of a fatal MID to occur are 84.6% higher than if this characteristic does not apply. As for the impact of the grievance variables, both of them turn out to be significantly associated with the occurrence of fatal MID on a bivariate level as well. However, each unit increase in the difference in GDP per capita within a dyad does not as expected increase the conflict likelihood but instead the odds of fatal MID are 6.9% less. Likewise for ethnic fractionalization, the variable does not turn out to increase conflict likelihood. Instead, with every unit increase in the dyadic average of ethnic fractionalization, the odds of a fatal MID are 80.0% less.

All control variables do significantly influence the odds of a fatal MID occurring on a bivariate level in the expected direction. Dyads with unconsolidated regimes, contiguity as

[5] See Graphs 7 and 8 in the Appendix as an example.

well as a higher difference in military capability do increase the odds of fatal MID. In contrast, a dyad consisting of two democracies, a higher number of shared IGO memberships, a longer peace history and intensive dyad trade do decrease the odds of interstate conflict.

Table 2: Logistic Regression of Water Abundance and MID

DV: fatal MID	Model 1	Model 2	Model 3	Model 4
Basin size	0.823***	0.781***	0.927**	0.975
	(0.016)	(0.021)	(0.034)	(0.056)
Small GDP per capita	0.744***	0.538***	0.741***	0.580***
	(0.366)	(0.036)	(0.069)	(0.085)
Upstream/downstream	1.846***	1.769***	1.471***	1.434**
	(0.144)	(0.175)	(0.179)	(0.266)
Difference in GDP per capita	0.931**	0.950	0.960	0.911
	(0.026)	(0.187)	(0.041)	(0.057)
Ethnic fractionalization	0.200***	0.187***	0.394***	0.411*
	(0.039)	(0.045)	(0.138)	(0.225)
Two democracies	0.229***		0.389***	0.577*
	(0.048)		(0.107)	(0.201)
Unconsolidated	1.612***		1.035	1.107
	(0.134)		(0.133)	(0.216)
Contiguity	4.572***		8.201***	6.535***
	(0.462)		(1.591)	(1.957)
Peace history	0.100***		0.076***	0.065***
	(0.012)		(0.011)	(0.014)
Difference in military capability	1.098***		1.013	1.158***
	(0.020)		(0.031)	(0.059)
Shared IGO membership	0.0648***			1.194
	(0.039)			(0.202)
Dyad trade	0.765***			0.944
	(0.044)			(0.113)
Constant		126.319***	0.093**	0.551
		(89.015)	(0.093)	(0.858)
N		22,560	20,704	10,769
Pseudo R²		0.056	0.190	0.183
Classification		74.32%	86.68%	88.60%
-Sensitivity		56.11%	57.59%	51.70%
-Specificity		74.69%	87.13%	89.11%

*p<.10 **p<.05 ***p<.01. Standard errors within parentheses. Data: Brochmann/Gleditsch 2012.

Model 2 presents a multivariate logistic regression which only includes the main independent variables of the hypotheses. The basin size stays significant – with each unit increase in the basin size the odds of interstate conflict occurring are 21.9% less. Hence, even in this first multivariate model, water abundance is related to conflict in the unexpected direction. As for greed, a one unit increase in the smaller GDP per capita of a dyad decreases the odds of a fatal MID occurring by 46.2%. In contrast, an upstream/downstream constellation increases the odds of conflict by 67.9%. As for grievances, only ethnic fractionalization remains significant in the multivariate model. With every unit increase in the fractionalization average of a dyad, the odds of a fatal MID occurring decrease by 81.3%. Just as in the bivariate model, the effect performs in the unexpected direction. The results indicate that higher ethnic fractionalization does not increase but decrease conflict risk. The difference in GDP per capita in a dyad turns out insignificant; hence, we cannot assume that this variable significantly influences the odds of conflict occurrence. The model's classification scores show, that 74.32% of the observations have been predicted right by the model. Furthermore, 56.11% of the low weight group (sensitivity), that is, those observations with fatal MID occurrence, and 74.69% of the normal weight group (specificity), non-conflict observations, have been predicted correctly.[6]

Model 3 is the first multivariate regression including each of the variables discussed in the research design. The same variables as in Model 2 turn out to be significant. When controlling for further possible influences, the odds of fatal MID are 7.3% less with every unit increase in basin size. That is, the effect of water abundance performs in the same direction as in the previous two models: water basin size does significantly contribute to lower conflict risk. The main explanatory variables do perform the same as in the previous model when it comes to significance and the direction of effects. As for the control variables, not all of those which turned out significant in the bivariate regressions are significantly associated with conflict occurrence in the multivariate regression. In a dyad consisting of two democracies, the odds of a fatal MID are 61.1% less. This effect is as expected as democratic dyads had been argued to be less conflict-prone. A possible conflict-increasing effect of dyads with unconsolidated regimes is not supported by the results as the variable turns out insignificant. Both, contiguity and peace history are significantly associated with conflict risk in the expected way. If the countries of a dyad do share a border, the odds of conflict occurrence are 820.1% higher; with every unit increase in the peace history of a dyad the odds of conflict are 92.4% less. Thus, longer peace periods contribute to a lower conflict risk. The difference in military capability turns out insignificant in Model 3. As for the explanatory power, this model explains about 19% in the variance of the dependent variable. When comparing the classification scores with Model 2 it performs somewhat better: 86.68% of the observations have been predicted right

[6]The classification calculation is used to assess a goodness of fit of the models. In contrast to the usually applied Pseudo R^2, classification numbers can be compared across models if the number of observations does differ, which is the case in this analysis. The cut-off point has been chosen at 0.024 which is more appropriate than the usual cut-off at 0.5 due to the low-probability event examined in this research.

by the model. In terms of sensitivity and specificity, 57.59% of the conflict observations and 87.13% of the non-conflictuous ones have been predicted correctly.

In Model 4, two more control variables have been added: shared IGO membership and dyad trade. Those variables were added separately since they reduce the number of observations in the analysis from 20,704 to only 10,769. In this model, the main explanatory variable turns out to be insignificant. That is, when controlling for two additional variables, the water basin size is not significantly associated with the odds of conflict. One possible explanation for this change in significance is the fact that the variance in estimating increases with a smaller sample size. All of the other main independent and control variables do perform the same as in the previous model when it comes to their significance and direction of effects with slightly different coefficients. The only variable changing its significance is the difference in military capability which previously did not seem to be significantly associated with conflict risk. In Model 4 though, with every unit increase in the difference in military capability in a dyad, the odds of fatal MID are 15.8% higher which supports the expected effect.

As for the additional variables shared IGO membership and dyad trade, both result in an insignificant relationship with conflict occurrence in Model 4. Hence, neither the indicator for a cooperation mechanism nor an increasing economic interdependence changes conflict likelihood. This model's classification score lies at 88.60% percent correctly predicted observations. Due to the fact that none of the two additional variables turned out significant but their inclusion roughly halves the number of observations, IGO membership and dyad trade will be dropped from further analyses.

5.4 Robustness Checks

Model 5 to 8 depict several robustness checks that perform various specificity-changes in the regressions. When reporting the results, not every single coefficient will be highlighted but only the important changes that come along with the changes in the regressions.

Model 5 includes the same variables as Model 3 but calculating clustered standard errors in order to account for heteroscedasticity and possible dependencies among the observations in the data. The difference in standard errors can be seen when comparing the numbers in parentheses. Compared to Model 4, the main predictor basin size does now turn out insignificant indicating that the data has significant heterogeneity and not all observations are independent but in reality clustered. This could possibly stem from the fact that the basin size variable is time-invariant. When taking a look at the other main independent variables, the poorer GDP per capita in a dyad and an upstream-downstream relationship stay significant predictors. Consistent with all previous multivariate models, the difference in GDP per capita is not associated significantly with fatal MID occurrence. Only ethnic fractionalization changes its significance, that is, once calculated standard errors are included in the model, ethnic fractionalization is not significantly associated with conflict risk anymore. None of the control variables changes in significance or direction of the effects compared to Model 3. The classification score remains the same.

Table 3: Robustness Checks

DV: fatal MID	Model 5	Model 6	Model 7	Model 8
Basin size	0.927	0.868***	0.857	0.901***
	(0.057)	(0.034)	(0.077)	(0.035)
Small GDP per capita	0.741*	0.622***	0.461***	0.679***
	(0.118)	(0.643)	(0.080)	(0.069)
Upstream/downstream	1.471*	1.353**	1.675*	1.327**
	(0.377)	(0.178)	(0.459)	(0.167)
Difference in GDP per capita	0.960	0.912**	0.824***	0.909**
	(0.084)	(0.041)	(0.050)	(0.039)
Ethnic fractionalization	0.394	0.204***	0.113***	0.306***
	(0.275)	(0.078)	(0.093)	(0.118)
Two democracies	0.389***	0.527**	0.547*	0.390***
	(0.140)	(0.139)	(0.174)	(0.108)
Unconsolidated	1.035	1.062	1.121	1.081
	(0.192)	(0.149)	(0.175)	0.143
Contiguity	8.201***	8.682***	9.400***	7.844***
	(2.537)	(1.902)	(2.928)	(1.527)
Peace history	0.076***	0.057***	0.251***	0.077***
	(0.018)	(0.009)	(0.049)	(0.011)
Difference in military capability	1.013	1.056*	1.019	1.049
	(0.058)	(0.035)	(0.064)	(0.033)
Year		1.018***	1.019***	0.106***
		(0.003)	(0.004)	(0.003)
Constant	0.093*	3.47e-16***	4.42e-16***	6.23e-15***
	(0.148)	(1.90e-15)	(3.41e-15)	(3.33e-14)
N	20,704	20,743	20,704	20,626
Pseudo R²/rho (Model 7)	0.190	0.225	0.475	0.180
Classification	86.68%	89.56%		86.41%
-Sensitivity	57.59%	58.16%		55.93%
-Specificity	87.13%	89.99%		86.85%

*p<.10 **p<.05 ***p<.01. Standard errors within parentheses. Data: Brochmann/Gleditsch 2012.

In Model 6, the multivariate regression was run with a lagged dependent variable in order to account for autocorrelation. Additionally, the control variable *year* was added to the model in order to include a time-component in the analysis. In this model, water abundance turns out significant: with each unit increase in the water basin size, the odds of conflict in the next year (due to the lagged dependent variable) are 13.2% lower. When checking the main independent variables, they do perform the same as in Model 3 in terms of significance and effect direction except for the difference in GDP per capita. This is the first model except for the bivariate regression that this variable turned out significant: with every unit increase in the difference in GDP per capita, the odds of fatal MID in the next year are 8.8% less. Just as in the bivariate result, this is not in the hypothesized direction as economic inequality had been expected to contribute to grievances and in turn to conflict occurrence.

The control variables perform the same as in Model 3 with slightly different coefficients. Only the difference in military capability is now significant on a ten percent level: with every unit increase in this variable, the odds of fatal MID in the following year are 5.6% higher. This change in significance does suggest that the variable influences conflict risk over time. As for the time component, *year* turns out to be a significant predictor too: with every unit increase in time, the odds of fatal MID are 1.8% higher. Following this result, the amount of conflicts does increase over time. When comparing the classification scores, Model 6 performs the best among all: 89.56% of the observations are predicted correctly. Out of those, the model predicted 58.16% of the low weight group observations (conflict) and 89.99% of the normal weight group (no conflict) correctly.

Model 7 is a random effects model accounting for the spatial heterogeneity among the sample's entities. That is, possible differences among the dyads that are not explained by the variables used in the model and that are possibly difficult to grasp with any indicators but which could nevertheless influence the results (Wilson/Butler 2007, 104). In order to account for possible clusters, the random effects model assumes heterogeneity to be normally distributed, averaging possible "within- and between-cluster variation in the data".[7] The indicator for water abundance turns out insignificant in this model. All further main independent variables do turn out significant. The difference in GDP per capita had been a non-significant predictor in the models previous to Model 6, but when using random effects, with each unit increase in the difference in GDP per capita the odds of fatal MID are 17.6% less. The other three main independents do behave in the same direction as in previous

[7] The random effects model has been chosen over the fixed effects model because it makes a stronger case when wanting to generalize results and time-invariant variables such as the water basin size can be included in the regression (Beck 2001, 284).

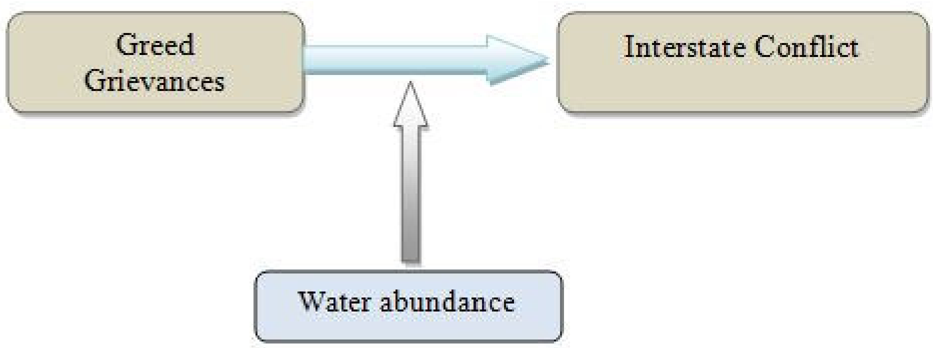
models. So do the control variables, except for the difference in military capability which again turns out insignificant in this model.

Model 8 includes the same variables as Model 6 excluding the outliers that had been detected in the regression diagnostics. None of the variables' significance or direction of effect change, only their coefficients are slightly different. With the exception of the difference in military capability which was a significant predictor in Model 6 but does not turn out significant in this model. Thus, when excluding the outliers from the model, the difference in military capability is not significantly associated with the occurrence of fatal MID.

5.5 Interaction Terms

In order to adequately test the formulated hypotheses, the following section builds models with interaction terms between the main explanatory variable and each of the indicators for greed and grievance. Thereby, it is possible to conclude whether the impact of greed or grievance on conflict changes as a function of basin size: with increasing water abundance, greed and grievance are expected to be more influential on conflict risk. It is important to note, that the moderator variable does either strengthen or weaken the effect of the predictor on the outcome. Interaction must not be confused with a possible intermediating effect of the association between the predictor and outcome or with controlling the effect of the moderator. Following the inclusion of the interaction effect in the regression, the coefficients of the predictor and moderator are interpreted as conditional not unconditional effects (Taylor 2007, 1).

Graph 3: Interaction Term - Water as a moderator



Model 9 tests for the interaction term between the smaller GDP per capita in a dyad as the predictor and water basin size as the moderator. Both variables do turn out insignificant as a conditional predictor, that is, basin size does not significantly contribute to a change in conflict risk when the smaller GDP per capita is zero. Equally, a dyad's smaller GDP per capita does not contribute to a change in the odds of conflict when the water basin size is zero.[8] The insignificance of the interaction term indicates that the greed element does not change as a function of water abundance. Hence, previous findings that had supported this greed element throughout all the models are not supported when testing for the interaction term which means that there is merely an unconditional impact of the small GDP per capita on conflict risk that cannot be connected to the presence of water abundance.

Hypothesis 3 has been assessed by an interaction term between the upstream/downstream relationship as the predictor, the second greed element, and basin size as the moderator. Only the moderator, water basin size, turns out significant as a single predictor in Model 10. Thus, water abundance exerts a conditional effect on conflict risk. With every unit increase in the water basin size and the dyad not having an upstream/downstream relationship, the odds of conflict are 14.6% less. The upstream/downstream relationship does not have a significant conditional impact on conflict risk. The interaction term between the two variables is insignificant, meaning that the risk of conflict in an upstream/downstream characterized dyad does not change as a function of basin size. Similar to the previous greed element (small GDP per capita), this result indicates that Hypothesis 3 is only supported when testing the unconditional effect of an upstream/downstream relationship on the conflict risk but not when it is set in interaction with water abundance.

The next two models test for a possible moderating effect of water abundance on the relation between the grievance indicators and the risk of fatal MID. In Model 11 both, the predictor and moderator, do have a significant impact on the odds of conflict occurrence. With the difference in GDP per capita being zero, each unit increase in basin size increases the odds of conflict occurrence. This is the first time that the basin size is related to conflict occurrence in the expected direction, meaning that increasing water abundance contributes to a higher conflict risk. In contrast, with the basin size being zero each unit increase in the difference in GDP per capita is also associated with increased odds of fatal MID occurrence. Just as it was the case for the basin size, the direction of the effect has changed when analyzed as a conditional one. Those strong changes in comparison to previous model can most likely be ascribed to the fact that the odd ratios of a conditional effect capture something completely different than the unconditional ones (Taylor 2007, 5).

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[8] This is not possible to happen in the context of this sample as the dataset only includes relevant dyads that do share a basin. In order to make the regression coefficients more interpretable, centered values could be calculated as a next step (see Taylor 2007).

Table 4: Interaction Terms

DV: fatal MID	Model 9	Model 10	Model 11	Model 12
Basin size	1.028	0.854***	2.075***	0.703***
	(0.339)	(0.043)	(0.365)	(0.051)
Small GDP per capita	0.816	0.612***	0.641***	0.620***
	(0.490)	(0.060)	(0.064)	(0.061)
Upstream/downstream	1.375***	0.615	1.513***	1.499***
	(0.173)	(0.530)	(0.191)	(0.190)
Difference in GDP per capita	0.910**	0.907**	4.873***	0.914**
	(0.039)	(0.039)	(1.639)	(0.039)
Ethnic fractionalization	0.196***	0.198***	0.208***	0.000***
	(0.071)	(0.071)	(0.075)	(0.000)
Two democracies	0.383***	0.386***	0.401***	0.369***
	(0.106)	(0.107)	(0.111)	(0.102)
Unconsolidated	1.093	1.092	1.154	1.070
	(0.142)	(0.142)	(0.150)	(0.140)
Contiguity	7.951***	8.012***	7.644***	8.000***
	(1.547)	(1.560)	(1.491)	(1.557)
Peace history	0.072***	0.073***	0.078***	0.074***
	(0.011)	(0.011)	(0.011)	(0.011)
Difference in military capability	1.039	1.038	1.035	1.066**
	(0.032)	(0.032)	(0.032)	(0.034)
Year	1.018***	1.018***	1.015***	1.018***
	(0.003)	(0.003)	(0.003)	(0.003)
Basin size * small GDP per capita	0.979			
	(0.044)			
Basin size * upstream/downstream		1.061		
		(0.068)		
Basin size * GDP/capita difference			0.885***	
			(0.021)	
Basin size * ethnic fractionalization				1.678***
				(0.243)
Constant	1.85e-16***	1.13e-15***	1.44e-18***	9.12e-15***
	(1.21e-15)	(5.89e-15)	(7.83e-18)	(4.77e-14)
N	20,704	20,704	20,704	20,704
Pseudo R^2	0.204	0.204	0.212	0.208
Classification	85.47%	85.68%	86.01%	86.22%
-Sensitivity	59.18%	58.23%	58.54%	58.23%
-Specificity	85.88%	86.11%	86.44%	86.65%

*p<.10 **p<.05 ***p<.01. Standard errors within parentheses. Data: Brochmann/Gleditsch 2012.

The interaction term between water abundance and economic inequality is significant. The independent variable, difference in GDP per capita, and the interaction term do show different signs though which means, that an increasing basin size weakens the effect of GDP difference on conflict risk. This result has main implications for this paper's conclusions: First, Hypothesis 3 cannot be confirmed as increased water abundance does not increase the effects of grievance on fatal MID occurrence. Second and adversatively, the hypothesis suggests an effect that some of the literature had already argued for, meaning that increased water abundance decreases the impact of other factors and thus makes grievances less likely to either occur or to even determine conflict occurrence.

Model 12 tests an interaction term between water basin size and the second grievance indicator, ethnic fractionalization. In this model, both variables have a significant, conditional impact on the odds of fatal MID. With ethnic fractionalization being zero, every unit increase in water basin size decreases the odds of fatal MID by 29.7%. An increase in ethnic fractionalization also decreases the conflict likelihood with the water basin size being zero. Both predictors' conditional effect on conflict risk is in the same direction as in the previous unconditional models. The interaction term with ethnic fractionalization as the predictor and water basin size as the moderator also turns out significant: Water abundance weakens the effect of ethnic fractionalization on the odds of fatal MID. This result implicates that Hypothesis 5 cannot be confirmed since the grievance element does not increase as a function of water abundance. Instead, water abundance seems to decrease the impact of ethnic fractionalization on conflict risk, which could either mean that water abundance diminishes a possible conflict-inducing effect of ethnic fractionalization or it is simply more important as a moderator than the predictor in determining conflict likelihood. In both, Model 11 and 12, the moderation is partial since the relationship between each independent variable and the outcome remains significant (Soltanov 2012, 322). Furthermore, the significance of the interaction term implicates that the impact of each predictor on conflict risk is not constant.[9]

5.6 Substantial Interpretation of Effects: Marginal Effects and Marginsplots

In order to interpret the regression coefficients more substantially, this section will calculate marginal effects computing "predicted or expected values for hypothetical […] cases." (Williams 2012, 308). Marginsplots help visualizing the impact of the analysis' main predictor, water basin size, on conflict risk as well as the significant interactions. The plots show that the impact of each predictor on conflict risk is not constant across all levels of the moderator (Berry et al. 2012; Wiggins 2013).

[9] When interpreting the interaction terms, it is important to keep in mind that they are always symmetric meaning that predictor and moderator are not determined but the interaction could work both ways (Berry et al. 2012, 1). Thus, the difference in GDP per capita as well as ethnic fractionalization can have a moderating effect on the link between water basin size and conflict risk.

Table 5: Margins of lnbasinsize

Margin at	Margin	Std. Err.	95% Confidence Interval	
-2 S.D.	0.019	0.002	0.015	0.023
-1 S.D.	0.017	0.001	0.014	0.019
Mean	0.015	0.009	0.013	0.017
+1 S.D.	0.013	0.001	0.011	0.016
+2 S.D.	0.012	0.002	0.009	0.015

Graph 4: Marginsplot Basin Size on fatal MID probability

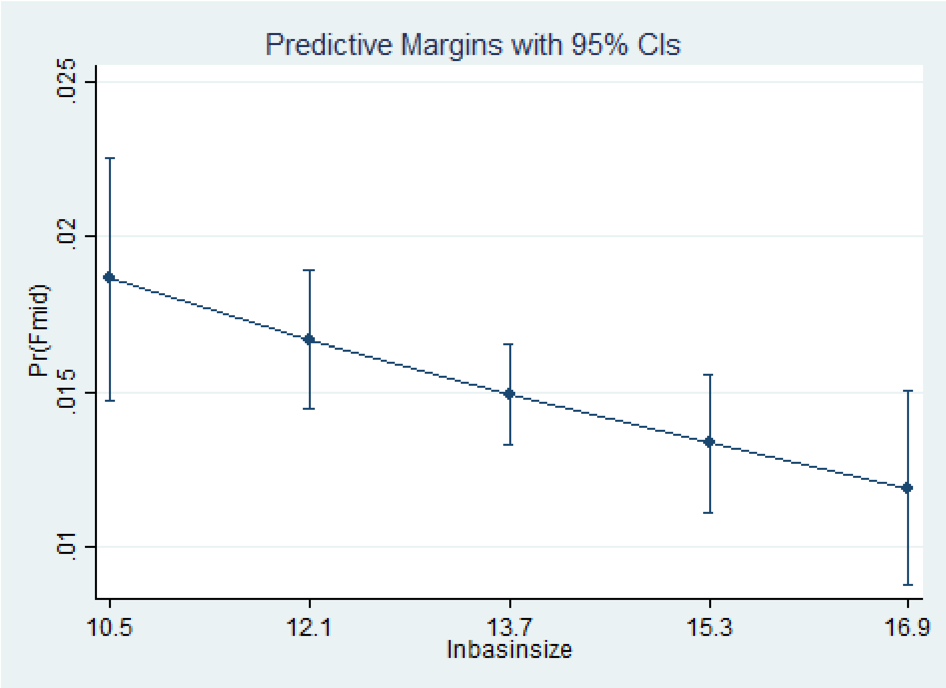


Table 5 shows the margins for the main predictor, water basin size.[10] The margins have been calculated for representative values (MER), which range from minus two standard deviations through the mean up to plus two standard deviations (S.D.). The average marginal effect of the mean water basin size on conflict risk is 1.5 percentage points. Meaning that everything else being equal, an increase of 1.5 percentage points in fatal MID occurrence is expected at a water basin of mean size. If a water basin was of the size plus one S.D., everything else being equal, one would expect a 0.2 percentage points decrease in fatal MID occurrence compared to the mean basin size. In contrast, with a water basin size of minus one S.D., one would expect an additional 0.2 percentage points increase in fatal MID occurrence. The margins confirm what had been the result in the regressions: with an increasing water basin size interstate conflict becomes less likely. What it is also able to show in contrast to the

[10] The margins for Table 5 have been calculated based on Model 3.

regression coefficients, is that up to plus and minus two S.D. the margin effects are of equal size, meaning that there is no basin size at which the probability of fatal MID suddenly increases or decreases stronger. Only when comparing the margin for plus one and two S.D., one can note that the change in size does only lead to a 0.1 percentage point decrease in the probability of conflict. This could indicate a possible diminishing effect with an increasing basin size. However, since it is only a very slight decrease in the marginal effect, conclusions cannot be drawn at this point. The marginsplot in Graph 4 visualizes the margins shown in Table 5: Dyads with smaller basin size are more likely to have a higher impact on conflict probability than observations with larger basin size; the size of the marginal effect of basin size is not changing across different levels of basin size. Put the other way around, with an increasing basin size, the probability of conflict continuously decreases. Thus, observations with larger basins are more likely to have a lower impact on conflict probability.

Table 6: Margins of poor country GDP on fatal MID at certain levels of basin size

Margin at	Margin	Std. Err.	95% Confidence Interval	
-2 S.D.	0.005	0.002	0.002	0.008
-1 S.D.	0.001	0.001	-0.000	0.003
Mean	-0.001	0.001	-0.002	-0.000
+1 S.D.	-0.003	0.001	-0.005	-0.002
+2 S.D.	-0.005	0.001	-0.008	-0.003

Table 6 depicts the margins for the first significant interaction term between basin size and the difference in GDP per capita. The coefficient in Model 11 was indicating a weakening effect of the moderator, water abundance, on the relationship between difference in GDP and conflict occurrence. The margins show that the impact of GDP difference on conflict probability decreases by 0.1 percentage points with a basin of mean size. With a basin size of plus one or two S.D. the impact of difference in GDP on fatal MID decreases by 0.2 percentage points respectively. That is, at a basin of size plus one S.D. the impact of the difference in GDP on conflict risk decreases by 0.3 percentage point; at a basin of size plus two S.D., the impact decreases by 0.5 percentage points. Thus, the larger a basin is, the lower the weakening effect of the moderator. In contrast, with a basin size from minus one S.D. on, the moderator's effect goes into reverse: at this size of a basin, the effect of GDP difference on conflict probability increases by 0.1 percentage points; at a basin size of minus two S.D. it increases by 0.5 percentage points. In other words, once a basin is of a size smaller than the mean, water abundance increases the effect of economic inequality on conflict probability. Graph 5 depicts the marginal effects shown in the table above. One can see the different effects the moderator can have: while smaller basin sizes lead to a strengthening effect of the difference in GDP on the conflict probability, the larger a basin the weaker is the effect of economic inequality on conflict risk. The marginal effects between the different basin sizes are predominantly the same with 0.2 percentage points.

Graph 5: Average Marginal Effects of difference in GDP per capita on fatal MID for different basin sizes

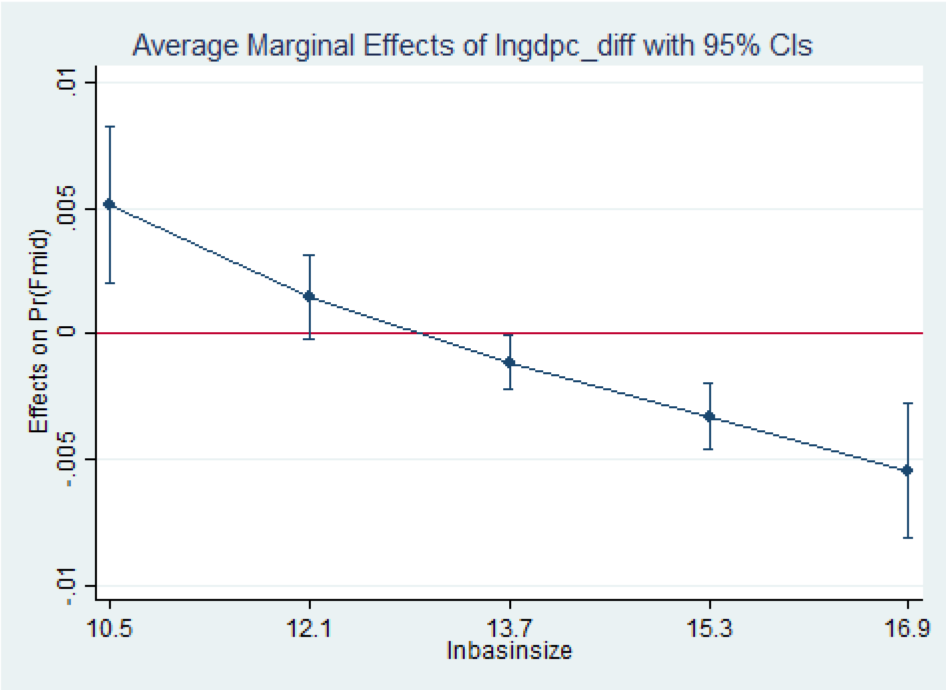
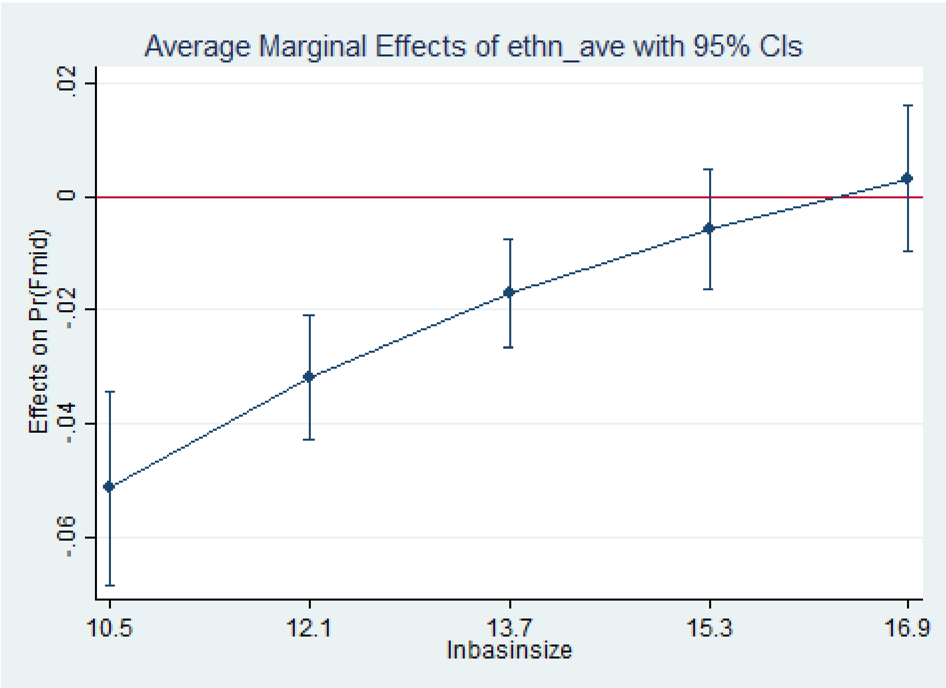


Table 7: Margins of ethnic fractionalization on fatal MID at certain levels of basin size

Margin at	Margin	Std. Err.	95% Confidence Interval	
-2 S.D.	-0.051	0.009	-0.068	-0.034
-1 S.D.	-0.032	0.006	-0.043	-0.021
Mean	-0.017	0.005	-0.027	-0.007
+1 S.D.	-0.006	0.005	-0.016	0.005
+2 S.D.	0.003	0.007	-0.010	0.016

The margins for the second interaction term between ethnic fractionalization and water abundance are shown in Table 7. The coefficient in Model 12 indicated that water abundance would have a weakening effect on the link between ethnic fractionalization and conflict risk. The margins show that with a basin size at the mean, the impact of ethnic fractionalization on fatal MID decreases by 1.7 percentage points. With a smaller basin size of minus two S.D., the impact even decreases by 5.1 percentage points. One can note that with a decreasing basin size, the margins become slightly bigger. From a basin size of plus one S.D. to the mean, the effect of ethnic fractionalization decreases by 1.1 percentage points; subsequently it decreases by 1.5 and 1.9 percentage points with a basin size of minus one and minus two S.D. respectively. The marginal effects suggest that with a basin of a smaller size, the weakening effect on the relation between ethnic fractionalization and fatal MID becomes stronger. In contrast, if a basin reaches a two plus S.D. size, the moderating effect goes into reverse and the impact of ethnic fractionalization on conflict risk increases by 0.03 percentage points. Water is thus not a clear weakening moderator but from some water level on it increases the ethnic fractionalization's decreasing effect on conflict probability. Thus, Hypothesis 5 cannot be supported. However, the results suggest that from some abundance level on, grievances' impact on conflict is likely to become stronger.

Graph 6: Average Marginal Effects of ethnic fractionalization on fatal MID for different basin sizes



Graph 6 visualizes the marginal effects of ethnic fractionalization on conflict probability for the chosen representative values of water basin sizes. Just as the table had shown, the marginal effect decreases as the water basin size increases which means that ethnic fractionalization as the second grievance indicator is less likely to have an impact on conflict occurrence when basins are larger. Yet, once water basins reach a size of plus two S.D., ethnic fractionalization's decreasing effect on the probability of conflict becomes stronger.

6. Discussion of Results

While each of the variables included in the analysis seemed to have a significant influence on interstate dispute on the bivariate level, the results do turn out to be much more diverse when changing the model specificities. The main predictor, water abundance, shows throughout the main analysis as well as the robustness checks an effect that had not been expected in the theoretical argument of this paper: water abundance decreases conflict likelihood instead of increasing it. Thus, Hypothesis 1 has to be rejected and up to this point, given the characteristics of this analysis, it does not seem like water abundance can be a curse. The results are largely robust (except for Model 5 and 7), as changes in the variables added to the model or including time components and a lagged dependent variable do not change the impact of water abundance. The fact that the variable turns out insignificant in Model 5 and 7 indicates that the variable's observations are not completely independent but clustered. The margins show that different sizes of water basins have a relatively continuous effect on the decrease of conflict risk: the effect of water abundance on conflict decreases with an increasing basin size. The fact that water abundance seems to be decreasing conflict will confirm the expectations and arguments of a large amount of researchers: it seems that for now the pure availability is more important than the actual access as this is in larger basins something that has to be less worried about. The possible monetary benefits or grievances that have been argued to possibly come up when water is abundant do thus not seem to constitute a reason to engage in interstate disputes.

One of the main mechanisms justifying a possible link between water abundance and interstate conflict occurrence was for greed to be a motivator to engage in conflict over water. The first indicator for greed, the poorer country's GDP per capita, is significant throughout all the Models (1-8). As expected, the higher the poorer country's GDP per capita, the lower is the conflict risk. Thus, it can be confirmed that a higher level of income within a country dyad decreases greedy motivations to engage in conflict. That is, with an increasing level of GDP per capita the costs of conflict are likely to be perceived as too high since the respective country could end up losing the achieved living standard. Since this result does not actually say whether water abundance is crucial for the link, an interaction term with poor country GDP as the predictor and water abundance as the moderator was tested. The interaction term turns out insignificant, meaning that the link between the poorer country's GDP and conflict risk is not changed through the availability of water. Thus, Hypothesis 2 can only partly be confirmed: a higher GDP per capita of the poorer country in a dyad does indeed decrease the conflict risk. However, this effect cannot be ascribed to the abundance of water.

The second indicator for greed, an upstream/downstream relationship, was expected to increase the occurrence of fatal MIDs since the dependence on another state's behavior could motivate greedy actions trying to secure one's benefits. As expected, the variable does indeed increase the risk of interstate conflict. The association is robust as it persists throughout all the models in the main analysis as well as the robustness checks. This result does partly confirm the third hypothesis, meaning that an upstream/downstream relationship does build a struggle about authority which can easily end in conflict. However, when testing for an interaction term with water abundance as a possible moderator in the relationship, the result turns out insignificant. Water abundance does thus not have an implication on the link between upstream/downstream relationship and interstate conflict which is why Hypothesis 3 cannot be outright confirmed.

In order to proxy the possible link between the second main explanatory concept, grievance, and conflict occurrence, two further main independent variables were tested: the difference in GDP per capita within a country dyad as an indicator for economic inequality and the average ethnic fractionalization as an indicator for the possibility of cultural clashes. Economic inequality does not have a robust influence on the occurrence of fatal MIDs. In those models where it does turn out significant, it affects conflict occurrence in the opposite direction than it was expected: Instead of increasing the conflict likelihood, economic inequality decreases the conflict risk. In all the basic models, except for the bivariate one, the variable had turned out insignificant. But once the time component (Model 6) was added or random effects (Model 7) and the model without the outliers was run (Model 8) it turned out to be a significant predictor. The change in significance in Model 6 (time component) and 7 (random effects) can have occurred due to the time component, meaning that economic inequality does not influence conflict risk in the same year but only over time. Furthermore, the outliers that had still been included in previous models could have biased the results of economic inequality to an extent that it turned out insignificant in Model 8. One possible explanation for this unexpected association between economic inequality and interstate conflict could be that a higher economic inequality within a dyad means that one of the countries may live through grievances but simply not possess the means to fight the economically stronger state which is why conflict is avoided.

The interaction term further tested how the link between economic inequality and fatal MID occurrence changes through water abundance's influence. The interaction showed that water abundance weakens the effect of economic equality on interstate conflict. The margins show that this direction of the moderator applies with an increasing water basin size: Thus, increasing water abundance weakens the impact of economic inequality on interstate conflict. In contrast, basins smaller than the mean exert a strengthening effect on the relationship. Thus, Hypothesis 4 cannot be confirmed since first, economic inequality's impact on conflict occurrence is in the opposite direction than expected and second, the margins show that economic inequality becomes increasingly important when basins are smaller, that is, less water is available. This result suggests the contrast of water abundance as a curse and suggests what plenty of researchers claim: water scarcity fosters grievances.

The second indicator for grievances, ethnic fractionalization, was expected to increase the conflict risk as an increasing degree of ethnic fractionalization would increase the probability of clashing interests, for instance in consequence of relocation due to the commercialization of abundant water resources. However, the variable turned out to decrease conflict risk throughout all the models except for Model 5. The non-significance of the predictor in that model can possibly be ascribed to a certain degree of heteroscedasticity, that is, some of the observations being clustered, in the data that had driven some of the results in previous models. Just as for the previous indicators, it was tested with an interaction term whether water abundance changes the relationship between this second grievance indicator and interstate conflict. The results show that water basin size weakens the impact of ethnic fractionalization on conflict risk. Only from an increasing size of basin on (plus two S.D.) the effect turns out to be strengthening the impact of ethnic fractionalization on conflict meaning that the larger a water resource is, the more does fractionalization contribute to a lower conflict risk. Thus, Hypothesis 5 has to be rejected as ethnic fractionalization does not influence interstate conflict as it had been expected. A possible explanation for this direction of the link is that ethnic fractionalization in abundant waters may be less of a grievance factor contributing to interest clashes. Instead, it is possible that larger basins also come along with a wider distribution of ethnic groups due to the larger areas which is why actual fights may become less likely.

As for the control variables, dyads consisting of democratic states do, in line with the democratic peace theory, reduce the conflict risk. In contrast, unconsolidated regimes were not found to have a significant influence on conflict risk. Contiguity is a clear conflict-inducing factor and its effect is robust throughout all the models. A longer peace history between the two countries of a dyad does, in line with the theoretical expectations reduce the occurrence of fatal MIDs. The difference in military capability did not turn out to be a significant predictor of conflict risk, nor did dyad trade and shared IGO membership. Especially the last variable, IGO membership, had been expected to be a significant predictor as it was used as an indicator for a possible cooperation mechanism and abilities to settle disputes peacefully between two countries. However, the indicator was not very accurate as it clearly does not capture whether an actual cooperation agreement between two countries does exist or not. When it comes to the time component in the research, the results have shown the following: First, the risk of fatal MIDs does increase over time and second, when using a lagged dependent variable all predictors turned out to significantly influence conflict occurrence in the following year. Since this analysis covered a rather large time frame, it has been checked whether a different time cut-off would have made a difference. However, a regression only researching the dyads after 1945 has not led to different results.[11]

7. Conclusion

This paper aimed to find out if water abundance can, just as other resources like diamonds and gold are argued to be, be a curse for a country's level of conflict. Following the concept of the resource curse it had been expected that larger international water resources would be linked to a higher occurrence of interstate conflict. Using the example of shared water basins, the analysis focused on two possible mechanisms that would link water abundance and conflict: first, greedy actions trying to appropriate the possible monetary value of water could be a conflict trigger and second, the social consequences of the commercialization of water resources was also expected to increase clashes of interest and hence lead to conflict. Multivariate logistic regressions with different model specificities were run in order to find out whether a water curse is at hand or not. Several robustness checks, interaction terms and marginal effects were further examined in order to answer the research question.

In conclusion and given the operationalization and choice of variables in this context, water is not a curse. Instead, larger water basins have been found throughout all the models to decrease conflict risk. Hence, this finding does not support a water curse hypothesis, but rather supports those researchers who have been arguing that scarcer water resources (in this

[11] See Table 9 in the Appendix.

context smaller basins) would be linked to higher conflict risk instead. In order to shed light on the possible mechanisms linking water abundance and conflict, four different indicators for greed and grievance have been examined. It can be concluded that greed does significantly influence conflict risk, but only if not set in relation to water abundance. In contrast, grievances' influence on conflict did not turn out as expected. First, grievances decrease the conflict risk among river-sharing dyads and second, the interaction term showed that their influence becomes stronger with decreasing basin size. This means that when set in relation to the size of water basins, grievances are more important if water is less abundant which is exactly the contrary of what had been hypothesized. Given the large sample size in this research, one may tend to generalize the findings, meaning that water abundance does not increase but decrease conflict risk which is why water abundance is not a curse.

The reason for abundant water resources not being a curse could be ascribed to the possibility that the costs of conflict are still too high compared to the possible monetary gains that parties can appropriate for themselves through the commercialization of water. Yet, one should not underestimate the possible conflicts that can arise when water resources are abundant and rashly rule out a possible water curse. In fact, the improvement of methodological factors would make it worth to research the link between water abundance and conflict in a different setting. First, a strong improvement of the indicators is necessary. This starts with the problem that the size of water basins does not actually indicate the availability or the access to those water resources. Furthermore, it does not capture the potential monetary value of those river basins. For instance, there is no information about the amount of dams or hydropower plants in a basin. Those numbers could help to indicate how the respective water resources are used and what capacities they entail. In this context, technical and political science research need to cooperate more in order to create appropriate datasets that are understandable for both sides. In relation to this, it would also be a benefit to be able to capture demand pressures in relation to water resources as the simple amount of water will never capture the actual pressure on those resources or their distribution. Second, as this paper did only present a first glance at a possible resource curse, future research could focus on how water abundance and conflict are linked in different settings of development – that is, developing, transitioning and developed countries. Unfortunately, this could not be realized in the context of this paper since the categorization of the countries has to be chosen wisely given the time-series cross-sectional data and the fact that some countries that may have been developing countries in the past are not so anymore today. Third, future research may examine water as a curse on an intrastate level as this is what the concept of the resource curse originally focused on.

As for the indicators of grievance and greed, they should be improved since the ones chosen in this context (poor country GDP, economic inequality, ethnic fractionalization) may have concentrated on the dyad's characteristic but not clearly been in relation to the shared basin. For instance, information about who controls the dams and water flows in a region, which parties benefit from the hydropower generated with the water resources as well as a number of the people that have been relocated in the basin area would certainly improve the research.

For both, researchers and policy makers, it will further be crucial to shed more light on the cooperation mechanisms in relation to water availability. The shared IGO membership as an indicator for a possible cooperation mechanism is quite decoupled from what it is supposed to measure. It would be interesting to analyze if a variable that actually indicates whether an institutional agreement over the respective river basin does exist has implications on the link between water abundance and conflict. The fact that the results indicate that smaller water basins are linked to more conflict means that policy makers should increasingly but not exclusively focus on those small water basins, trying to establish robust conflict resolution and prevention mechanisms in order to avoid risking conflict. In any event, cooperation will also be crucial in larger basins as they do not only contain more water that has to be managed adequately but further could be future sites of conflict if the pressure and demand for water is to increase in the following years and decades.

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Appendix

A) Validity and Reliability

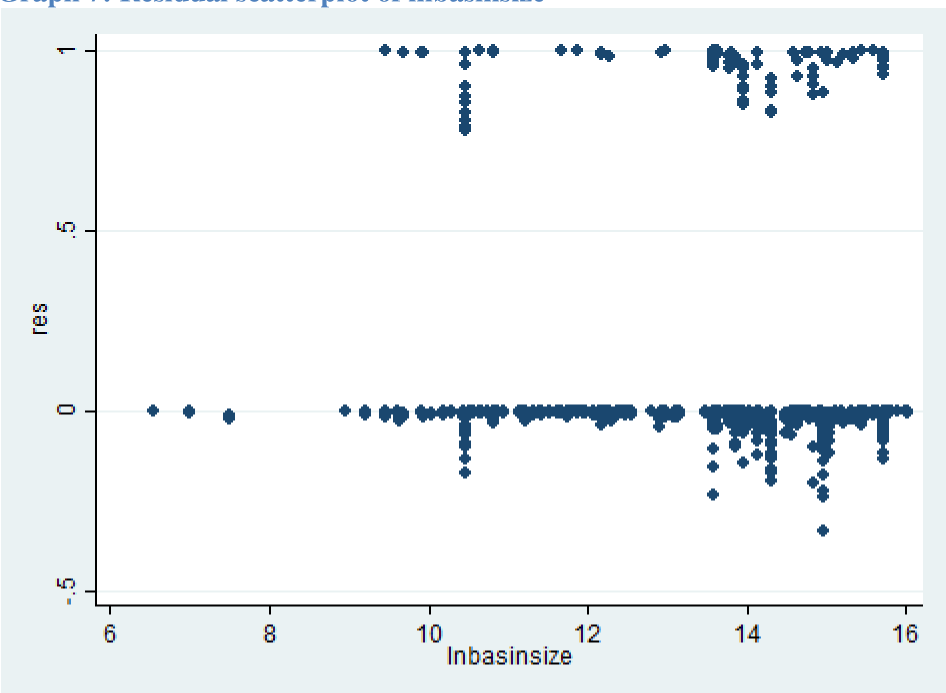
a. Multicollinearity

Table 8: VIF and Tolerance Values

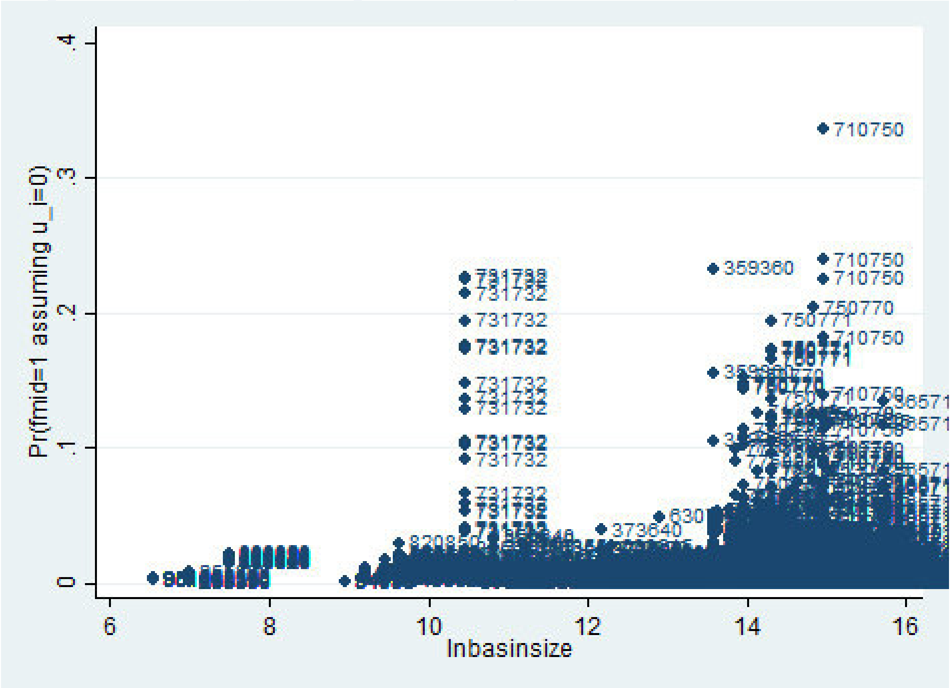
	VIF	Tolerance
Basin size	1.36	0.736
Poor country GDP per capita	3.29	0.304
Upstream/downstream	1.10	0.911
Difference in GDP per capita	1.24	0.807
Ethnic fractionalization	2.27	0.441
Two democracies	1.83	0.546
Unconsolidated	1.14	0.877
Contiguity	1.74	0.891
Peace history	1.08	0.922
Difference in military cabability	1.49	0.672
Shared IGO membership	1.74	0.574
Dyad trade	1.84	0.544
Mean VIF	1.63	

b. Multicollinearity

Graph 7: Residual scatterplot of lnbasinsize



Graph 8: Probability scatterplot detecting outliers



B) Alternative Model Specifications

Table 9: Regression Model 3 with alternative time cut-off (only post-1945)

DV: fatal MID	**Model 3a**
Basin size	0.870***
	(0.034)
Small GDP per capita	0.648***
	(0.066)
Upstream/downstream	1.353**
	(0.176)
Difference in GDP per capita	0.957
	(0.044)
Ethnic fractionalization	0.275***
	(0.102)
Two democracies	0.443***
	(0.130)
Unconsolidated	1.138
	(0.158)
Contiguity	7.486***
	(1.513)
Peace history	0.070***
	(0.011)
Difference in military capability	1.081**
	(0.036)
Constant	1.257 (1.410)
N	17,800
Pseudo R^2/rho (Model 7)	0.213
Classification -Sensitivity -Specificity	85.22% 61.89% 85.61%

*p<.10 **p<.05 ***p<.01. Standard errors within parentheses. Data: Brochmann/Gleditsch 2012.