INTERNATIONAL RIVER ORGANISATIONS, CONFLICT AND COOPERATION

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Master thesis

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26 November 2009

Acknowledgements

Writing this master thesis would not be possible without the support of several people.
First and foremost I would like to thank my great husband and three kids for patiently giving me time and space to reach this goal. I would also thank my husband for critically reviewing my work continually in the process.

Three people have been particularly helpful during this process. I am very grateful for all support, good advice and quick responses from my supervisor, Nils Petter Gleditsch. I have felt great support all along the process from him. He is an Icon. Many thanks also to Marit Brochmann, my second advisor, who has been there all along the process, helping me suggesting literature, giving me skilled considerations and a great deal of technical support with the analyses. And finally many thanks to Håvard Hegre for valuable comments on my statistical analyses and methods used. His knowledge impresses me.

Thanks to Stine Otterbekk and Olav Skarpaas for answering all kind of questions regarding the analyses and statistical methods used. Thanks also to my very good friend Wendy Kingston for reviewing my thesis.

The Department of Political Science at the University of Oslo has been very helpful in arranging my study progress. Being a part time student with three kids gave the department some challenges that they solved perfectly. A special thanks to Siv Håberg for her support. Thanks to the Centre for the Study of Civil War (CSCW) at the International Peace Research Institute in Oslo (PRIO) for letting me use their facilities while writing this master thesis

Finally I am grateful for living in this peaceful and wonderful country, which gives great opportunities for ordinary people. I feel I have won the world lottery.

Oslo, November 2009 word count: 29,666
Camilla Edi Hille

"But the water problems of our world need not be only a cause of tension; they can also be a catalyst for cooperation…If we work together, a secure and sustainable water future can be ours." Kofi Annan (World Day for Water, 22 March 2002).[1]

Source: www.waterwar.com

[1] See: www.un.org/News/Press/docs/2002/sgsm8139.doc.htm.

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1 Research question

Do countries that share a river and also have an international river organization have more cooperation and less conflict, compared to countries without such organizations?

1.1 Introduction

In the post-Cold War world, scholars as well as the general public have increasingly focused on the scarcity and abundance of natural resources as potential causes of conflict. This thesis focuses on freshwater resources shared by two or more states.

Some scholars have found that countries that share a river have a higher risk of fatal military disputes (Gleditsch et al., 2006). From water-abundant areas like Norway to the arid Middle East, water resources may generate conflicts of interest. Without strategies to anticipate and mediate between competing users of water, both within and across borders, water conflicts are likely to become more frequent. Water is a resource for which there is no obvious substitute, and cross-national water resources are regulated by poorly developed international law. Water users at all levels compete for this economic and life-essential resource. This calls for satisfactory management solutions.

In this field, we can divide researchers into two broad approaches; the neomalthusian and the cornucopian (Gleditsch, 2003). Cornucopians hold the optimistic view that technology, distribution and well-functioning markets will prevent future scarcities from becoming critical. According to the cornucopian view, there is no inherent scarcity, only unequal distribution and inefficient use. In this perspective, states that share a scarce resource are more likely to cooperate than to end up in a violent dispute. Institutions can play an important role in meeting the challenge of scarcity. For instance, an international river organization may help different actors cooperate in regulating the use of a resource in the best common interest. The organisation may be able to prevent conflict and find sustainable and mutually agreeable solutions. If the cornucopians are right, there will be less conflict and more cooperation over shared

resources. In this study, I will investigate if international river organisations have a significant effect on conflict and cooperation, although for reasons to be explained later, the empirical analysis of cooperation remains very limited.

The opposing, neomalthusian view is more pessimistic and predicts increasing conflict over scarce resources. In hard-core realism a scarce resource is very likely to cause conflict, from minor disputes to war. Not only is there unequal distribution, there are also global resource scarcities, which technological innovation cannot eliminate. The Intergovernmental Panel on Climate Change (IPCC, 2001, 2008) firmly established climate change as a political issue on the global agenda. Climate change seems likely to generate major changes in our ecosystem, which can change water access for many people. With deteriorating access to natural resources, a neomalthusian view predicts increasing conflicts. Even if the most drastic future scenarios are unsubstantiated, a number of reports and policy statements underscore that climate change may become a security threat (Nordås & Gleditsch, 2007). In the neomalthusian view, an essential resource like water is likely to be a resource worth fighting for.

The neomalthusian and cornucopian views serve as a background picture for this thesis. My theoretical framework is neoliberal institutionalism. I will try to find out if international river organizations have any effect on cooperation and conflict between countries that share a river basin. Neoliberal institutionalism emphasizes that institutions have an important role to play in international relations, regardless of whether one is a liberal or a realist, an optimist or a pessimist. Neoliberal institutionalism will be explored in greater detail later in Section 2.1. First, I outline some terms which I use frequently.

1.2 Definitions

A dyad is defined as a pair of two countries. A dyad-year is a dyad for a particular year.

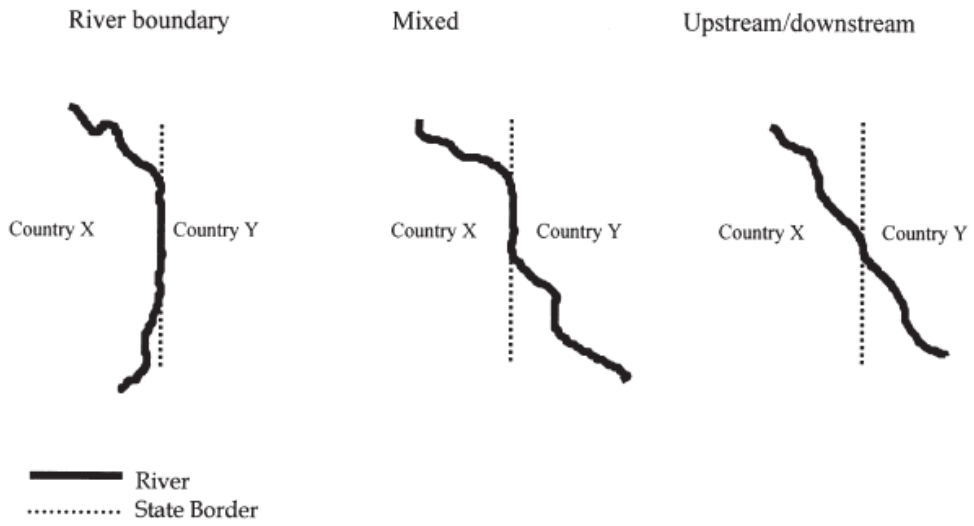
Integrated Water Resources Management (IWRM) is defined as: "process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (Global Water Partnership, 2000: 22). This holistic approach to water management has been promoted as a central answer to the question of how to manage shared water resources and avoid conflict (Dombrowsky, 2007: 7). This concept lays the foundation for the establishment of international river organizations.

An international river is defined by the Convention on the law of the non-navigational Uses of International Watercourses[2], as a river that flows through or forms a boundary between two or more countries. Thus, an international river can serve as a boundary between two states, as does the Rio Grande on the border between the USA and Mexico. A river can also cross the border, making one state upstream from the other. Some rivers run both across and along boundaries, as illustrated in Figure 1. A state can be upstream to one of its neighbors and downstream to another, and even upstream and downstream to the same state, in different river basins. A river can cross a border several times, then cross a border to a third state before again crossing back to the state where it originated. This complicates the relationship between states regarding management and ownership of the resource. Like dyads with rivers running across the boundary probably would be expected to give rise to resource scarcity-related conflict, while in dyads where the river forms the boundary conflict may arise because river boundaries are fluid and fuzzy. Scholars have found support in a multivariate analysis, that shared water basins predict an increased propensity for conflict, but support for

[2] http://untreaty.un.org/

the fuzzy boundary scenario was not found. Neither did they find that the number of river crossings or the share of the basin upstream are significantly related to conflict (Gleditsch et al., 2006: 361).They did, however, find that basin size is significantly associated with conflict. I will investigate basin size together with international river organizations in my analyses later in Chapter 5, but I will not distinguish between how states share a river (Fig. 1). I have to leave that challenge to another researcher for capacity reasons.

Fig.1. Typology of shared rivers



Source: Toset et al. (2000: 980).

An *International river basin* can be defined as "the area which contributes hydrologically (including both surface and groundwater) to a first order stream, which in turn, is defined by its outlet to the ocean or a terminal (closed) lake or inland sea" (Wolf 1999: 389) According to this definition a river is international when any tributary crosses the border between two or more states. This gives a total of 263 International river basins, and 86 of them are shared by three or more states.[3] Approximately 40% of the world's population lives in international river basins, and the international river basins cover 45% of the earth's surface and account for 60% of

[3] This total of 263 international river basins is not regarded as 100% complete, but includes all important shared rivers (Dombrowsky, 2007).

the global freshwater flow, using this definition. 145 states share an international river (Dombrowsky, 2007: 4). These figures illustrate the importance of well-functioning water management, especially considering water as an increasingly scarce resource. Gleditsch et al., (2006), Toset et al., (2000), and Brochmann & Gleditsch, (2006), all focus on shared water and conflict. Brochmann & Gleditsch (2006) emphasize in addition that shared water resources can increase cooperation between dyads.

An *intergovernmental organization (IGO)* is defined as a "formal, continuous institution established by treaty or other agreement between governments with a long-range purpose. IGOs are multilateral; (…) there must be three or more members. They have secretariats to record their activities and monitor their affairs and they meet more or less regularly" (Russett & Oneal, 2001: 160).

An *International river (basin) organization:*[4] While an *international river basin organization* aims to cover the whole geographical area which contributes hydrologically to the river, an *international river organization* often only covers parts of a river. In the following I do not distinguish between them and will refer to them as international river organizations (IROs). The definition used here relates to formal, government-based institutions specifically designed for the management of international river basins. An organization does not need to be multilateral to be included, as long as it is formalized between governments. No less than 57 of the 86 organizations included in this study are bilateral, in line with Dombrowsky (2007, Table A-1[5]). While the term 'institution' is often used to refer to treaties and other legal agreements and 'organization' to a body set up to monitor compliance with the agreements, I use the terms interchangeably here to refer to the organization. Dombrowsky (2007: 118) found that the 86 IROs that she identified vary greatly in geographical and substantive scope, form and function. For instance, some have large secretariats whereas others have limited staff and play a minor role. Most of the IROs

[4] I use IRO as an abbreviation for international river (basin) organization. Other scholars use RBO or IRBO, but they refer to the same organizations.

have monitoring functions but few have effective enforcement mechanisms. Some have the power to implement projects, while others do not. I will return to the implication of this later in Section 3.2 but I do not use these differences between the IROs in the statistical analysis.

Cooperation: A wide definition is joint operation or action. Another, more feasible for this thesis, is "voluntarily arrangement in which two or more parties engage in a mutually beneficial exchange, instead of competing. Cooperation can happen where resources adequate for both parties exist, or are created by their interaction"[6] Liberal peace theory emphasizes cooperation as one of the main pillars of peace together with democratic regimes and durable trade ties (Russett & Oneal, 2001). Trade and joint membership in international organizations are important forms of cooperation and I will use them as indicators in the statistical analyses.

Conflict: While 'conflict' may broadly be interpreted as 'conflict of interest' or 'conflict of values', I will use it here mostly as a short-hand term for armed conflict. To qualify as a war in the best-known statistical source of war data, an armed conflict needs to have a minimum of 1,000 battle deaths in a single year[7]. It is unreasonable to expect many conflicts over shared water resources to escalate to this level (Toset et al., 2000). The UCDP/PRIO dataset on armed conflict has a lower threshold of 25 battle deaths per year (Gleditsch et al., 2002). Even that threshold is a bit high, and the data are backdated only to 1946. For these reasons, previous statistical studies of shared rivers and conflict have used the Militarized Interstate Dispute (MID) dataset, also from the Correlates of War Project. MIDs include less regularly a range of low-level hostilities including threats to use force and displays of force, and they use the following definition:

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[5] See also Dombrowsky (2007: 329ff.).

[6] (www.businessdictionary.com).

[7] See www.correlatesofwar.org for further information regarding this project and for the data.

> Militarized interstate disputes are united historical cases of conflict in which the threat, display or use of military force short of war by one member state is explicitly directed towards the government, official representatives, official forces, property, or territory of another state. Disputes are composed of incidents that range in intensity from threats to use force to actual combat short of war (www.correlatesofwar.org).

I return to a discussion of the dependent variable, conflict, in Section 4.4.2.

State vs. *country* vs. *nation*: Although in some studies, these terms have specific and different meanings, I do not distinguish between them here. Neither do the authors of previous work in this area and those who have generated the datasets.

1.3 The importance of water

We live in a world which changes rapidly. No one can predict the future with any confidence and climate change further increases our uncertainty. Increased human activity may cause stress and deterioration of our natural environment, resulting in climate change, land degradation, loss of biodiversity, deforestation, altered waterways, and declining water resources in some areas. The increasing demand for water is likely to become a great challenge, at the domestic as well as the international level.

The management of water resources is gaining increasing attention. A large number of international conferences have focused on water management[8]. Developing the knowledge and skills to cooperatively manage international rivers is one of the great political and environmental challenges of the 21st century (World Commission on Dams, 2000). So why is water particularly important?

[8] www.conferencealerts.org/water.htm has listed all conferences on water from October 2009 until November 2010. For instance, there is a conference in Batna Algerie on 10 November 2009, "First Conference on the Integrated Water Resources Management", and another in Kyoto, Japan, on 27 October 2010, "International Conference on Sustainable Water Resources Management (ICSWRM).

First of all, freshwater is essential for all living organisms. It is also an indispensable resource needed for states to develop. Water is used as transportation, hydroelectricity, and commodity production. It also has symbolic and sacred value in many religions. The varied uses of freshwater obviously complicate its management.

More than two thirds of the earth's surface is covered by water, but only about 3% is in the form of freshwater. Of all freshwater on earth, less than 15% is found in lakes and rivers (UNEP 1999: 4). A lot more is found in aquifers and glaciers, and on the poles.

In water-abundant countries like Canada or Norway, the resource is often taken for granted. In many other countries, the situation is very different. Egypt has very little rainfall. To feed its population of more than 72 million people, it is completely dependent on water from the Nile. Being downstream from other states makes Egypt dependent and vulnerable.

Controlling waterways and moving water to where it seems most needed are important and unavoidable elements of any country's development policy. For many states where water is a scarce resource, it has high priority on the political agenda, especially when the control of the resource lies in the hands of other states. Controlling water has been a cornerstone of all civilizations. London was established as an economic metropolis for centuries solely because of the river Thames and the highly fluctuating tides, which made it possible for ships to transport goods up the river at high tide (Tvedt, 2007: 8).

Water resources have been used as a means to influence other states, cities, and civilizations at all times. Gleick (2008) categorizes different ways in which water is related to conflict.[9] He divides water conflicts into six different categories, distinguishing between cases where water was a direct cause of conflict and cases where it served as a tool in an ongoing conflict:

[9] The categories are taken from Gleick's water and conflict chronology found at www.worldwater.org/chronology.html.

Control of Water Resources (state and non-state actors): where water supplies or access to water is at the root of tensions.

Military Tool (state actors): where water resources, or water systems themselves, are used by a nation or state as a weapon during a military action.

Political Tool (state and non-state actors): where water resources, or water systems themselves, are used by a nation, state, or non-state actor for a political goal.

Terrorism (non-state actors): where water resources, or water systems, are either targets or tools of violence or coercion by non-state actors.

Military Target (state actors): where water resource systems are targets of military actions by nations or states.

Development Disputes (state and non-state actors): where water resources or water systems are a major source of contention and dispute in the context of economic and social development.

It would have been interesting to investigate tools as well as causes of conflict using these categories. However, this would require substantial recoding of the MID data, which is not possible within the framework of this thesis.

The earliest documented interstate conflict regarding water is a dispute between the Sumerian city-states of Lagash and Umma over the right to exploit boundary channels along the Tigris in 2,500 BCE (Wolf, 1998). Approximately 500 years ago Machiavelli and Leonardo da Vinci planned to divert water from the Arno River to weaken Pisa which had a conflict with Firenze. In 1957 India and Pakistan started negotiations after India had stopped water supply to Lahore (Tvedt, 2007: 10). Since independence in 1947, Pakistan and India have been engaged in a bitter conflict regarding Kashmir. Controlling Kashmir means controlling water, among other resources. India and Pakistan have fought three wars since independence in 1947, but none of them can be directly attributed to water issues. Rivers flowing to Pakistan from the Indian-administered part of the disputed state of Jammu and Kashmir have newly emerged as a bilateral flashpoint, since India started a controversial project on

the Chenab River that will reduce water flow into Pakistan. The rights to the water of Chenab were assigned to Pakistan by the Indus Water Treaty from 1960 (www.isn.ethz.ch/).

China is upstream in the Mekong river basin, but does not cooperate with the other states sharing the Mekong River. Cambodia, Laos, Thailand, and Vietnam are members of Mekong River Commission (MRC), while China and Myanmar are observers. China is building dams upstream which will influence the downstream states (Tvedt, 2007: 18). China's increasing demand for water have also made the Chinese government discuss leading water out of the Brahmaputra Basin, which is of great economic and mythical value for India and Bangladesh (Tvedt, 2007: 114). States that are highly dependent on upstream water resources that they do not control become very vulnerable. When there is an acute conflict of interest, there is a risk of armed conflict and the need to develop cooperation is all the more urgent. The world's geography is rather fixed, while human adaptation to it is not. The Tibet plateau is the source of many significant rivers, which have shaped the history of Asia, such as Yangtze, Brahmaputra, Yellow River, Indus, Salween, and Mekong. These rivers will be even more significant in the future with rising demands for water, and increased concerns regarding global warming and the melting of the Tibetan glaciers, which serve as a major water reserve in dry periods (Tvedt, 2007: 16). The Tibetan plateau holds the key to the destiny of enormous areas in Asia. If the glaciers melt, there may be increasing droughts as well as floods in the rainy season, and the rivers may alter course. This scenario threatens China's future economic growth and political stability (Tvedt, 2007: 18). Ganges, one of the major rivers in India, gets approximately 45% of its water from glaciers in Himalaya. Predictions state that water flow will decrease by about 67% between every July and September without the contribution from glaciers. This will affect 500 million people and 1/3 of land areas which are under artificial irrigation (Tvedt, 2007: 18). Given the importance of Tibet in this perspective, it is unlikely that China will ever grant Tibet independence.

Water is our most valuable resource, relevant at all levels; political, environmental, religious, economic, etc. Water is used at the micro level and for macro projects. Different uses such as irrigation, industry, transportation, and hydropower all require vast amounts of water. Economic growth frequently leads to a deterioration of freshwater resources (Gleditsch, 2003). Water is very unevenly distributed, so the challenge of deteriorating water quality and quantity differs significantly among regions. Climate change threatens to increase these challenges. Artificially altered waterways such as China's many artificial canals diverting water from the Yangtze River, may contribute to increasing tension, as well as solving problems. The increasing demand for water will lead to greater focus on water management.

The number of IROs is increasing. The Dublin Statement on Water and Sustainable Developments was adopted by several countries in 1992. Its principle number two states that "Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels" (www.gdrc.org/uem/water/dublin-statement.html). This has probably helped to stimulate the formation of new IROs. After 1992, more than thirty[10] IROs have been formed, indicating that such international management will play a more important role between states in the future. The increase in IROs may also indicate a much higher demand for water and a higher awareness of water-related problems. Many states that were previously water-abundant now experience, or will soon experience, scarcity and deteriorating water quality. Some states also experience increased floods. Water will therefore remain a resource high on the political agenda as well as the research agenda.

[10] Source: Dombrowsky (2007: Table A-1). Some organizations may have been founded earlier than her table indicates, but have been reestablished with new members, e.g. because many countries gained independence by the end of the Cold War. The figures are therefore not completely precise.

2.0 Theoretical framework

Theories in international relations (IR) generally take it for granted that all actors are rational. States are faced with many important challenges since they cooperate in an insecure world with no overarching authority with power to enforce laws and regulations. Liberalism and realism hold different views as to how states can cooperate and their willingness to do so. I will first outline some of the basic ideas of realism and liberalism before moving on to neoliberal institutionalism, which borrows from realism as well as from liberalism. I will try to show how the theory suggests why we should expect more peaceful interaction between states that have international institutions. The aim of this thesis is to show that river-specific institutions can have an independent effect on the behaviour of states. My analyses will show whether specific IROs have an independent impact on cooperation and conflicts between states. Conflict and cooperation often fit together like a hand in a glove. Cooperation often emerges out of disagreements. Conversely, cooperation can be a catalyst for future conflict. Cooperation does not mean there will no longer be any disagreements or conflict, rather that there exists a wish to solve disagreements peacefully.

While realists are concerned with relative gains, liberals are more concerned with absolute gains. At the core of realism we have self-interested actors striving for greater relative power. State interaction is all about state survival, leaving little room for cooperation. Classical realism, as explored by e.g. Morgenthau (1948/1985), emphasizes that states' struggle for power drives all interaction between states. Cooperation will only emerge when states see the rationality in it for themselves and their position in the world hierarchy. Liberals sympathize more with idealism, emphasizing the important role of norms and values. Structural realism (neorealism) does not completely reject that liberal ideas are also important in international relations. Within the framework of these main ideas neoliberal institutionalism has evolved.

2.1 Neoliberal institutionalism: The role of institutions

Interdependence between states will generate conflict. When one state's advantage becomes a disadvantage for another, there will be tension and disagreement. Neoliberal institutionalism holds that international institutions can help solve some of these disagreements.

When the use of a shared water resource is inefficient, disputable or one anticipates future conflicts, there is a need to cooperate to manage the use. Both formal and informal rules may be applicable, and reaching an agreement meets many challenges. The need for cooperation and management regarding a resource does not mean that states will succeed in establishing joint management. A common understanding must be reached that cooperation will benefit all and that the risk of degrading the resource is greater with no cooperation. Even knowing this does not necessarily result in efficient cooperation. States often refrain from obligations thinking that keeping their options open may be more beneficial. The lack of commitment can often carry substantial hidden costs. There are many obstacles and actors, both domestic and international, which complicate the process of mutual understanding and joint action. Getting a good general view is almost impossible. The interdependence between states generates tension and conflict, and to avoid violence, states have to adjust their policies to one another. Keohane (2005) argues that this is more necessary now than ever because of the lack of a hegemonic power. Non-hegemonic cooperation is difficult since self-interested states, ordinarily motivated by what is best for them, would have to devote themselves to work for the world's common good. Despite the resistance to cooperation, states have complementary interests that will make cooperation beneficial. One important challenge here is to make states understand these potential benefits from cooperation. Institutional arrangements can play an important role in regulating and manage a resource. Institutions can serve as neutral arenas where states can cooperate and solve conflicts by providing reliable information, reducing uncertainty and minimizing transaction costs (Keohane, 2005: 3). Institutions can facilitate issue linkages both among and within states to help them

find feasible solutions. Cooperation over time through institutions brings states into continuing interaction. In such environments incentives for cheating are reduced and the value of a states' good reputation increases. Institutions play a role to legitimize and delegitimize states' actions (Keohane, 2005). The optimal condition for cooperation through treaties or international organizations are when the expected benefits of the cooperation are high, the transaction cost relatively low, and the member states believe in the sustainability and compliance of the cooperation (Espey & Towfique, 2004). Institutions can be functionally specific, like institutions created for the purpose of solving water-related conflicts, such as the Nile Basin Initiative. Other institutions are more general in nature, such as Organization of African Unity (OAU). In a well-functioning institution, countries can refer disagreements for a peaceful settlement, decreasing the risk of violent conflict (Hensel et al., 2006). With regular contact between member states, norms for peaceful conflict resolution may develop (Russett & Oneal, 2001). This will help states to be adequate and predictable in interaction with other states regarding e.g. natural resources.

Keohane (2005: 52) argues that cooperation in the international system is not harmonious, but an "intensely political process of mutual adjustment in a situation of actual and potential discord". This is in line with Waltz (1959: 182), who states that, "in anarchy there is no automatic harmony". The natural state of the world is conflict and competition. How can institutions evolve under such circumstances? Keohane (2005: 16) builds on both realism and liberalism, arguing that states don't cooperate out of altruism or plight for others, but because they seek security, power, and wealth for their own people. Keohane (2005: 6) further states that we need to go beyond realism not discard it". States cooperate because it is functional for them. International regimes are founded and built to promote an environment where states can pursue their self-interest but at the same time be mutually beneficial to each other. Even on the restrictive premises that states are egoistic, self-interested, and rational, institutions are necessary in order for states to achieve their purpose. A state's conception of its interest and how to pursue its objectives depends on national interests and the distribution of world power, as well as the quantity, quality, and distribution of

information. Agreements that are hard to reach under conditions of high uncertainty may be feasible with the help of well-functioning institutions (Keohane, 2005). States can calculate their own outcomes from participating in an organization, and states are driven by self interest. The functional argument of cooperation between states builds upon this idea. Neoliberal institutionalism builds on both realism and liberalism. The insights realism gives to the understanding of world politics are fundamental and cannot be ignored. However, the concept needs to be reframed and also reflect the impact institutions have on states even when states' rational egoism persists (Keohane, 2005: 245). Keohane emphasizes the important and central role institutions play in international politics, and by that he goes beyond the traditional realism where states are the only principal actor. Joint membership in an organization binds states together in a mutually complex interdependence (Keohane, 2005). Even if states are concerned with relative gains, states also pursue absolute gains because they see the rationality in it; that the cake gets bigger with cooperation and that it is mutually beneficial for all states to cooperate. This fits neatly with the liberal peace argument, which among other things, says that states that trade/cooperate with each other are more peaceful with each other, too. In classical realism cooperation would be difficult because of the importance of state security and relative gains. States prefer to refrain from trading or cooperating rather than lose their relative power advantage over others.

IROs are growing in number, and it is likely that this trend will continue as more attention is given to water as an important resource possibly deteriorating in quantity and quality. Increasing numbers of IROs might be an indicator of more cooperation between member dyads. We might also find that these organizations are present between dyads that have less conflict. In the following I will further explore the need for integrated water management, and how different scholars link resource scarcity to both conflict and cooperation, before conducting my own analyses.

3.0 Earlier research

Earlier research has paid attention to three concerns regarding environmental security: to prevent war and armed conflict as a result of resource scarcity and environmental degradation, to prevent disasters other than war resulting from scarcity and degradation, and to prevent the erosion of the carrying capacity of the earth resulting in the loss of environmental sustainability in the future (Gleditsch, 2001: 177).

Traditional IR theory has always been concerned with state security and the idea that resource scarcity can enhance prospect for conflict. A lot of conflicts are over territory, which is a resource in itself and also a way to control other resources, such as water. While water may seem like an abundant renewable resource, growing population and development creates an increasing demand for it, for uses like irrigation, hydropower, and sanitation. In addition to increasing demand, water is unevenly distributed globally. North America has an annual run-off of approximately 17,000 cubic meters per person per year (UNEP, 1999: 4). In comparison, Africa has 6,000 and Egypt just 50 (Gleditsch et al., 2006: 363). Off all the world's usable freshwater, less than 1% is found in the Middle East or North Africa, and this region contains 5% of the world's population. Many countries with lower water availability today, particularly in Africa, also have population growth, so their water shortages may be exacerbated in the future (Toset et al., 2000: 974). Scholars have therefore predicted more conflict in areas with water scarcities like the Middle East and Northern Africa. According to UNEP (1999: 6), two out of three persons will live with poor water conditions by 2025 if the world continues to develop at the same pace as today. Since water is a renewable resource, there is reason to believe that abundant amounts of water not will create conflicts to the same extent as non-renewable resources like gold, diamonds, oil etc. However, conflicts may arise where water is a scarce resource, and many actors demand the use of it or where the water is affluent but the distribution is skewed.

3.1 Earlier research on resource scarcity, conflict, and cooperation

Thomas Homer-Dixon (1994, 1999) and his associates have conducted the largest and best known body of work linking resource scarcity and environmental degradation to

conflict. They concluded that resource scarcity has an effect and contributes to violent conflicts in many parts of the developing world. These conclusions are based on a number of case studies. Homer-Dixon (1994) claims that conflict will increase even further in the future, since greater demand and increasing environmental degradation will lead to more severe resource scarcities. His main focus has been on non-renewable resources, but among the renewable resources he argues that water has the greatest potential for stimulating international war, although only under special conditions (Homer-Dixon, 1994: 18). This is in line with the neomalthusian approach that generally expects conflicts to arise from increasing scarcities. However the empirical evidence comes largely from case studies of countries in conflict and it is difficult to draw general conclusions. Many other scholars also predict "water wars" or describe historic conflicts over water. So far, there are not many published large-n studies of water and interstate conflict. Toset, Gleditsch & Hegre (2000) showed that the probability of a militarized, interstate dispute in a dyad increases when a dyad shares a river. In a later related study (Gleditsch et al., 2006) found that states that share a river, particularly when the river is crossing rather than running along a border, have an increased risk of conflict, even when controlling for other relevant variables used in the study of interstate conflict. Klare (2001) argues that after the decline of ideological conflicts the struggle for essential life resources will grow, and water in particular. Klare (2001: 57) claims that by 2050 the increased demand for water may create intense competition for this essential resource in all but a few well-watered areas of the planet. Homer-Dixon (1994, 1999), Klare (2001) and Gleditsch et al. (2006), are far from the only scholars predicting conflicts regarding water. We also see a growing concern among politicians and in the media. UN Secretary General Ban Ki-moon warns that water shortages will drive future conflicts (www.un.org). To emphasize the water war scenario, the examples most widely used are conflicts between Israel and neighboring states. The Jordan River has been named as a contributing factor both in the 1967 war between Israel and its Arab neighbors and in the 1982 Israeli invasion of Lebanon.

Other scholars argue that a pessimistic future water war scenario is unjustified and that states can cooperate to overcome resource scarcity. According to Wolf (1998), the problem with the example of Israel and its Arab neighbors is a complete lack of evidence that water was a significant casual factor. Wolf (1998), states that shots have been fired over water between Israel and Syria e.g. in 1951 and 1964–66. The latter conflict regarding water arose because Syria diverted water from the Banias Stream before the water entered Israel. This conflict was solved one year prior to the seven day war in 1967, and water was not a significant factor in that war (Wolf 1998). Wolf et al. (2003) identify 1,831 transboundary water-related events between 1950 and 2000. Almost two thirds of them were classified as cooperative whereas only one third as conflictive. Of that third, only 37 events involved violence and 30 of them took place between Israel and its neighbors before 1970. This provides a good empirical foundation for the view that states are more inclined to cooperate than to conduct armed conflicts over shared water resources. This is in line with the cornucopian view and neoliberal institutionalism. But even though there is little evidence that water historically has created few conflicts, the problem remains that the demand for water increases in certain areas of the world. Wolf (2003) stresses that water scarcity is a major challenge. An uneven distribution of water is a potential cause of local and international strife, although cooperation remains more likely. It is precisely the concern for future water scarcity that will stimulate cooperation. He views full-scale water wars as very unlikely (Wolf, 1997; Gleditsch, 2003: 481). Wolf (1998) states that the history of shared international water *resources* is undramatic and that the only war fought over water was 4500 years ago[11]. Drawing on data from the International Crisis Behavior Project, he finds that in modern history only seven minor conflicts have been provoked by international water issues. Internal conflicts regarding watern are much more common, but internal instability may also infuse international water conflicts and political instability between some states in the future. Wolf (1998, 2003)

[11] The earliest documented interstate conflict known is a dispute between the Sumerian city-states of Lagash and Umma over the right to exploit boundary channels along the Tigris in 2,500 BCE (Wolf 1998).

does not completely reject the neomalthusian scenario but is generally more in line with the cornucopians.

Cornucopian and liberal institutionalist scholars have generally focused on the cooperative aspect of environmental scarcity. They do not deny that conflicts occur, but cooperation is more likely (Brochmann, 2005). Brochmann & Gleditsch (2006) find some support for the idea that rivers stimulate cooperation as well as conflicts, but the effects are not strong. Kalpakian (2004) argues that the rational answer to a scarcity of water resources is cooperation. In his case studies he finds support for the claim that water disputes do not cause serious conflicts. This is in accordance with the findings of Wolf (2003).

Most scholarly work in this area agrees that conflicts over water are possible, but differ in their assessment of the hazard of an outbreak of violence and their estimate of its likely intensity. A few scholars fear water wars, while others believe that peaceful negotiations between states are more likely.

3.2 International river organizations

More than 260 river systems are shared by two or more countries, and many of these countries also have a history of conflict (Gleditsch, 2003: 484). A number of countries in these river basins also cooperate through more specific river organizations. Agreements exist in more than 40% of all international river basins. In a quarter of all basins some form of international river basin organization exists (Dombrowsky, 2007: 266). Establishing international river organizations is a relatively new phenomenon. The first one, Central Commission for the Navigation on the Rhine, was not founded until 1815. With increased water stress, the need for better management has become obvious and IROs have multiplied.

Institutionalists emphasize the conflict-reducing effects of institutions. Thus, we expect the existence of a river organization to make a difference in the countries' histories of conflict. Formation of IROs or the conclusion of international bilateral

water treaties seem to be dependent on various characteristics of the rivers. For instance, Espey & Towfique (2004) found that the larger a basin as a percentage of a country's size the more likely the country is to conclude a treaty regarding the resource. The same study also shows that the more control one state has over the water basin, the less likely it is to conclude a treaty. Espey & Towfique (2004) also found a strong relationship between strong trade ties and effective enforcement of agreements. Other probable variables influencing states' willingness to enter into agreements are culture, language, history, distance between the states, regime type, etc.

There are many obstacles to interstate cooperation over shared water resources. Cooperation is often constrained by imbalances in economic, political, and military power between the states that share the resource. International river management also involves social, political, economic, hydrological, and ecological dimensions (Espey & Towfique, 2004). The costs and benefits of cooperation will vary between the states. For some, the costs might be higher than the benefits: for instance one country might experience little water stress, and the shared water source might not be important for the state's overall supply, which naturally will be an incentive for not joining an IRO or other water treaty. The opposite might be the situation for another country that might be highly dependent on the shared water. In addition, imbalances in the power structures, economy, military and policy, will complicate cooperation and lead to disputes and conflicts. Just & Nethanyahu (1998) argue that ''asymmetric country characteristics'' are major obstacles to cooperation, whether real or perceived. Obstacles that restrain cooperation originate from asymmetric information, scientific gaps, technological uncertainties, conflicting national interests, lack of effective enforcement mechanisms, lack of well-functioning institutions, natural claims for sovereignty, and geographical considerations such as an upstream/downstream relationship (Just & Netanyahu 1998: 9). Asymmetries between the states will normally raise the transaction costs and the net benefits from formal arrangements. It is likely that these asymmetries also will be obstacles to informal cooperation. This increases the need for formal arrangements (Espey & Towfique, 2004: 3).

In a realist view, a state will not engage in any form of cooperation which may alter the power balance negatively. Elhance (1999) contradicts this when he says that states refrain from exploiting the water resource unilaterally even if they have the power to do so, and are compelled to seek some form of cooperation with a weaker neighboring state. Statements like these provide some support for the liberal approach: cooperation might happen out of altruism, not only from a hard-core realist appreciation of national interest.

According to international law, a state cannot use shared water resources in a way that might have negative impacts on other countries (Espey & Towfique 2004). Despite international law, not all states comply with the regulations. The interpretation of the law might be different in different states, or some states might not even feel bound by it. The Convention on the Protection and Use of Transboundary Watercourses and International Lakes, from Helsinki 1992, has been ratified by 36 states, which means that it has not been accepted by the majority of states.[12] Conflicts then can arise over the use of the shared resource. Upstream states may feel that they have territorial sovereignty and the right to use the water regardless of the need of downstream states (Espey & Towfique, 2004). The downstream state will try to use international law to prevent an upstream state from depreciating the quality and quantity of water in the basin. Increasing demand and deteriorating water resources give rise to conflict and demonstrate the need for cooperation. International law regarding shared water is in progress. In 1997 the states in the General Assembly of the United Nations ratified the Convention on the Law of the Non-navigational Uses of International Watercourses. To enter into force, the convention requires ratification by 35 states, but as of 2008 only 16 have ratified. Even if the convention is not ratified, the document is regarded as an important step towards arriving at an international law governing water. The convention addresses the principle of equitable and reasonable waterway usage and the "no harm" rule which covers a whole range of interstate relations to protect the environment (Epsey & Towfique 2004: 2). International law and an increasing

[12] See: www.unece.org/env/water/status/lega_wc.htm.

awareness of the growing challenge in water management can serve as an incentive and foundation for states to join different forms of cooperation to develop and improve the water management even further. States can cooperate through treaties, bilateral or multilateral agreements, or through IROs. All cooperation seeks to benefit the participants and different forms of cooperation will only be established if there is currently inefficient management, conflict over water use, or anticipated future conflict. Even these circumstances do not guarantee cooperation between states over water use, but seems to be important conditions. Another seems to be that the gains need to outweigh the costs for all parties (Epsey & Towfique 2004: 2). Treaty formation will be optimal when the expected benefits are relatively high, the transaction costs are relatively low, and the probability of compliance, or sustainability of the treaty, is high (Epsey & Towfique 2004: 3).

In addition, the existing degree of both conflict and cooperation between states and the importance of the water resource to each country will influence the expected benefit from formal arrangements. If states control the resource, if it is not very significant for the overall water supply, or if neighboring states have not experienced conflict over water use, they will probably be less prone to seek joint water management. The benefits will not outweigh the costs. On the other hand, lack of control over the water resource, a history of conflict, and high dependency on water will increase the likelihood of cooperation through formal arrangements (Epsey & Towfique 2004: 3).

One important means to improve management and cooperation between states that share an international river may be to establish, develop, and strengthen international river organizations with influence over the states' resource policies. At the International Conference on Water and the Environment in Dublin in 1992, four guiding principles of water management were established.[13] The basis for this agreement was a rising international awareness of the increased demand and use of water. Poor water management could create negative consequences for our

[13] All principles in full can be read at www.cawater-info.net/bk/water_law/pdf/dublin_statement.pdf.

environment and development. One of the key challenges to water management is to overcome the lack of an overarching authority in an anarchic world, an authority that makes sure international law and agreements are enforced. The principles established at the Dublin conference emphasize the need for holistic and sustainable water management (ICWE, 1992). The conference emphasized that all management has to involve all levels and all interest groups to best protect the ecosystem and prevent deteriorating the water resources (principle one and two). The principles emphasize that water ought to be regarded as an economic good to which all humans have a right to gain access. The Dublin Conference had many participants from more than one hundred states and eighty organizations (ICWE, 1992).

Water is essential for life and is also a multifunctional resource used and needed at all levels in life, agriculture, industry, recreation, habitat for threatened species etc. This multiple use complicates the possibilities for efficient and holistic management.

Water use in transboundary rivers frequently generates both positive as well as negative externalities. These effects are often unidirectional and reciprocal effects are often excluded in the same use. In border rivers, shared lakes and shared aquifers the users affect each other. The mix of both positive and negative externalities complicates the water management (Dombrowsky, 2007). Non-consumptive use like navigation also calls for cooperation, but will probably not be as potent a force as consumptive use. Table 3.1 shows four different types of externalities.

Source: Dombrowsky (2007: 268), Table 8.1.

Table 3.1 A Typology of International Water Management Problems

Type of externality	**Reciprocal**	**Unidirectional**
Negative	Water abstraction from a border river/shared lake or aquifer Wastewater discharge into a border river/shared lake or aquifer	Upstream water abstraction Upstream water pollution
Positive	Wastewater treatment at a border river/shared lake Provision of retention area at a border river	Upstream wastewater treatment Upstream provision of retention Area

It is reasonable to believe that cooperation is more likely in the case of reciprocal externality problems than in the case of unidirectional externality problems, and more likely in the case of positive unidirectional externality problems than of negative unidirectional externality problems (Dombrowsky, 2007: 274).[14]

Numerous actors will claim the right and need to water, and often with legitimate and adequate grounds. It is easy to understand how complicated the management is with multiple domestic actors trying to cooperate in an international river basin, which often have many riparian states, e.g. the Nile which consist of ten basin states. Rules and regulations for water management are unavoidable to secure water quality and quantity, but at the same time extremely complicated. Neoliberal institutionalism believes in international organizations to play an important role in water management in international water basins. This theory was investigated in Section 2.1.

Many rivers have organizations, committees, commissions, and so on to cooperate over different water use, both domestic and between states. This collaboration has often had a sectoral focus, losing sight of the larger picture. Since there are multiple actors and multiple uses of water, holistic water management is essential. Numerous conferences, both domestic and international, develop recommendations regarding water management and point to important global challenges. Guidelines and principles drawn up at international conferences can serve as important instruments for future cooperation and conflict prevention. The need for more integrated and holistic approaches has resulted in the development of the concept of Integrated Water Resources Management (IWRM).

This holistic approach to water management has been promoted as a central answer to the question of how to prevent conflicts and how to manage shared water resources, and plays a predominant role in the prevailing multi-disciplinary policy discourse on

[14] Dombrowsky (2007, particularly Chapter 5) analyses this in detail.

water (Dombrowsky, 2007: 291). Incorporated in IWRM we find the concept of River Basin Management (RBM), which states that the water resource should be managed within the catchment area of the river basin, as we defined under Section 2.1. The aims of these over-arching concepts are to integrate all actors at all levels. The idea of a need for river basin management is not new. We find river organizations that were established almost two hundred years ago, e.g. the previously noted Central Commission for the Navigation on the Rhine[15], founded in 1815. The organization had a narrow focus, cooperating only over the navigational use of the Rhine.

In the last decades we have seen a renewed focus on water management and the development of a legal framework. For instance, river basin management is a legal requirement of the Water Framework Directive of the European Union (EU, 2000). The main ideas behind the integrated water management, through IWRM and RBM, can be summarized as follows: to manage water resources at the level of the river basin, not just at the level of the political jurisdiction of a state, to implement all water using sectors and actors, and to ensure that water resources can best be managed through the set-up of IROs (Dombrowsky, 2007: 10). These organizations' main goal is to secure a sustainable and just use of a common resource, to prevent conflict and enhance cooperation.

A new era of water management started with the International Conference on Water and the environment in Dublin 1992. Major international organizations like the UN and the World Bank support the increasing need for a global policy dialogue on water issues (Dombrowsky, 2007: 10). New global actors such as the World Water Council (WWC) and the Global Water Partnership (GWP) have also emerged. The WWC was established in 1996 and is an international water policy think tank. The WWC is a non-profit and non-governmental umbrella organization that facilitates political commitments to sustainable water management at all levels.[16] The GWP was

[15] See Table A-1 in Appendix 1.

[16] See www.worldwatercouncil.org for additional information.

established in 1996 by the World Bank, the United Nations Development Program (UNDP), and the Swedish International Development agency (SIDA).Their aim is to support and work with all organizations involved in water management[17]. By analyzing statements from different international water conferences, there seems to be a lot of political will in the international community. However, international water management is expected to meet considerable challenges because of the many actors and multiple uses in international river basins. The increased awareness of water issues and a common goal of sustainable water management, gives hopes to the difficult challenge of international cooperation in international water basins. But, all the good intentions need to materialize.

Despite the call for IROs that involve all basin states, more states tend to prefer bilateral agreements. The majority of river organizations established over the last few decades have also had a narrow and sectoral focus. Thus, a few countries might reach an agreement at the expense of other states in the water basin (Dombrowsky, 2007). When not all actors and sectors are being heard, agreements like this might lead to disagreements and conflicts. Who gets to enforce their will upon other actors when there is a conflict of interest? According to realism, the strongest state will generally win and have its requests granted. A strong state will not voluntarily give up their power and influence to an IRO and therefore it still seems to be rare to grant such organizations sufficient authority to influence the behavior of states (Dombrowsky, 2007: 13). One IRO with executive power is the Organization for the Development of the Senegal River (OMSV). Senegal, Mauretania, and Mali are members, while Guinea is still an observer. The organization is dealing with multiple areas like ecology, economic development, hydropower, irrigation, navigation, river regulation, river quality, and river quantity. The organization has autonomy and the power to enter into contracts. All decisions are made unanimously and the decisions are binding for the member states. The countries seek to settle disputes through conciliation and mediation. If this does not succeed, the dispute is taken to the African Union (AU) and

[17] See www.gwpforum.org for additional information.

from there to the International Court of Justice as last appeal tribunal (Dombrowsky, 2007: 13, 349).[18] Unfortunately, organizations with authority like OMSV remain rare. Nevertheless, it is important to develop more such organizations that have a potential to play an important role in international water management (Dombrowsky, 2007). States need strong organizations that benefit all states riparian to an international water basin even if it is difficult to establish them. Building, not to say maintaining, institutions in an anarchic world can be frustrating and difficult when the building blocks do not fit together. However, not all institutions need an effective centralized authority like OMSV. Institutions can also be important and effective when the actors and issues are relatively few. Small and narrow organizations can serve as a first important building block and be developed further at a later time. The cooperative environment can positively influence other actors to develop in the same direction, completely in line with the theory of neoliberal institutionalism. Dombrowsky (2007: 292) found in her study that the degree of integration of the majority of existing international water management institutions is relatively low. Her economic analysis does not support a general imperative to integrate (Dombrowsky, 2007: 292).

The main objections to the development of IROs have been that they are much too costly, complicated, and extensive. The chances of success are small compared to the input of resources. The gap between prescription and reality is too wide. The whole concept of integrated international river management is described by some researchers as inadequate. Marty (2001), a political scientist, rejects the role that integrated river management can play in international waters. He supports a more sectoral or a case-by-case approach. He sees no need for an overarching framework like an IRO, since many riparian problems by themselves are so complex that it seems unwise to increase their complexity even further (Marty, 2001: 399). This view is supported by other scholars, e.g. Waterbury (1997), who warns that the cost of integrated water management in international rivers will be excessive and that the whole concept of integrated water management is elusive. Other scholars take a more balanced view and

[18] See Table A-2 in Dombrowsky (2007: 349) for further analyses of OMSV.

argue that the structures of integrated water management can be difficult to establish, but that they can play an important role in international rivers.

> Many experts tend to regard integrated-issue river management as the more promising approach, but whether it really performs better than single-issue management depends on a variety of conditions. Integrated management … may also provide more opportunities for issue-linkages, which may improve the possibilities for cooperation (Bernauer, 1997: 184). It seems that although international river management institutions, designed to manage transboundary rivers in an integrated manner are probably more difficult to establish and operate, they may contribute to better performance or river management (Bernauer, 1997: 192f).

Even if the challenges in establishing IROs seem overwhelming, and the effects of their presence might be limited, they raise the awareness of the important role of water, and the need to balance the multiple needs and uses of it. An IRO cannot be judged merely on how well it serves one state at a given time, but on an assessment of what the institution can contribute in the future, which of course cannot be precisely defined (Keohane, 2005). The theoretical concept of integrated water resource management undoubtedly has important aspects, but does not specify under which circumstances the concept can be implemented (Dombrowsky, 2007: 15). All the unresolved issues regarding this call for more research in this area. My own research will focus on the effects IROs might have on conflict and cooperation in a dyad. Despite the IROs' difference when it comes to institutional design, main goals, effectiveness etc., I found no time exploring this to develop a way to categorize them e.g. into different issue areas. This is an obvious weakness of the present research design, but points to possible future extensions. In my analyses I will mostly lump all the IROs together, although I will also analyze bilateral and multilateral IROs separately.

3.3 Hypotheses

To answer my research question, "Do countries that share a river and also have an international river organization have more cooperation and less conflict, compared to countries without such organizations?" I have formulated the following hypotheses, that all presuppose that everything else is equal.

The first two hypotheses seek to investigate differences where at least one state in a dyad is member of an international river organization vs. dyads where no states are members:

H1: A dyad where at least one state is member of an international river organization has less conflict than dyads where no states are members.

H2: A dyad where at least one state is member of an international river organization cooperates more than dyads where no states are members.

The next hypotheses seek to investigate the effect of shared membership in an international river organization on conflict and cooperation:

H3: A dyad where both states are members of the same international river organization has less conflict than other dyads

H4: Two states that are members of the same international river organization cooperate more than other dyads.

The following hypotheses investigate differences between bilateral and multilateral international river organizations on conflict and cooperation.

H5: Dyads where both states are member of the same bilateral international river organization have less conflict than other dyads

H6: Dyads where both states are member of the same bilateral international river organization cooperate more than other dyads

H7: Dyads where both states are member of the same multilateral international river organization have less conflict than other dyads

H8: Dyads where both states are member of the same multilateral international river organization cooperate more than other dyads

4.0 Units, Data, and Methods

4.1 Data and units

The hypotheses will be tested using statistical analysis. The dyad year[19] will be the unit of analysis throughout my thesis. Transboundary cooperation and conflict necessarily imply the participation of more than one state; therefore it is appropriate to conduct the analysis at the dyadic level. Only dyads on the same "continents"[20] are included because states separated by ocean cannot (by definition) share a river basin. In this sense, island states, which do not share land territory with other countries, form separate continents and will also be excluded. This reduces the number of dyad-years substantially, from 528,640 to 83,406 in the period between 1950 and 2000.[21] Another condition for most analyses in this thesis is that the dyads used in the analyses share a river basin. There is no reason to suspect IROs to make a difference in a dyad's level of conflict or cooperation if they do not share a river basin. This will further reduce the number of units for the analyses. Due to data limitations for some of the variables the time span chosen for my analyses is mainly 1950–2000. Many of my explanatory variables are coded from 1814 onwards, so the time span for similar analyses can be extended as the data improve. Since the drought data are only accessible from 1975, the analyses will go from 1975 when this variable is being used.

I will mostly use data from the dataset collected and used by Gleditsch et al. (2006). Their dataset on shared rivers builds on a dataset created by Hans Petter Wollebæk Toset and analyzed in Toset et al. (2000). Later it was supplemented with additional data from Aaron Wolf's Transboundary Freshwater Spatial Database. The supplements

[19] A dyad is a pair of two countries. A dyad-year is a dyad for a particular year.

[20] Apart from single-island states, I use the same eight continents as Gleditsch et al. (2006: 9): North America (which includes all countries from Panama and northwards), South America (all countries from Colombia and southwards), Hispaniola (Haiti and the Dominican Republic), Africa (Egypt is only included here), Great Britain and Ireland, Western Eurasia (which includes all countries west of Russia and Turkey), Eastern Eurasia (includes all countries east of Russia and Turkey), and Borneo & New Guinea. Russia and Turkey are included in both eastern and western Eurasia.

[21] The number 83,406 is for a dataset where all dyad-years with missing data have been excluded.

aimed at creating a more complete dataset that included all principal river basins, to include non-contiguous basin-sharing dyads, to include data on the magnitude of the water resource, and to clarify the ratio between upstream/downstream and boundary-demarcating rivers in the dataset (Gleditsch et al., 2006: 366). An example of an important dyad that shares the same river basin without being contiguous is Egypt and Ethiopia. PRIO's Shared River Basin Database contains information on all pairs of countries (contiguous and non-contiguous) sharing rivers (either upstream/downstream or border-demarcating) between 1816 and 2002. The dataset also contains information about the size of the river basin (measured as the area), the number of river crossings, the share of the basin in the upstream state, contiguity between the countries in the dyad, the length of river boundaries, etc. (www.prio.no/cscw/envi/rivers). Several of these variables will be used in the following analyses. The dependent variable comes from the Militarized Interstate Disputes data of the Correlates of War Project (COW)[22]. The control variables come from different sources and are described in Section 4.5. On the basis of Dombrowsky's (2007: Table A-1, p. 330) I have created four variables[23] and added them to the 2006 dataset. Information coded is: the foundation year of the first international river organization in a dyad, the foundation year of the IRO when both states in a dyad are members of the same international river organization, and whether the states in a dyad are members of the same bilateral or multilateral IRO. The variables make it possible to investigate the relationship between membership in IROs and their effect on conflict and cooperation. As far as I know this has not been tested earlier.

4.1.1 Other river organization data

As part of Marloes Bakker's PhD research at the Institute for Water and Watershed at Oregon State University, a new dataset[24] is in progress. Like Dombrowsky (2007), the new dataset lists all known international river organizations (IROs). The new source

[22] More information about COW is found at www.correlatesofwar.org.

[23] All the variables and their sources are thoroughly described in Sections 4.4 and 4.5. A more thorough description about the data coded can be found in the codebook in Appendix 1.

[24] See http://transboundarywater.geo.orst.edu/research/RBO/ for all information regarding Bakker's dataset.

builds on Dombrowsky's work, with many additional contributions[25]. In Bakker's database, IROs are defined as "formal, government-based institutions specifically designed for the management of international river basins" (http://transboundarywater.geo.orst.edu/research/RBO/). Dombrowsky (2007) does not have a similarly precise definition. But a comparison with Bakker's dataset leaves the impression that their coding criteria are very similar. However, Dombrowsky (2007) is probably somewhat more restrictive, which explains why she has a somewhat lower number of IROs. Bakker's data have more river basins (mostly sub-basins) than Dombrowsky (2007) and she also lists more IROs. I considered using Bakker's data, but since it is described as a dataset in progress I decided to use Dombrowsky's published data. However, I did compare the two datasets in order to assess how much information I would lose using Dombrowsky (2007) rather than Bakker. I found that using or supplementing Bakker's data probably would not alter my results much. Many of Bakker's IROs are in river basins which are also found in Dombrowsky's data. For instance, while Dombrowsky (2007: 331) lists only one joint IRO in seven international river basins between Canada and USA and one joint organization in five international river basins between Guatemala and Mexico, Bakker has coded 36 organizations in 15 international river basins between Canada and USA and eight IROs in five international river basins between Guatemala and Mexico. Table 4.1 illustrates this. We can see that Bakker's data contains both more IROs and International river basins.[26] I have coded Dombrowsky's data in dyadic form. Therefore, I do not lose much information by not adding the missing IROs, as long as the same dyads have already been coded in another IRO, and the foundation dates[27] do not differ significantly.

[25] All contributing partners to Bakker's data project are found at http://transboundarywater.geo.orst.edu/research/RBO/.

[26] The sources for this table are http://transboundarywater.geo.orst.edu/research/RBO/ and Table A-1 in Dombrowsky (2007: 330ff).

[27] In the Candelaria river basin the foundation dates differ, If Bakker's date is correct, I have lost 27 observations for this dyad.

Table 4.1 Differences in Bakker's and Dombrowsky' data

River basins	Member dyads	Bakker's IRO	Founded	Dombrowsky's IRO	Founded
Candelaria	Guatemala Mexico	International Boundary and Water Commission	1990	International Borders and Water Commission	1987
	Guatemala Mexico	The International Commission on Limits and Waters between Mexico and Guatemala (CILA)	1961		
Coatan Achute	Guatemala Mexico	International Boundary and Water Commission	1990	International Borders and Water Commission	1987
	Guatemala Mexico	CILA	1961		
Alsek	Canada USA	Joint Transboundary Technical Committee(TBRTC)	1999		
	Canada USA	Int. Joint Commission (IJC)	1909		
	Canada USA	The Pacific Salmon Commission	1985		
Columbia	Canada USA	Int. Joint Commission (IJC)	1909	Int. Joint Commission (IJC)	1909
	Canada USA	IJC Board: Int. Columbia River Board of Control	1941		
Colorado	Canada USA	International Water and Boundary Commission (IBWC)	1950		

Another difference is that Bakker divides certain international water basins into sub-basins. For instance, La Plata is divided into six different sub-basins and the Nile is divided into three sub-basins. Bakker also list the same IROs in different international river basins where there is one IRO representing many international water basins, e.g. the International Boundary and Water Commission, between Guatemala and Mexico, which represents four different water basins[28]. Dombrowsky (2007) does not. I concluded that most differences in the two datasets are likely to play only a minor role with regard to the information I need to answer my research question. The additional effort required to merge the data would only add a few units to my coded variables, and the work would be too time consuming within the framework of this thesis.

[28] See http://transboundarywater.geo.orst.edu/research/RBO/RBO_S.Am.html.

4.2 Methods[29]

Chapter 5 contains the empirical analyses. Both the dependent variables in the analyses of cooperation, Joint membership in IGOs, and Dyadic trade, are continuous variables. Ordinary Least Squares (OLS) regression will therefore be my analytical tool in these analyses. In the analyses of conflict I use logistic regression analyses, since my dependent variable is dichotomous. In both cases I use the gravity model[30] as a baseline, and add other relevant variables to the model. Specifying the model so it adequately fits the data is crucial for the ability to achieve high accuracy in the interpretations of the results. This is often called the model's goodness of fit. But most importantly theory and empirical facts always have to be the main determinant of which variables to implement in the analyses, statistical considerations less so.

4.2.1 OLS regression for continuous dependent variables

Multiple regression allows the researcher to ask general question like "what is the best predictor of conflict between two states in a dyad?" The major conceptual limitation of all regression techniques is that we can only ascertain relationships, but never be sure about underlying causal mechanisms (Gujarati, 2003).

OLS regression needs to meet some requirements in order to reach reliable results. It assumes a linear relationship between the dependent and the independent variables. A scatter plot between variables can show if the relationship is indeed linear. Another condition for OLS regression is that the residuals are distributed normally. To test for this I produced histograms for the residuals as well as to check normal probability plots, in order to inspect the distribution of the residual values. Correlations between independent variables also cause problems in regression analyses, and to test for this I made correlation matrixes between all my independent variables and ran tolerance tests[31].

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[29] All general information regarding method and analytic challenges are found in Gujarata (2003), Chatham (1989), Skog (2004), Brochmann (2005), and www.statsoft.com.

[30] See e.g. Zipf (1946), Isard (1956), and also a description in Section 4.2.4.

[31] This is discussed in Chapter 5.

4.2.2 Challenges for time-series data

Time-series data are often better suited than cross-sectional data to explain causal relations, but these data are not unproblematic to analyze. It is expected that certain events cause an effect, as when I investigated whether IROs have any effect on conflict and cooperation. To be able to test for this there is a need for data where it is possible to test for change over time, with the aim of explaining the observed changes. For example, why was there conflict in a certain dyad before 1979 and peace now? Is it partly because of the IRO? Regression analyses can help answer questions like these, and perhaps provide a basis for concluding that the establishment of an IRO contributed to the creation of peace. But some caution is in order. Temporal and spatial properties of time-series cross-sectional (TSCS) data can create serious problems in regression analyses. Residuals from a regression model are most likely not independent in time-series data, where observations represent intervals of time, usually equally spaced, e.g. every five years. The main problem of autocorrelation is that the standard error of the beta coefficients are underestimated, which can make variables look more significant than they are (Gujarati, 2003:455). Autocorrelation and heteroskedasticity are standard features of a lot of data in the social sciences. When observations are dependent, the same applies to the errors. For instance, we might experience a trend of increasing establishment of IROs together with a decrease in the onset of military disputes in the world. But this might be a spurious correlation rather than a causal relation between the events. This problem is highly relevant here since the increasing awareness of the importance of water parallels so many other rapid changes. If trends develop simultaneously there is a risk of concluding in favor of a causal relationship on the wrong grounds. Having a long time-series decreases the chance of spurious correlations between independent events but does not eliminate the problem. Stronger trends increase the risk of finding high correlations that are causally meaningless (Skog 2005:325).

There are, however, ways to work around these different challenges to make OLS regression a suitable method for TSCS data. I use OLS regression in my analyses of the relationship between membership in IROs and cooperation. To control for time

dependence, I include lagged variables[32] of the dependent variables as controls. It does not eliminate the problem; it is, however, the only statistical means available for me in this thesis.[33] Lagged variable is one way to handle the autocorrelation problem when the dependent variable is continuous. The problem of systematic changes over time in the residuals can also be eliminated by identifying variables that may create the effect and including them as independent variables in the analyses. But it can be challenging to identify all the necessary control variables when dealing with complex research questions (Skog, 2004:337). The advantage of including a lagged variable is that we do not need often inaccessible data to explain the trend making causes in the residuals.

Brochmann & Gleditsch (2006) used GLS regression in their TSCS analyses[34]. GLS regression stands for Generalized Least Squares and is a variant of OLS regression which takes into consideration the problem of autocorrelation and heteroskedasticity in time series data. The GLS model gives observations coming from units with greater variability less weight than observations with lower variability. Therefore the GLS regression model is capable of making estimates that are BLUE (best linear unbiased estimator). The observations that are clustered around the unit mean will be given more weight than widely scattered observations. If I had ignored the problems above and tried to test different hypotheses I would have created too large confidence intervals which decreases our probability to yield any significant results from our analyses. Another risk is that the estimates created from the OLS regression may be biased without the possibility of knowing if they are underestimated or overestimated. This may bias the conclusions drawn from the results. Analyses with GLS regression help to create a more accurate confidence interval and that increases the probability to gain significant results. The rule should therefore always be to use GLS regression in the presence of heteroskedasticity and autocorrelation. It may not always be easy to use GLS regression, so there should be serious problems with heteroskedasticity and

[32] According to Håvard Hegre (personal communication, 12 October 2009), a lagged dependent variable takes away a major part of the problems of autocorrelation

[33] SPSS does not have a GLS regression for panel data to correct for the autocorrelation.

[34] See Section 5.1, Table 5.1, Models 2 and 3.

autocorrelation before OLS is abandoned. The problems with TSCS data also apply when using logistic regression analyses.

4.2.3 Logistic regression for dichotomous dependent variables

The dependent conflict variable, onset of a militarized interstate dispute (MID) with at least one fatality, is a dichotomous variable which makes logistic regression a useful method to explore the causal relationship between IROs and conflict. Maximum likelihood logit estimation evaluates whether the expected frequencies under the respective model are significantly different from the observed ones. Reviewing the residuals tells us whether the model is appropriate for the data. The residuals should be random noise. In logistic regression the residuals are different from ordinary OLS regression. The residuals are not normally distributed. This has to be taken into consideration when estimating the regression coefficients. One common method to use is the maximum likelihood method.

In logistic regression a linear relation cannot be assumed. A non linear relationship is e.g. if the dependent variable Y increases more rapidly with low values of X, than high values of X, or vice versa. Another example is if Y decreases with low values of X, but increases with high values of X (curve-shape). Typically the logistic regression curve will have an s-shape. A linear regression model usually takes this form:

$$Y = b_0 + b_1*x_1 + b_2*x_2 + ... + b_n*x_n$$

When the simple linear regression model does not adequately fit the data a nonlinear regression model can be used, or the data need to be transformed to fit a linear model. We observe 0 and 1 in the dependent variable MID onset[35], but by performing the logit transformation on the left-hand side of the logit regression equation we obtain something similar to the standard linear regression model where the left hand side is the log odds of the latent probability of Y=1. To interpret the logit scale is not as simple as to interpret shares or percentages, but the transformation of the data gives a

linear regression curve. The name logit stems from the fact that a non linear model is made linear via the logit transformation. The logit regression model will always yield predicted values for the dependent variable between 0 and 1, regardless of the values of the independent variables. The model can be written as:

$$Y = \exp(b_0 + b_1*x_1 + ... + b_n*x_n)/\{1 + \exp(b_0 + b_1*x_1 + ... + b_n*x_n)\}$$

Or written as:

$$\ln(p/1-p)=b_0+b_1*x_1+b_n*x_n\ldots$$

To interpret the results, the parameter estimates should be converted into odds by using the anti-log function.

4.2.4 The gravity model as a baseline[36]

In the model used in the replication of Brochmann & Gleditsch (2006), and in my analyses of the effects of IROs on cooperation and conflict, I use a gravity model as a baseline (Isard, 1956; Zipf, 1946). The gravity model is well established in geography and economics. The model was originally developed to assess travel flows between cities relative to distance (Zipf, 1946), and has since been adapted to other fields of research, such as dyadic trade flows. The basic gravity model explains bilateral trade between countries as proportional to the product of the size of the economies and inversely proportional to the distance between them. This is usually measured by GDP and distance between the capitals. This basic gravity model typically takes the following form:

$$T_{ab} = f\ (Y_{ab}, D_{ab}, R_{ab})$$

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[35] See Section 4.4.2.

[36] My sources for the description of the gravity model are Zipf (1946), Isard (1956), Brochmann (2005), Brochmann & Gleditsch (2006), Simmons (2005), Hegre (2008), and www.wikipedia.org/wiki/Gravity_model_of_trade.

where f is a constant, T_{ab} represents the trade flow between countries a and b, Y_{ab} represents the economic size of countries a and b, D_{ab} represents the physical distance between two countries, and R_{ab} represents other factors that influence trade between them (Simmons, 2005: 17). The model is multiplicative:

$$T_{ab} = x(GDP_a\text{^}_{b1} * GDP_b\text{^}_{b2} * R_{ab}\text{^}_{b3}) / D_{ab}\text{^}_{b4}$$

By taking the logarithms of all the terms, this multiplicative model can be transformed into a linear model. The gravity model then takes the following form: [37]

$$\ln(T_{ab}) = \beta_0 + \beta_1 \ln(GDP_a) + \beta_2 \ln(GDP_b) + \beta_3 \ln(D_{ab}) + \ln(R_{ab}) + \mu$$

This gravity model serves as a baseline for further analyses, both when I conduct the replication of Brochmann & Gleditsch (2006) and when I investigate the impact of IROs on cooperation and conflict. Other variables needed for the analyses will be added to the model, as parts of the term R in the equation above. μ represents the error term. Since conflict is considered a form of interaction, just like trade, the gravity model is also considered to be a suitable model to investigate the impact on conflict.

4.3 Validity and reliability

Without reliable data, the empirical analyses will not be valid. Reliability means trust, in a sense that the data's correctness can almost be taken for granted. If the coding of the data is repeated, the same result is obtained every time. It means that another researcher will get the exact same information if the same instruments are being used in the collection of the data, or when using the same methods. Most of the data used in this thesis have been previously used by Brochmann (2005) and by Brochmann & Gleditsch (2006). Empirical analyses based on the same data should normally yield same results. Most of the data have been used in publications by other scholars and in that sense been critically evaluated several times. Many of the variables used are parts

[37] In this model ln(R) will contain the rest of the variables in the analyses and the constant X becomes part of β_0.

of larger well known databases such as the Transboundary Freshwater Spatial Database. This strengthens the reliability of the data.

There will always be a risk of coding errors. I have coded some variables used in the analyses. The information coded is: the foundation date when both states in a dyad became members of the same IRO, whether or not states in a dyad are members of an IRO, when an IRO was first established in the dyad, and whether or not the states in the dyad are members of bilateral or multilateral IROs. These variables are completely new, coded by me and not tested earlier, which naturally makes them less reliable. I did however code the data twice to produce more reliable data. Coding data yourself give you more control over the data, but does not prevent any coding errors.

To determine whether the research can be considered valid substantial theoretical theories and arguments have to lay the foundation. Fundamental in all empirical research is to discover factors that explain complex phenomena, like cooperation and conflict. Trade and joint membership in NGOs have been used as indicators of cooperation by other scholars as well (cf. Brochmann, 2005; Brochmann & Gleditsch, 2006). Empirical studies using trade data have often yielded different results. This can be explained by low accuracy and reliability of official trade statistics, but also by how scholars choose to use the data. Scholars use different measures for trade and treat missing data differently. This can explain some divergent empirical results (Schneider et al., 2003: 28).

The validity of the data used in this thesis is closely connected to the operationalization of the variables, the variables chosen, the coding accuracy, and how well the model fit the data. Many of the variables in these analyses are well known and commonly used as central in international relations. Earlier studies have used many of the variables in research on conflict /cooperation and water related issues e.g. Gleditsch et al. (2006), Wolf (1998, 2003) among others. Based on neoliberal institutionalism and liberal peace theory using trade and membership as indicators of cooperation is well substantiated. Brochmann (2005: 39) found in her two models,

using trade and membership as dependent variables, that the results point in the same direction. These findings strengthen the variables validity.

4.4 Dependent variables[38]: cooperation and conflict

4.4.1 Cooperation, dyadic trade, and joint IGO memberships

To measure cooperation I use the same variables as in Brochmann (2005) and Brochmann & Gleditsch (2006), joint membership in international organizations and dyadic trade. Membership in IGOs is collected from the Correlates of War project (COW[39]). The choice of joint IGO membership as a measure of cooperation is based mostly on Keohane's (2005) theory of complex interdependence that broadly states that countries cooperate by joining organizations since there is no supranational, absolute authority in the world system. The idea is that membership in IGOs indicates willingness and extensive interaction between the members. States also interact more generally and dyadic trade is a good measure for this cooperation (Brochmann, 2005). Joint membership in IGOs is measured with the number of IGO memberships for both states in a given dyad. The dataset covers the period 1815 to 2000. The variable includes 495 different IGOs with a total of more than 500,000 members. The number of observations for my analyses will be substantially lower since they will cover a shorter time span and only include dyads on the same continents. Brochmann & Gleditsch (2006) and Brochmann (2005) used joint membership in IGOs as a dependent variable and as a measure for cooperation. The number of joint memberships from the COW data was summed up for each dyad. Since the IGO membership data are coded for every fifth year, the missing data was estimated through linear interpolation. The variable goes from 0 and up, with one decimal. The variable has been transformed by taking the square root, to better meet the requirements of OLS regression (Brochmann, 2005: 44).

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[38] The codebook for the river basin data can be found at www.prio.no/cscw/envi/rivers. For more information about the dataset and variables, see Gleditsch et al. (2006). I have made no changes in the rivers dataset itself, but have added some new variables to it.

[39] For more information see www.correlatesofwar.org.

One objection to using IGOs as a measure for cooperation in this study is that my independent variables deal with membership in international river organizations. Both the independent variable and the dependent are similar, and there might be a high correlation between them. On the other hand, IROs constitute only a small proportion of all IGOs in the world, and dyads that are member of an IRO are probably members of many other IGOs, so that the variable still can serve as a measure for cooperation.

The dyadic trade data are originally from Gleditsch (2002).[40] The dataset includes import and export data for the period 1948–2000, measured in millions of US dollars at current prices. Since the data quality is best after 1950, I use 1950–2000 as the time period for the analyses. Trade is frequently used as an independent variable in studies of conflict, particularly to find out if trade reduces conflict (Gleditsch, 2002). In this analysis the dyadic trade variable will be seen as a second measure of cooperation. I use a variable created by Brochmann (2005) based on Gleditsch (2002) that measures the total imports in the dyad. This variable was log transformed to reduce the influence of extreme values and better meet the OLS regressions requirements (Brochmann, 2005: 45).

4.4.2 Conflict: The onset of a MID with at least one casualty

To measure conflict, I use militarized interstate disputes and wars from the MID and COW projects[41]. As mentioned in Section 2.1, the COW project defines a conflict as a war if there are at least 1,000 battle deaths in a year. The UCDP/PRIO conflict dataset has a lower threshold of 25 battle deaths per year to qualify as an armed conflict (Gleditsch et al., 2002). They define armed conflict as "a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle related deaths" (www.pcr.uu.se). Lowering the threshold makes it possible to include significant events like the conflict in Northern Ireland and the Basque conflict in Spain

[40] See http://privatewww.essex.ac.uk/~ksg/exptradegdp.html or Gleditsch (2002) for further information.

[41] Links to both datasets are found at www.correlatesofwar.org/.

which do not qualify for the COW project's list of wars (Gleditsch et al., 2002). For statistical purpose, lowering the threshold for inclusion will yield more conflicts and thus more flexibility regarding analyses of the material as well (Gleditsch et al., 2002). The Militarized Interstate (MID) Dispute Dataset includes militarized conflicts with no actual violence. This dataset also comes from the Correlates of War Project. MIDs include a range of low-level hostilities including threats to use force and displays of force. This dataset has been criticized for being less reliably coded and containing greater uncertainty regarding end and start dates of wars. "They also suffer from what might be called an 'attention bias'; while a war can scarcely be hidden from public view, a militarized dispute may not catch the attention of the media and thus will not have been caught by the COW coders" (Toset et al., 2000: 984). Toset et al. (2000: 984) choose an intermediate solution to reduce this problem of attention bias by measuring conflict behavior as the onset of a MID with at least one casualty. The same operationalization is used by Gleditsch et al. (2006) and will be used here, too. It is a dummy variable, coded 1 if a MID was started in a given year and 0 otherwise. The years following the onset of the MID are coded 0, even if the MID continues. The low threshold yields more conflicts and is appropriate to my research question. Using the same variable as (Gleditsch et al., 2006) is also important in order to be able to compare the results.

4.5 Independent variables and control variables

In the following 4 independent variables are listed. The sources of the variables are from Dombrowsky's Table A-1 (2007:330). She lists 86 IROs, bilateral as well as multilateral. For each IRO she provides information about the basin name, the foundation date, the number of member states, the total number of states in the basin, and the IRO's issue areas (Dombrowsky, 2007, Table A-1: 330-360). These organizations are represented in 68 international river basins. These data are coded to distinguish between different combinations of dyads. For example if both countries in a dyad are members of the same IRO, none are members or only one is a member.

4.5.1 International river organization (IRO) in the dyad

By coding the foundation dates I am able to test for differences in conflict and cooperation before and after the establishment of an international river organization in a dyad. This variable is coded with the year the first international river organization was founded in the dyad. I might find that even when only one of the states in a dyad is a member, the presence of the river organization will have an effect on conflict and cooperation in dyads which also share a river basin. The presence of an IRO probably increases the overall management in the shared basin, and this increases the interaction between them. I expect this variable to be positive related to cooperation and negative related to conflict. This effect is expected to be weaker compared to dyads where both states are members of the same IRO. The variable was recoded into a dichotomous variable. In the analyses dyads where no countries are members are given the code 0, and in dyads where there is an IRO the code is a 1.

4.5.2 Both countries in dyad members of the same IRO

This variable is coded with the foundation year of the first international river organization of which both states in the dyad are members. The variable was recoded into a dichotomous variable in the analyses, and given the code 1 if both countries are members of the same IRO in the same year, and given the code 0 otherwise. I expect dyads where both states are members of the same international river organization to have less conflict and more cooperation, compared to states that do not share membership.

4.5.3 Both states member of same bilateral IRO

The variable is disaggregated from the variable, Both countries in the dyad members of the same IRO. The dyad is coded 1 if there exists a bilateral IRO of which both states in a dyad are members, and 0 otherwise. The coding into bilateral and multilateral IROs is conducted since I expect there to be a difference between them, and that will be investigated in the analyses in Chapter 5.

4.5.4 Both states member of same multilateral IRO

The variable is also disaggregated from the variable, Both countries in dyad members of the same IRO. The dyad is coded 1 if there exists a multilateral IRO of which both states in a dyad are members and 0 otherwise.

4.5.5. Shared river basin

This is a variable coded as a dummy variable which states whether or not two states share a river basin, regardless if they are contiguous or non-contiguous. Gleditsch et al. (2006: 373) found a positive and significant dyadic relationship between sharing a river basin and the onset of conflict, and that the risk of fatal MIDs (Military Interstate Disputes) is approximately doubled by the presence of a shared basin. Brochmann (2006: 59) found in her study that sharing a river basin has a positive and significant effect on cooperation. These findings calls for more research on water related issues, such as what impact and role the presence of an IRO has on conflict and cooperation. This variable was created by Gleditsch et al. (2006) as a part of their dataset[42], which combines data from Toset et al. (2000), and Wolf's Transboundary River Basin Registry[43].

4.6 Control variables

The control variables I use in the analyses, where I look at the effect IROs have on conflict, are basically the same as Gleditsch et al. (2006) use in their study. Many of the same control variables are also suitable as control variables when I look at the effect IROs have on cooperation. Control variables used are Peace history, Regime type, Level of development, Dyad size, Presence of one or more major powers within the dyad, Alliance, Inter-capital distance and Contiguity (Gleditsch et al., 2006). These variables are well established and widely used as explanatory factors within research on conflict and cooperation.

When Gleditsch et al. (2006) analyzed the relationship between conflicts and shared river basins, they tested the significance of certain variables. Their results strongly

[42] Available at www.prio.no/cscw/datasets.

[43] Available at www.transboundarywaters.orst.edu.

suggest that the size of the basin is more important than either the river boundary length or the number of river crossings. Based on the results from that study I have added basin size as a control variable in addition to the ones mentioned above. I do not include river boundary length or number of river crossings as control variables.

The danger of only using established "facts" is that the ability to engage in critical and unconventional thinking might be lessened, which will hurt the progress within research. There are no established truths and that has to be the foundation of all research.

In the following section I justify my choice of control variables[44], and discuss what results we might expect from the analyses. The choice of control variables is important to prevent crediting to the independent variable too much effect. For instance two states that are allied and highly developed tend to cluster geographically and allied dyads therefore appear to fight each other more frequently if one does not control for contiguity (Toset et al., 2000: 982). Using a large number of control variables makes it harder to determine the causal linkages between them. On the other hand fewer control variables means that we have probably left out essential information. The main purpose of this thesis is not to investigate the causal relationship between explanatory factors, but rather to test if membership in IROs has any additional effect on conflict and cooperation between states in a dyad. Based on this, implementing a large set of control variables is essential. All control variables that are of any significance should be present in the analyses.

4.6.1 Peace history

This variable is a decay function containing the number of previous years without militarized interstate dispute (MID) in the dyad or the time since the younger of the two countries gained independence. The variable was originally created to be a control for temporal dependence in conflict, which is widely used in logistic regressions. It is

[44] The control variables used in this thesis are the same as the ones used by Gleditsch et al. (2006), Brochmann & Gleditsch (2006) and Toset et al. (2000).

less common to include this in regular regression models (Brochmann & Gleditsch, 2006: 14). This variable is included because there is reason to believe that previous levels of conflict in a dyad will have an independent impact on later conflicts. The variable will test for temporal dependence between the dyads (Toset et al., 2000). Brochmann & Gleditsch (2006) argue that it is reasonable to expect that positive interaction increases with years of peace in a dyad, while the risk of new conflicts decline. This argument makes sense, but I am not sure whether that effect will show positive or negative. One might think that cooperation is more likely when there is a long history of peace, but it can also be looked at the other way around, that a history of conflict really calls for necessary cooperation to prevent further damaging conflicts. The eagerness and effort to cooperate in a dyad might therefore be higher with a history of conflicts. Irrespective of positive or negative effects, this is an important choice of control. The variable is created by Gleditsch et al. (2006) but the original idea behind the creation of the variable belongs to Raknerud & Hegre (2007)

4.6.2 Regime type[45]

On the basis of the well established liberal peace argument, this variable is an important control. The democratic peace argument claims that two democracies rarely, if ever, fight one another. However, democracies may be involved in wars with other regime types. A dyad containing two democracies will therefore presumably automatically have fewer conflicts than "mixed" dyads, supposing that the liberal peace argument is true. The variable is included in the analyses as three dummy variables. The reference category consists of two democracies. The variables are labelled One democracy, Two autocracies and Unconsolidated regime according to the political make up of the dyad. For a dyad to be labelled One democracy, one of the countries has to have a value of 6 or higher on the Polity IV scale (democracy minus autocracy) drawn from the Polity IV Dataset. In Two autocracies, both countries have –6 or lower. In Unconsolidated regime dyads at least one of the countries has a value between –5 and 5 and the other has 5 or below (Brochmann & Gleditsch, 2006). The

[45] See www.systemicpeace.org/polity/polity4.htm for a description of the dataset and variable used.

scale goes from -10 to + 10. The variable is originally taken from the Polity IV scale of democracy and autocracy which is an updated version of the Polity Project.

4.6.3 Dyad size

There has been a renewed interest of the role of geography in international relations (Starr, 2002). War will naturally be more likely between states that are close to each other. Of course, this does not prevent wars over long distances. Today's technology makes long distance war much more feasible. There are however some arguments why both more cooperation and more conflicts between states that are geographically proximate might be expected, like the distance between capitals, number of roads crossings, railroad crossings, steepness of the terrain etc. (Starr, 2002: 248). The more contact points, the more interaction, regardless of the nature of the contact (peaceful, conflictual, etc.). That's the main intention for implementing control variables like, Inter-capital distance, Contiguity, and Dyad size etc.

Dyad size is measured by population and coded for the largest and smallest country in the dyad. The variable has been log transformed. This variable is the same as used in Brochmann & Gleditsch's (2006) study. In an earlier study by Gleditsch et al. (2006), a similar population variable showed to be highly significant and positively related to conflict. Since Gleditsch et al. (2006) found that proximity increased the conflict levels in a dyad it is likely that similar results regarding cooperation will be found; that proximity is positively related to cooperation, since higher populations usually give more need and opportunities for contact. A dyad's GDP can also be seen as a measure of size. GDP variables are also included in the analyses as a measurement for development, thoroughly described under Section 4.6.8. The dyad size variable is from the COW Project.

4.6.4 Inter-capital distance

Inter-capital distance and Contiguity are included because there are expected more interaction between neighboring or proximate states, as mentioned in Section 4.6.3. Gleditsch et al. (2006: 372) found that more distance between the capitals in a dyad significantly reduces the probability of conflict. They also found that greater length of

a shared boundary slightly increases the propensity for conflict. Buhaug and Gleditsch (2006), among other scholars, have also found that distance is negatively and significantly related to conflicts even when controlling for contiguity. Based on these articles the effect of geography should be tested with several control variables, Dyad size, Contiguity and Inter-capital distance because they individually have explanatory power. Inter-capital distance is measured in kilometres, but has been log transformed to decrease extreme values. This variable is from the COW Project.

4.6.5 Contiguity

Contiguity is a dichotomous variable, coded 1 if two states share a border and 0 otherwise. It is reasonable to expect that a shared boundary will give more interaction between the states sharing it. This variable would be expected to have effect both on conflict and cooperation. Countries with common boundaries are more likely to have more conflict and more cooperation, and this variable will be implemented in the analyses as a control. The substantial argument here is the same as in Section 4.3.3 above. All the variables measuring proximity will be regarded as important controls.

4.6.6 Presence of one or more major powers within the dyad

This variable comes from the COW project. It is a standard dichotomous variable and the dyad-years are coded with a 1 if there is at least one major power in the dyad. When one state is a major power it has a large capability advantage over the other states. This will most presumably affect both conflict and cooperation. On one hand the presence of a major power can show to be stabilizing but it can also show opposite effects. Homer-Dixon (1994) emphasizes that the military power balance between upstream and downstream states in a river basin influences the potential for conflict, especially if the downstream state is more powerful e.g. Egypt. To test this, Major power is included as a control. This also applies for testing cooperation. The presence of a major power can boost cooperation but probably also limit it. The major power can force through cooperation if desired, but can also act in self-interest, disregarding other states, and creating conflict. It is assumed that the geographical position to the international river plays a decisive role in the outcome. This thesis does not test for upstream/downstream scenarios. It would be interesting to test for different scenarios

between two such states regarding water, e.g. we might find that an international water basin with a major power upstream will not cooperate as much as when the Major Power is located downstream. This scenario, among others, can serve for another paper.

4.6.7 Alliance

The Correlates of War (COW) project lists three types of alliances: defense pacts, neutrality pacts, and ententes. The variable used here is a dichotomous variable. It is coded 1 if there is an alliance in a dyad, and 0 otherwise. An alliance concluded in one year is coded from the next year, and an alliance ended in a particular year is coded as a non-alliance from that same year. An alliance formed and ended in the same year is not coded at all (Toset et al., 2000: 985). Gleditsch et al. (2006: 372) found that alliance was not a significant predictor for conflict. The variable may show to be significant when I test for cooperation. I have therefore decided to keep it as a control variable for the analyses. The theoretical argument is that it seems feasible to assume that allied countries are more likely to cooperate.

4.6.8 Level of development

All states have conflicts, and the level of development is thought to be a determinant of whether states go to war. Some scholars expect higher levels of development to generate less conflict and more cooperation (Hegre, 2000: 5ff). The variable might show opposite results too. It is my expectation that we will find more conflict in the dyads consisting of either very poor or very rich countries, like a U-curve. Very poor countries do not have much to lose on a conflict but probably a lot to gain, whereas very rich states can afford even long-lasting warfare without risking much. Highly developed states often have more resources with which to pursue their interest, and they have the military capabilities to pursue, or threaten to pursue, their interest. Average states have something to lose and uncertainty when it comes to financing conflicts and the outcome of it. Another reason that we might expect more cooperative behavior in average states, and less conflict, is that they often have ample water resources. With restraints on the water supply they probably have the technology and resources available to conserve the water resource in a sustainable way. “Therefore,

when countries sharing a river basin also have a relatively high level of economic development, we would expect less overall strain on the water resources in the dyad" (Gleditsch et al., 2006: 370). Gleditsch et al. (2006: 376 ff.) found economic development to be significantly related to less conflict in the bivariate analysis, but unrelated to conflict in the multivariate analysis. Their analysis shows that the more developed a dyad, the less is the increased risk resulting from sharing a river basin. The substantial argument for this claim is that wealthier states have the means to cope with resource crises and to make use of advanced water management technology. Other scholars have found mixed results regarding this variable.

Gross Domestic Product (GDP) per capita is commonly used to measure development levels. In these analyses development is measured as GDP per capita in the smallest economy and GDP in the largest economy. The variables have been log transformed. I distinguish between the largest and the smallest economy, since it is likely that the differences in economic size influence the level of conflict and cooperation differently. For instance it is likely that the smallest economy will have a larger negative impact on cooperation by having fewer means or resources which limits their possibilities. The GDP data covers a time span from 1950 and is from Gleditsch (2002).

4.6.9 Water scarcity

It seems reasonable to expect that conflict over water resources are more likely in water-scarce regions, especially if states sharing a river place a high value on the resource. The need for cooperation will also be greater where water resources are limited. I therefore expect this to have effect and implement this as an important choice of control. In water-scarce areas, like the Middle East, we might find that membership in IROs shows positive effect, promoting cooperation and reducing conflicts. Scarcity is measured through drought. The variable is coded as a dummy variable (drought) that records whether or not one or both countries experienced at least one drought at any time during the past 5 years from 1975 to 2000 (Gleditsch et al., 2006: 369). The substantial argument for bringing this variable in as an important choice of control is that it is likely to expect that conflicts over water will be more

frequent in regions where water is considered a scarce resource. At least that is what the water scarcity literature suggests; that basin-sharing countries in water-scarce regions probably have a higher risk of dispute than basin-sharing countries elsewhere (Gleditsch et al., 2006: 376). This scenario was not supported in Gleditsch et al.'s (2006) study. It may be found that states with endemic water scarcity, and that also share a water basin, have long term incentives to cooperate over the management of the resource. It might follow that more cooperation between states in water-scarce regions as well as increased potential for conflicts is present. The information regarding water scarcity is originally from EM-DAT[46], which is an international disaster database.

4.6.10 Size of a shared basin[47]

Gleditsch et al. (2006: 373) found that basin size shows a positive and significant effect on conflict. The bigger the shared basin the more there is to fight over. This might sound odd since earlier arguments have emphasized that water scarcity may increase conflict, while ample supply of water probably would show opposite effect. This effect can probably be indirectly linked to higher levels of development which causes increased need of water for industrial and agricultural purposes. Gleditsch et al. (2006: 373) controlled for both the size of the two countries, major power status, and the length of the border between them which make them highly certain that basin size has independent effect on conflicts. On the other hand they do not leave out the possibility that there might be a spurious effect caused by variables not taken into consideration. The effect may be indirectly dependent on water as mentioned above e.g. for industrial purposes, because of population densities, fisheries and other activities linked to the river which has had an historic economic importance (Gleditsch et al., 2006: 373). The variable is measures by the log of the total size of the basin in square kilometres shared by the dyad.

[46] See, www.emdat.be/.

[47] This variable is originally from Aaron Wolf's Transboundary Fresh Water Dispute Database at Oregon State University. See www.transboundarywaters.ors.edu/.

I start with a large number of control variables but may drop some of them in further analyses if they are found to be insignificant.

5.0 Analyses

On the basis of the collected variables, several analyses will be conducted. Bivariate and multivariate, OLS and logit models will be used to investigate the relationship between membership in IROs and conflict/cooperation. First, I ran descriptive statistics on all variables, checked normal distributions, histograms, residuals, correlation matrixes, scatter plots, heteroskedasticity etc..[48] Describing problems and consequences with heteroskedasticity is much easier than detecting it in the data, and when it is detected it is not obvious how to correct the problem. To test for any problems with heteroskedasticity, I ran an OLS regression on the assumption that there is no heteroskedasticity with both my dependent variables dyadic trade and IGO memberships with all my independent variables in the model and created a residual (z) variable. Investigating the residuals[49], together with educated guesswork, speculations, empirical experience etc., can hopefully tell us where and why we have a problem with heteroskedasticity. I squared the z variable to avoid the possibility that the variance around the regression line would eliminate each other. After doing this I ran bivariate regression analyses for all the independent variables towards the residual of the dependent variables. All 24 analyses, except two, resulted in significant results. Only shared basin yielded insignificant result for the dyadic trade residual variable and GDP per capita yielded insignificant results using the residual variable for joint IGO memberships. The theory (Gujarati, 2003: 387ff) states that if I gain significant results I most likely have heteroskedasticity, which can cause some problems. By taking one and one variable and running bivariate OLS regression analyses, I can find out which variable is causing the problem, and decide if the variable can be transformed to make the residuals homoskedastic, if its presence can be accepted, or if the variable should be excluded. This exploration of the data is called the Park test (Gujarati, 2003: 403). Objections to this test are that the residual variable itself can be heteroskedastic and

[48] Only some results of the inspection of the variables will be reported in Appendix 2.

[49] The residual plots for Dyadic trade and Joint IGO membership, in Appendix 2, indicate that there is some heteroskedasticity.

therefore violate the OLS assumptions. Another objection to this method is the large number of cases. Reaching significant results using the squared residual is very common when the number of cases is high. To take an example, a correlation of 0.2 can give a significant result with about 100 cases. Since I have more than 83,000 observations the Park test does not contribute any valuable information. My bivariate analyses show that almost all my variable yield significant results. By this test we cannot interpret that we do or do not have serious heteroskedasticity problems. Concluding either way would be a mistake based on this test for this particular dataset. The data need more investigation and the scatter plots of the residuals give some support to heteroskedasticity since the residuals do not completely follow the regression line[50]. The heteroskedasticity seem much larger for the residuals of the regression analyses with IGO membership as dependent variable than for trade.

The correlation matrix of all the independent variables reports satisfactory correlations for almost all the variables. The correlation is high between the variable Largest GDP per capita in the dyad and Smallest GDP per capita in the dyad. This is unproblematic since they are used only as control variables. A much more serious problem is the high correlation of 0.82 between the main independent variable, Shared basin and Contiguity, since I built my research question on the assumption that sharing a water basin is significantly related to states' interaction. This is further discussed in Section 5.1. The rest of the correlations were all between 0.52 and 0.01. Correlations below 0.5 do not usually create any serious problems. Values above 0.8 are critical.

The results from the inspection of the variables were somewhat surprising. If the residual of a variable is not normal distributed they are not perfect to meet the conditions for using certain statistical models. The real world is very complex to represent in simple models and variables often do not have a perfect fit to the requirements of different methods[51]. My aim with this thesis is not to solve all the

[50] See residual plots in Appendix 2

[51] Most of the variables in this thesis are widely used by scholars both in international relations and in economics.

technical obstacles and weaknesses with the data. I have tried to point out problems and ways to solve them as satisfactorily as possible within the framework in this thesis. I have decided that the requirements are satisfied for the variables I use in what follows.

5.1 Replication of Brochmann & Gleditsch

Before analyzing my own data I start with a replication of the logistic analyses of shared water basin and conflict in Brochmann & Gleditsch (2006: 15, Model 2) to see if my data and method yield more or less the same results. It will confirm that changing statistical programs does not change the results in any drastic way, as long as one uses the same method and data. Their article focuses on the assumption that shared water resources provide both willingness and opportunity for interaction, and that it can generate more conflicts as well as cooperation. They found support for this hypothesis in the multivariate analyses of all dyads capable of sharing a river basin for the period 1950–2000. Brochmann & Gleditsch (2006) used GLS regression for shared IGO memberships and trade, and logistic regression to test for conflict, using the gravity model as a baseline. Some changes had to be made to be able to replicate the analyses of dyadic trade and IGO membership in Brochmann & Gleditsch (2006). SPSS does not have a GLS regression model or a regression model with panel-corrected standard errors (SPCE). This makes an exact replication of their analyses difficult. Using SPSS, I was only able to replicate the logistic regression analyses of shared basin and conflict. The test for the cooperation variables had to be done as a second best alternative, by including lagged dependent variables as controls for autocorrelation[52], as mentioned above in Section 4.2.2. The results from these analyses were somewhat different for many of the variables, and are discussed below. The results from Brochmann & Gleditsch (2006) and the results from the replication are reported in Table 5.1.

[52] According to Håvard Hegre (personal communication, 12 October 2009), a lagged dependent variable takes away a major part of the problems of autocorrelation.

Brochmann & Gleditsch (2006) found support for their hypothesis that dyads sharing a river basin have more overall interaction, positive as well as negative. They found that sharing a river basin had a significant positive relationship to MID onset, Joint IGO memberships and Dyadic trade, even when controlling for the other factors in the model. Thus, shared water resources increase conflict as well as cooperation. My replication of the logistic regression for conflict is consistent with their finding (Model 1). This will serve as a basis for further research. Models 2 and 3, especially the latter, deviate from the earlier study. Particularly problematic is the main independent variable, Shared basin. The OLS regression in SPSS gives hardly any effect for this variable at all with a coefficient of 0.002 (Table 5.1 Model 6) when including the lagged dyadic trade variable as control. While Brochmann & Gleditsch (2006) found that sharing a water basin increases trade, I find that trade is not significantly influenced one way or the other. When the lagged trade variable is left out, the coefficient; -0.160, is significant at the $p = 0.01$ level, but in the wrong direction – sharing a river decreases trade. This was my main problem with the replication. The problem can be due to collinearity since Shared basin and Contiguity have a correlation of 0.82. Correlation this high is critical and it makes it hard to distinguish which variable really is the most influential. This is proved by my replication. As Table 5.1, Model 4 shows, both variables, Contiguity and Shared basin, are significant and the effects combined are the same. However, I get the strongest effect for the Contiguity variable whereas Brochmann & Gleditsch (2006) got the strongest effect for the Shared basin variable. Which variable is estimated to have the strongest effect is somewhat arbitrary when the two variables are highly correlated as they are here. Since most countries sharing river basins are neighbors the correlation is necessarily high, but approximately 1/3 of the dyad-years sharing a river basin are not neighbors (Brochmann & Gleditsch 2006: 15). Excluding either Shared basin or Contiguity strengthens the results for the other variable. To test for this I ran two logistics analyses excluding either Contiguity or Shared basin. When Contiguity was excluded most of the effect was ascribed to the Shared basin variable and vice versa.

Table 5.1: Analyses of states' interaction

	Results from Brochmann & Gleditsch (2006: 14, Models 2–4)			Results replication of Brochmann & Gleditsch (2006)		
Variables / Model	1 MID onset	2 Joint IGO memb.ship	3 Dyadic trade	4 MID onset	5 Joint IGO membership	6 Dyadic trade
Independent variable						
Shared basin	0.786** (1.33)	0.111*** (2.40)	0.400*** (7.57)	0.543*** (0.14)	0.028***#0.015*** (0.04) (0.02)	–0.160***#0.002 (0.03) (0.02)
Gravity model						
Inter-capital distance (log)	–0.671*** (4.54)	–0.146*** (4.55)	–0.992*** (21.44)	–0.613*** (0.05)	–0.113***#–0.032*** (0.003) (0.001)	–0,848***#–.143*** (0.01) (0.01)
Contiguity	0.520** (0.54)	–0.110*** (2.07)	0.028 (12.27)	0.836*** (0.15)	0.085***#0.063*** (0.01) (0.01)	1.038***#0.216*** (0.34) (0.017)
Population in the largest country (log)	0.231*** (2.05)	0.027*** (2.88)	0.398*** (5.90)	0.218*** (0.04)	–0.001#0.002** (0.002) (0.001)	0.418***#0.075*** (0.01) (0.003)
Population in the smallest country (log)	0.367*** (3.19)	0.149*** (5.65)	0.797*** (37.54)	0.354*** (0.04)	0.104***#0.022*** (0.002) (0.001)	0.723***#0.128*** (0.01) (0.003)
GDP per capita of the largest economy (log)	0.295** (0.34)	0.047*** (2.42)	0.765*** (9.16)	0.275*** (0.07)	–0.032***#–0.002 (0.003) (0.001)	0.738***#0.133*** (0.01) (0.01)
GDP per capita smallest economy (log)	–0.428*** (1.43)	0.106*** (3.06)	0.886*** (19.05)	–0.425*** (0.08)	0.127***#0.019*** (0.003) (0.002)	1.058***#0.164*** (0.01) (0.01)
Major power	–0.077 (2.01)	–0.356*** (0.26)	0.953*** (16.04)	–0.067 (0.16)	–0.224***#–0.041*** (0.009) (0.004)	0.836***#0.107*** (0.03) (0.01)
Other control variables						
Peace history	–3.509*** (7.48)	0.493*** (26.73)	0.256*** (116.97)	–3.484*** (0.09)	0.961***#0.738*** (0.009) (0.004)	1.004***#0.784*** (0.03) (0.01)
One democracy	1.264*** (2.32)	–0.060*** (3.68)	–0.229*** (10.82)	1.288*** (0.23)	–0.416***#–0.089*** (0.009) (0.004)	–0.991***#–.165*** (0.02) (0.01)
Two autocracies	1.443*** (1.29)	–0.080*** (3.66)	–0.266*** (11.77)	1.477*** (0.24)	–0.490***#–0.108*** (0.008) (0.004)	–1.106***#– 0.175*** (0.03) (0.01)
Unconsolid. regimes	1.705*** (2.55)	–0.084*** (4.49)	–0.294*** (13.01)	1.707*** (0.24)	–0.513***#–0.113*** (0.008) (0.008)	–1.150***–0.174*** (0.03) (0.01)
Lag dyadic trade						#0.841*** (0.002)
Lag IGO membership					#0.781*** (0.002)	
Constant	–7.718*** (3.61)	1.598*** (4.40)	–14.907*** (19.54)	–7.811*** (0.76)	2.939***#0.743*** (0.04) (0.02)	–15.847***#– 2.71*** (0.13) (0.07)
Hosmer-Lem. p-value				0.17		
Pseudo-R^2 (Nag.k)				0.42		
R^2 (OLS)					0.33 (0.83)	0.69 (0.93)
(n)	83,406	82,218	83,400	83,406	82,019	83,404

Results with lagged dependent variable (dyadic trade and IGO membership) marked #.
Robust z statistics in model 1,2,and 3, and S.E. in model 4,5, and 6 in parentheses
* p <0.10, ** p < 0.05, *** p<0.01.

Most of the control variables in the replication show similar results when including or not including the lagged variable. But comparing the results with Models 2 and 3 in Brochmann & Gleditsch (2006), the results are quite different, except for the variables in the gravity model. These differences seem most likely to occur from the fact that I use OLS with a lagged dependent variable with SPSS, whereas Brochmann & Gleditsch (2006) used GLS regression with lagged panel corrected standard errors with STATA. In my analyses, the lagged dependent variables steal a lot of the effect from other variables, but excluding the lagged variables means ignoring the problem of autocorrelation. I decided to report both variants to show the differences in the estimates.

Since I did not succeed in my replication of Models 2 and 3 I have decided to abandon further investigation of the determinants of cooperation. Instead, I concentrate on a more detailed analysis of the determinants of conflict, and in particular my IRO variables. I will only be able to answer a part of my research question, and to test Hypotheses 1, 3, 5, and 7 in the following analyses.

The control variables in Model 1 and in my Model 4 all perform very much in accordance with the theoretical assumptions. Peace history has a negative effect on conflict. Regime type with Two democracies as the reference category is the most stable. All the dummy variables controlling for regime type are positive in relation to the reference category in the model of MID onset, meaning that two democracies are less likely to start a conflict. All the variables show significant results which support the liberal peace theory, mentioned earlier in Sections 1.2, 2.1, and 4.6.2. The gravity model underlines the importance of proximity. The logical arguments for using the gravity model as a baseline model for states' interaction is also clearly supported since the impacts of the gravity variables are considerable (Brochmann & Gleditsch, 2006: 18). Almost all variables in the gravity model show significant results. An exception is that Major power does not have a significant effect on MID onset, although it comes close. The GDP variables display some collinearity problems. GDP in the largest dyad correlates with GDP in the smallest dyad at 0.87. This is critically high. The

collinearity test gives a tolerance value of 0.192 and VIF value of 5.203 for the smallest GDP in the dyad and tolerance value of 0.223 and VIF value of 4.887 for the largest GDP in the dyad. The standard error of the estimates is doubled when VIF is 4.0 and tolerance is .25. This will lead to overlapping confidence intervals and the likelihood of finding any significant results is reduced. Generally, a tolerance value less than 0.3 and a VIF value over 3 indicate multicollinearity, although scholars use different cut-off points. A cut-off value of VIF=4 is arbitrary but common for deciding when a given independent variable displays too much multicollinearity, but some researchers use the more lenient cut-off of 5 or even 10.[53] A researcher may wish to drop the variable with the highest VIF if multicollinearity is indicated and the theory warrants it. My analyses indicate that there is some collinearity, but since these variables are in the gravity model and I use them as controls I decided to keep them in the further analyses.

In the replication of the logistic regression analyses on MID onset, the Hosmer–Lemeshow test, which gauges the overall fit of the model, shows acceptable level with a p-value of 0.17.

The dyad-years for the next analyses will be considerably reduced since I will analyze dyads from 1950 to 2000 sharing an international river basin. This reduces the dyads from approximately 83,406 dyad-years to 11,111 dyad-years. Of 86 IROs, 79 were founded after 1950. When the drought variable is included, results are reported from 1975–2000 which reduces the observations to 5,780.

5.2 The impact of IROs on conflict

The next step in the analysis is to include the IRO variables in the conflict model. In Table 5.2 I report the results from bivariate analyses for two independent variables measuring IRO membership for all dyads between 1950 and 2000. One is whether

[53] See http://faculty.chass.ncsu.edu/garson/PA765/regress.htm#toleranc.

both countries in the dyad are members of the same IRO, the other whether at least one of the countries is a member of an IRO.

Table 5.2 Bivariate analyses of the effects of IROs on MID onset

Variables	MID onset
IRO in dyad	1.717*** (0.072)
Both members of same IRO	1.591*** (0.086)
N	83406
* p <0.10, ** p < 0.05, *** p<0.01. S.E. in parentheses	

Both IRO membership variables were significantly associated with conflict in bivariate analyses. The exp(1.717) means that the odds are 5.5 times higher for MID onset in dyads where at least one country is member of an IRO. In other words, the likelihood for conflict is considerable higher in dyads with at least one IRO compared to other dyads without any IRO memberships. In dyads where both states are members of the same IRO the odds for MID onset decrease to about 4.9 (exp(1.591)), but the likelihood is still much higher than for other dyads.

In Table 5.3 I report the result for the same IRO variables in a full logistic regression analysis with all dyads from 1950–2000 with the same control variables as in Table 5.1. I do not report the control variables from Model 5.1, since the estimates and their significance barely changed when adding the IRO variables.

Table 5.3 Multivariate logistic regression analyses of the effect of IROs on MID onset

Variables	MID onset
IRO in dyad	0.450*** (0.095)
Both members of same IRO	0.413*** (0.086)
N	83406
* p <0.10, ** p < 0.05, *** p<0.01. S.E. in parentheses	

In the full regression model both IRO membership variables remain significant at the 1% level. As expected, the effect decreased relative to the bivariate analysis. The odds of MID onset in dyads with at least one country being member of an IRO are approx.

1.6 (exp(0.450)) compared to dyads without membership in an IRO. The same applies for dyads where both countries are members of the same IRO. The odds for conflict are approximately 1.5 compared to dyads where both countries are not members of the same IRO.

The results are counterintuitive and do not support any of my hypotheses regarding the impact of IROs on conflict. We often obtain significant results when the number of observations is high, almost regardless of what variables we include in our model. However, the results in Models 5.2 and 5.3 are not supported by theory. Why would IROs stimulate conflict? One possibility for the puzzling result is that the analysis includes dyads that do not share a joint water resource? I decided to eliminate these dyads and include only dyads sharing an international river basin, since it is here we would expect a shared IRO to have an impact.

5.2.1 The impact of IROs on conflict in dyads sharing a river basin

First I will investigate international river organization's effect on conflicts for all dyads sharing a river basin between 1950 and 2000. Following Gleditsch et al. (2006) I include basin size and drought as additional control variables[54]. Gleditsch et al. found basin to have a positive and significant effect on conflict. This runs counter to the idea of scarcity causing conflict, but the size of the basin might be a measure of the total value of the resource. The greater the value, the more to compete for, and the greater the potential importance of an IRO as a management tool. The scarcity variable will pick up whether or not water scarcity also matters. In theory, a large shared basin might be even more important to a water-scarce country. Based on this assumption I decided to include an interaction term between the basin size variable and my main independent variable, Both countries in dyad member of same IRO, and the same for drought.

The estimates from variables in bivariate analyses compared to the estimates from the same variables in analyses with multiple variables sometimes differ. If they do, it is a

[54] The substantial argument for this can be found in Sections 4.6.7, 4.6.9, and 4.6.10, and is therefore not repeated here.

strong indicator of confounding variables. Often variables tend to appear together which makes it hard to distinguish the relative significance of each variable. The estimates will be wrong and also the standard errors, which makes them harder to interpret substantially. This may lead to results that are not significant even if it is most likely that the variables, or at least one of them, are important factors. The problem of multicolinearity in multiple regression analyses is often present in social science, and the problem becomes even more relevant when an interaction term is added into the model which is often done to create a better model fit. The Hosmer-Lemeshow test is very useful in logistic multiple regression analyses and helps to explore the multiplicative nature of the model.

Ultimately this might lead to a false interpretation of the relationship between the dependent and the independent variables. The likelihood ratio test is useful to avoid falling into this trap. When two or more variables are confounded one way to solve the problem is to create one variable out of the confounding ones and add that variable to the model instead, but that complicates the substantial interpretation of the model.

The dependent variable is still dichotomous, so I continue with a logistic regression analysis. I first conducted a full multivariate logistic regression with MID onset as dependent and all the control variables from the replication (Model 7, Table 5.4) to see if it makes a difference that I now only analyze dyads sharing a river basin. Model 7 has only minor deviations in the estimates for all variables except Contiguity and GDP in the largest country in the dyad. Contiguity is no longer significant, which is surprising, since it is usually very robustly associated with conflict.[55] The reason why Contiguity is no longer significant might be due to the strong effects from the other variables included in the gravity model, since we now only analyze dyads sharing an international river. The dyads in this analysis are therefore more likely to be more proximate than dyads not sharing an international river. To check this I conducted an

[55] In the replication the correlation between Shared basin and Contiguity caused a serious correlation problem. See Section 5.1.

analysis with Inter-capital distance excluded, which led Contiguity to be significant at the 1% level. There is no sign of collinearity between Contiguity and the other independent variables, judging from their intercorrelations and from tolerance and VIF tests. Contiguity had a tolerance value of 0.855 and VIF value of 1.170, and Inter-capital distance had a tolerance value of 0.497 and VIF of 2.13, which is acceptable[56]. The correlation between Contiguity and Inter-capital distance is not very high at 0.28. Since Contiguity becomes insignificant when Inter-capital distance is included, I exclude Contiguity from further analyses. Inter-capital distance has a coefficient of –0.808 in Model 7, meaning that the odds of conflict are approximately 0.4 (exp (–0.808)) for dyads with proximate capitals, compared to other dyads.

In Model 7 there are some collinearity problems between the two GDP variables, between Major Power and Population in the smallest dyad, and also between the two Population variables, but I am not concerned here with the relative importance of the control variables. Multicollinearity among the control variables does not affect my research question as long as none of them correlate highly with my independent variable, and none of them do. I decided to keep the problematic control variables for which VIF was barely above 5.

[56] See Appendix 2 for collinearity diagnostics. I only report one matrix to give an example, but have run tolerance tests for all my analyses.

Table 5.4 Results of logistic regression of MID onset 1950–2000, full model

	MID onset				
Variables /Model	**7**	**8**	**9**	**10**	**11**
IRO in the dyad		0.099			
		(0.103)			
Both member of same IRO			0.097 (0.109)		
Bilateral IRO in the dyad				0.186 (0.154)	
Multilateral IRO in the dyad					–0.110 (0.137)
Gravity model					
Inter-capital distance (log)	–0.808*** (0.078)	–0.803*** (0.077)	–0.800*** (0.079)	–0.792*** (0.085)	–0.831*** (0.082)
Contiguity	–0. 01 (0.19)				
Population in the largest country (log)	0.275*** (0.058)	0.225*** (0.051)	0.226*** (0.051)	0.235*** (0.055)	0.241*** (0.055)
Population in the smallest country (log)	0.275*** (0.056)	0.292*** (0.056)	0.290*** (0.056)	0.282*** (0.058)	0.284*** (0.058)
GDP per capita in the largest economy (log)	0.068 (0.103)	0.034 (0.105)	–0.035 (0.105)	0,050 (0.107)	0.039 (0.108)
GDP per capita in the smallest economy (log)	–0.353** (0.115)	–0.364*** (0.115)	–0.366*** (0.115)	–0.383*** (0.1189	–0.357*** (0.117)
Major power	–0.316 (0.208)				
Other control variables					
Peace history	–3.366*** (0.122)	–3.361*** (0.120)	–3.362*** (0.120)	–3.323*** (0.124)	–3.321*** (0.124)
One democracy	1.048*** (0.258)	1.001*** (0.255)	0.995*** (0.255)	0.950*** (0.257)	0.942*** (0.256)
Two autocracies	1.155*** (0.274)	1.108*** (0.273)	1.101*** (0.271)	0.993*** (0.274)	0.984*** (0.273)
Unconsolidated regimes	1.257*** (0.264)	1.200*** (0.261)	1.195*** (0.261)	1,128*** (0.263)	1.121*** (262)
Size of shared basin		–0.031 (0.036)	–0.029 (0.036)	–0.041 (0.037)	–0.018 (0.042)
Size shared bas.*both member			–0.042 (0.061)		
Constant	–3.528*** (0.998)	–2.562*** (0.984)	–2.551* (–0.981)	–2.371** (0.989)	–2.541*** (0.988)
Hosmer–Lemeshov p-value	0.95	0.40	0.68	0.34	0.561
Pseudo-R^2 (Nag.k)	0.389	0.385	0.385	0.384	0.384
-2LL	2,877.7	2,878.8	2,878.2	2697.2	2697.9
(n)	11,111	11,111	11,111	11,111	11,420

Standard errors (S.E.) in parentheses
* p <0.10, ** p < 0.05, *** p<0.01.

The regime type variables were all significant compared to the reference group (Two democracies), as expected from liberal peace theory. Surprisingly, dyads with a major power have less conflict, although the relationship is not significant. However,

Brochmann & Gleditsch (2006: 15) did not find any significant result for this variable either. Major power correlates 0.65 with Largest population in the dyad. Thus, the standard error of the estimates increases by more than 25%. Together with fewer observations (11,111 instead of 83,406), this might explain why this variable is not significant.

5.2.2 IROs in the dyad and MID onset

Model 8 seeks to test Hypothesis 1, whether dyads with at least one IRO membership have a lower propensity for conflict. Basin size is included as an additional control variable. Since I do not suspect interaction between the size of the water resource and membership in IROs I do not add an interaction term to this model. However, in Model 9 I add an interaction term between Basin size and Joint membership in an IRO. I did, however, also explore if there could be interaction between Basin size and IROs in the dyad (Model 8). This investigation showed hardly any interaction, since the estimates from the analysis with and without the interaction term were not significantly different from each other, and did not improve the explanatory power of the model.

Major power is not significant in the replication of Brochmann & Gleditsch (2006) or in the analysis with dyads sharing a basin. This variable is also excluded from the analyses together with contiguity. The control variables will only be discussed here if the analysis yields results that require further explanation.

Tolerance and VIF values showed no signs of collinearity, other than that mentioned in Section 5.2.1. The independent variable does not correlate highly with any of the control variables. Basin size has a correlation of 0.486 with Inter-capital distance. When eliminating Inter-capital distance from the model, Basin size becomes significant at the 1% level. Since Inter-capital distance is a very important control for investigating conflicts, and basin size probably is too, I have decided to keep them both.

The coefficient for the variable IRO in the dyad reports an exp(0.099), which means that the odds for MID onset in dyads where there is an IRO is 1.1 compared to dyads that do not have an IRO. This result is counterintuitive, and goes against my expectations, that IROs would reduce conflicts, not enhance them. But the result is not close to being significant with a p-value of 0.34. Model 7 has a better fit than Model 8, with a higher R^2 and a higher Hosmer-Lemeshov value. It makes no sense comparing the two –2LL values, since Models 7 and 8 are not nested[57]. If they had been nested, –2LL could give us valuable information.[58] The difference between the models is minimal. The results do not support Hypothesis 1, that a dyad where at least one state is member of an international river organization has less conflict than dyads where no states are members.

5.2.3 MID onset in dyads where both countries are members of the same IRO

Model 9 has Both countries member of same IRO as an independent variable. In this analysis, I will add an interaction term between my independent variable and Basin size. Even though Basin size was not significant in the previous model we might find that it will be in interaction with joint membership in the same IRO. If two countries share a large water basin they are probably more likely to be member of the same IRO to manage the resource. I first conducted the logistic regression analysis with an ordinary interaction term. The tolerance test discovered extreme values for some of the variables with a tolerance of 0.17 and VIF of 57. Interaction terms are particularly prone to multicollinearity problems. To try to reduce the multicollinearity between my main independent variable and the interaction term, I centered the variables by subtracting the mean. I then computed a new centered interaction term. A new test showed that the tolerance values for the problematic variables now ranged from 0.53 to 0.99 and VIF between 1.00 and 1.90. Thus, the collinearity problem had been eliminated. The new lower estimate of 0.097, after the correction of the collinearity

[57] If all explanatory variables in one competing model is a perfect subset of variables included in a second model, then we may say that the first is "nested" within the second, and a likelihood ratio test is appropriate to assess the empirical adequacy of one model against another (Gujarati, 2003: 530).

[58] This is like a t-test in OLS regression.

problems, means that the odds for going to war are 1.1 (exp(0.097)) in dyads where both countries are members of an IRO compared to dyads where at least one country is not. The results do not supported liberal peace theory and neoliberal institutionalism that led me to believe that less conflict would follow cooperation between states. On the other hand, increased interaction also can be a catalyst for increased conflicts, especially between dyads experiencing water stress. However, none of the variables was significant. The Hosmer-Lemeshow value of 0.68 in Model 9 is lower than in Model 7, and the squared-r value is also unchanged. Hypothesis 3, that a dyad where both states are members of the same international river organization has less conflict than other dyads, is not supported. The variables that were included in the interaction term did not change when I removed the interaction term from the analysis, which mean that there is hardly any interaction between them. The interaction term will be excluded from further analyses.

5.2.4 MID onset and membership in bilateral and multilateral IROs

These analyses were designed to answer Hypotheses 5 and 7. For Models 10 and 11, I discuss only the results from the new variables in the analyses, since none of the control variables change very much. Since I did not find any significant results from the analyses of Models 8 and 9 regarding IRO membership, it was unlikely that I would get any significant result when using disaggregated data with even fewer observations. The variable measuring whether or not both countries are members of the same bilateral IRO is not significant (p-value of 0.22). The R^2 is reduced with 0.05 percent from 0.39 in Model 8 to 0.38 in Model 10, which means it explains less. Since the models are non-nested, a –2LL test is inappropriate. The Hosmer-Lemeshov test shows that the previous Model 8 has a better fit to the data since the values reported decrease from 0.68 to 0.34. Hypothesis 5, that dyads where both states are member of the same bilateral international river organization have less conflict than other dyads, is not supported.

The effect of multilateral IROs MID onset, with a p-value of 0.42, is even further from being significant than bilateral IRO membership in the dyad. The Hosmer-Lemeshov

value (0.56) shows a better fit for Model 11 compared to Model 10, but is has a poorer fit than Model 9. Hypothesis 7, that dyads where both states are member of the same multilateral international river organization have less conflict than other dyads, is not supported.

So far I have not succeeded in yielding any significant results for IRO membership on conflict. My next analyses will investigate membership in IROs in relation to water scarcity for dyads sharing water basins.

5.3 IROs impact on MID onsets in dyads with water scarcity

Out of 86 IROs worldwide, 48 were founded in 1975 or later. A large share of my observations is within this time period. We also know that water stress is a relatively new phenomenon and that it is closely connected to countries' development level, population size, and water availability. Since the available water scarcity data only cover the time period from 1975, this analysis is limited to the period from 1975 to 2000. A water crisis or water scarcity of any kind is likely to set focus on the water issue and that probably increases the likelihood of both cooperation and conflict. According to the neomalthusians limited access to resources is critical for a region's stability. Water scarcity therefore might show to be significantly associated with conflict. The cornucopians on the other hand, emphasizes that there is enough water resources and that the process of distributing this will lead to cooperation. I believe water scarcity to motivate states to join IROs to secure satisfactory water supply. This is highly relevant e.g. for the Nile water basin where ten states share a common water resource, and several of them have often experienced water scarcity. The water is especially needed for irrigation, to feed a growing population and for hydro-power. The potential water stress will probably initiate or increase cooperation, but may also lead to MID onsets. Water issues are especially important for Egypt which is downstream from all the other states. Controlling water access by joining IROs and other formal agreements with other states is crucial for their survival. Based on this example I expect there to be interaction between IRO membership and drought. To investigate this I will include an interaction term in my model. I will not discuss the

result from the other control variables in the analyses unless they change significantly from the replication. A brief investigation of the drought and IRO membership variables in bivariate analyses shows that drought was significantly related to conflict at the 1% level, but that the odds for MID onset is 0.6 for dyads that have experienced drought compared to dyads that have not. This supports the cornucopian view that resource stress probably will enhance cooperation rather than stimulate conflict as argued by the neomalthusians. My IRO variables point in different directions. Table 5.5 shows that the presence of an IRO in the dyad increases the likelihood of a MID onset. In dyads where both countries are member of the same IRO, the likelihood of MID onset is reduced. This is understandable considering that many of the IROs are bilateral whereas many international rivers are shared by more than two countries.

Table 5.5 Bivariate analyses of MID onset

Variables	**MID onset**
Water scarcity (drought)	–0.558***(0.128)
IRO in dyad	0.085 (0.137)
Both member of same IRO	–0.068 (0.133)
(n)	5780
* p <0.10, ** p < 0.05, *** p<0.01. S.E. in parentheses	

In other words, two countries can reach an agreement beneficial for the two countries that is not necessarily beneficial for the other states in the shared water basin, and this may increase the tension in other dyads. A dyad where both states are members of the same IRO will therefore reduce conflict, and the opposite may be the case for dyads where only one country is member of an IRO. This scenario was discussed in Section 3.2. The results from the IRO membership variables were not significant so I have come no further in finding support for my basic hypotheses.

I conducted a multivariate logistic regression model with only the control variables from the replication first, except Contiguity and Major power since they were not significant in any of my previous analyses. After this I ran a full logistic regression analysis with Basin size, Drought, IRO in the dyad and an interaction term between IRO in the dyad and Drought. I compared the –2LL values from the two models and

the latter model was a significantly better model.[59] I ran a full regression model with all the variables to check if anything changed, from the bivariate logistic regressions. The full models were conducted with all the control variables used, except the interaction term between Both countries member in the dyad and Basin size, which displayed hardly any interaction and was not significant. Basin size was not significant in Models 8 and 9, but I decided to keep it in the next model together with Drought. In addition I included an interaction term between the IRO membership variable and Drought. The interaction terms have been centered to reduce collinearity. A tolerance test reports no collinearity problems for any of the new variables entered in the models with acceptable VIF and tolerance values. Table 5.6 reports all the results from the analyses. In Model 12 the presence of an IRO in the dyad is still not significant ($p = 0.34$), but it is in the interaction term with the water scarcity variable ($p = 0.044$). For IROs in dyads which also have experienced drought the odds for MID onset are 0.4 compared to other dyads, everything else being equal. The presence of an IRO in a dyad gives odds of 1.2 (exp(0.165)) for MID onset compared to dyads without IROs. Water scarcity is significant at the 5% level. The odds for MID onset in dyads that have experienced drought are 0.7 compared to other dyads. Basin size is very close to being significant at the 5% level ($p =0.056$). The larger a water basin the less likely it is that there will be conflicts in the dyad, everything else being equal, with odds of 0.9 (exp(–0.11). All other control variables reported results as expected, with Peace history and Inter-capital distance as the strongest predictors for conflict reduction in dyads. The regime type variables all increase the likelihood of MID onset compared to the reference category Two democracies

[59] These models are nested so a -2LL test is appropriate. -2LL (first model) – -2LL (last model) = 1,390-1,378 = 12. With 4 df. (4 additional variables were added to the model) the critical value is 9.49. The full model with all the extra variables is probably a better model investigating MID onset.

Table 5.6 Results for logistic regression of MID onset 1975–2000, full model

Independent variable/Model	12	13
IRO in the dyad	0.167 (0.176)	
Both countries member of IRO		0.371** (0.176)
Gravity model		
Inter-capital distance (log)	–0.605*** (0.125)	–0.59*** (0.124)
Population in the largest country (log)	0.128 (0.079)	0.124 (0.079)
Population in the smallest country (log)	0.431*** (0.089)	0.435*** (0.089)
GDP per capita in the largest economy (log)	–0.088 (0.153)	–0.022 (0.151)
GDP per capita in the smallest economy (log)	–0.446*** (0.161)	–0.515*** (0.163)
Other control variables		
Peace history	–3.431*** (0.175)	–3.301*** (0.176)
One democracy	0.601** (0.293)	0.687** (0.294)
Two autocracies	0.646* (0.338)	0.751** (0.340)
Unconsolidated regimes	0.774*** (0.307)	0.835*** (0.309)
Size of shared basin	–0.107* (0.056)	–0.123** (0.057)
Drought	–0.398** (0.178)	–0.394** (0.175)
Drought*independent	–0.639** (0.318)	–0.159 (0.306)
Constant	–0.922 (1.451)	–0.924 (1.458)
Hosmer-Lemeshov p-value	0.40	0.89
Pseudo-R^2 (nag.k)	0.386	0.386
-2LL	1,378	1,379.3
(n)	5,780	5,780

S.E. in parentheses
* p <0.10, ** p < 0.05, *** p<0.01.

From this analysis we found some support for Hypothesis 1, but only for dyads that have also experienced drought. For all other dyads IROs seem to have the opposite effect and the likelihood for conflict increases with the presence of an IRO. As mentioned earlier, this might be due to the fact that some IROs reach agreements affecting all dyads but which might benefit only a few dyads, and hurt others in the same shared basin. In situations with water scarcity, dyads are forced to cooperate. Reaching agreements regarding important water resources is therefore highly relevant. Based on this I decided to also conduct a new analysis with an interaction term

between basin size and IRO membership. When adding this variable to the model, the interaction term between IRO membership and drought was no longer significant, but the new interaction term between basin size and IRO membership was significant at the 5% level ($p = 0.014$). The presence of IROs in large water basins that also have experienced drought seems to reduce conflict.

In Model 13 the variable measuring if both states are members of the same IRO yields a surprising and significant result. The odds for MID onset in dyads where both countries are members of the same IRO are 1.4 compared to other dyads, everything else being equal. I have no explanation for this. I expected the presence of an IRO where both countries are members of the same IRO to reduce the conflict level in a dyad, not to increase it. Hypothesis 3 is not supported. In interaction with the drought variable the likelihood of MID onset in a dyad where both countries are member of the same IRO is lower than for other dyads. This is more in accordance with my theoretical assumptions but the result is not significant. Perhaps states that have not experienced water scarcity will fight for the water instead of reaching peaceful agreements? That fighting for the resource is not so threatening, since they never have experienced water stress? Fighting over water for other reasons than sustaining life is legitimated but when it is threatening life one cannot lose and this is a major motivator for cooperation? All other variables in Model 13 report results as expected and did not change much compared to Model 12.

Models 14 and 15 investigate the relationship between membership in bilateral and multilateral organizations and conflict in dyads. These are disaggregated data from the Both countries member of the same IRO variable. The interaction term between the shared IRO membership variable and drought was not significant and is therefore excluded. Only the estimates for the new variables are reported in Table 5.6, since none of the other controls changed significantly.

Table 5.6 Results of logistic regression of MID onset 1975–2000, full model

Independent variable /Model	14	15
Member of same bilateral IRO	0.167 (0.241))	
Member of same Multilateral IRO		0.110 (0.201)
Hosmer-Lemeshow	0.973	0.878
Pseudo-R2 (Nag.k)	0.38	0.379
N	5437	5437
S.E. in parentheses * p <0.10, ** p < 0.05, *** p<0.01.		

Nothing in Models 14 or 15 supports my Hypotheses 5 and 7. From the analysis we do not know of any significant effect for dyads with multilateral or bilateral IRO memberships on MID onset in dyads. The Odds for MID onset are approximately 1.2 for dyads with bilateral IRO membership. The odds for MID onset in dyads with multilateral IRO memberships are a little bit lower with odds of 1.1 compared to dyads without IRO membership. Since none of the estimates are significant my hypotheses are not supported.

5.4 IROs impact on MID onsets in dyads between 1990–2000

In this chapter I investigate the period after the Cold War. In these analyses I will not analyze bilateral and multilateral IROs unless I yield very strong results from the variable Both countries member of the same IRO. None of the earlier analyses has reported any significant differences between these IROs and the estimates have only reported minor differences between the two of them.

Neomalthusians emphasize that resource and environmental issues are becoming more important conflict factors, since the end of the Cold War unlocked the world from a tightly bipolar confrontation between East and West (Toset et al., 2000: 981). Resource scarcity challenges shared water resources, and this question has become more serious because of population growth and increasing consumption. Water issues are more important factors regarding both cooperation and conflict. This increased focus on natural resources after the Cold War has probably provided an added

incentive for establishing IROs to meet the challenge of water stress and shared water basins. 31 of 86 IROs were founded after the Cold War (Dombrowsky, Table A-1: 330–360) In Table 5.7, I only report the results from the IRO variables, and the interaction terms between my IRO variables and Drought and between my IRO variables and Basin size.

All the other controls show the same tendencies, but the regime type variable Two autocracies is no longer significant. Peace history and Inter-capital distance are the strongest and most significant predictors for conflict. In Model 16 dyads where at least one state is member of an IRO is significantly related to conflict with a p = 0.023. The odds for MID onset are 1.8 compared to all other dyads, everything else being equal.

Table 5.7 Results logistic regression of MID onset 1990–2000, full model

Independent variable/ Model	16	17
IRO in the dyad	0.611** (0.269)	
Both countries member of same IRO		0.092 (0.254)
IRO and Drought	–0.721 (0,071)	0.299 (0.426)
IRO and Basin size	–0.071 (0.130)	0.323 (0.168)
Hosmer-Lemeshow	0.228	0.877
Pseudo-R2 (Nag.k)	0.313	0.305
N	3202	3202

S.E. in parentheses
* p <0.10, ** p < 0.05, *** p<0.01.

This change in interaction with the Drought variable. The odds of 0.49 means that the likelihood for MID onset in dyads that also have experienced drought is reduced compared to all other dyads. This result was not significant (p = 0.13). The same applies to the interaction term between Shared basin and IRO in the dyad. The likelihood of MID onset is reduced when the size of a water basin increases. In Model 17 all the control variables again show the same tendencies and all regime type variables are significant. Neither Drought nor Basin size is significant in this model. The odds for MID onset increase slightly in dyads with joint IRO membership with odds of 1.1 (exp(0.086)), but the result is not significant. The interaction term with

basin size is close to significant (p = 0.055). The likelihood for MID onsets increases with larger water basins, everything else being equal.

The Hosmer-Lemeshov value has a much lower value compared to all the other previous models, which means that the model is less suitable for the data. From the previous models the R^2 is reduced. Model 17 has a better fit to data with a higher Hosmer-Lemeshow value, but the model explains even less of the variance in the dependent variable.

Based on the analysis, none of my hypotheses are supported. Where I yielded significant results, the likelihood of MID onset increased and was not reduced as I expected from Hypothesis 1. I have argued earlier that this may be due to some IROs reaching agreements with negative externalities. The joint membership variable was not significant at all, not even in the interaction terms. Thus, Hypothesis 3 is not supported. It is hard to explain why. By theoretical assumptions it is hard to argue that cooperation through IROs leads to increased conflicts. One possible explanation might be that most of the IROs are established between dyads where there is tension and need for cooperation to lessen the tension. However, I do not have data to test this possible explanation.

5.5 IROs impact on MID onsets in specific regions

Following leads in some of the earlier research, I decided to test if some regions with high water stress, such as Sub-Saharan Africa (SSA) or the Middle East/North Africa (MENA) exhibited different patterns regarding IRO membership and conflict. 27 IROs are established in these two regions. 17 IROs of them were founded in the late eighties and until 2002. The region variables are originally from Gleditsch et al. (2006). The next analysis covers the time span from 1975 to 2000 for dyads also sharing a water basin. This reduces the observations in Model 18 to 2,477 dyad-years in SSA, and in Model 19 to 845 dyad-years in MENA. In this period 71 MID onsets with at least one casualty have been observed in SSA and 75 in MENA. The region variables are both expected to have a negative effect on conflict when used in an interaction term with

the variable Both countries in the dyad member of the same IRO. This follows from the theoretical perspective that the underlying threats of water stress can lead to cooperation as well as confrontation. Cooperation through IROs might reduce conflict in these regions. The countries are often poor, with limited means to cooperate. In addition they often have unstable regimes, which may also stimulate conflict and inhibit cooperation

The results from these analyses were not encouraging. Not even the control variables were significant, except Peace history. This variable has been the strongest predictor for reduced conflict throughout all my analyses. My IRO variables were not significant either alone in bivariate analyses or in the full model. The results will therefore not be reported.

5.6 A short summary of the analyses

To answer my four hypothesis regarding IRO membership and MID onset, I started with a replication of Brochmann & Gleditsch (2006). Their analysis provided support for the importance of shared basins for conflict and cooperation. In addition Gleditsch et al. (2006) found that the size of a shared basin was significantly related to conflict. Based on these results I wanted to investigate whether international river organization could add to our understanding of conflict and cooperation in dyads sharing a water basin. However, a long road through multiple analyses yielded very little. Because of a major problem with the replication of the analysis regarding cooperation, that part of my research question could not be pursued empirically. When analyzing the effect of IROs on conflict there was only little support for my hypotheses. The significant effect of IRO memberships in dyads also sharing water basin in the period between 1975 and 2000 contradicts my hypothesis. A similar significant result was found for the period between 1990 and 2000. In the same time period (1975–2000), the presence of an IRO that includes both countries in the dyad was significantly related to reduced conflict if the dyad had also recently experienced drought. This was the closest I got to finding support for a part of my research question.

6.0 Objectives

The validity of all research will always be dependent on the researcher's ability to consider the right factors. Militarized disputes arise for a variety of reasons. If we find a correlation between membership in IROs and cooperation, we cannot be certain whether the membership caused cooperation directly or whether it simply had an indirect effect, or if the effect was spurious. The same applies for the correlation between membership in international river organizations and conflict. The research on this subject has to develop further and only a few analyses are never enough to build any durable theory. All results therefore have to be interpreted with circumspection. How much does the theoretical assumption and predictions match with the empirical findings? Have we asked the right questions and picked the most relevant variables? Are the operationalizations of the variables good enough or are they questionable? How good is the quality of the data? And finally, is the model fit for the data, so the interpretations of the results give any substantial meaning? The analysis of TSCS (time series cross sectional) data is very challenging. Often researchers are not skilled enough to build proper models to fit the data. The more variables in a model, the easier it is to build castles in the air. It can be hard to know if we analyze real causal relations or only random noise. The traps are many, and often the researcher prestige is at stake. Is it possible that the eagerness to reach significant result for a theory one believes in, sometimes can make researchers close the eyes for obstacles they should have taken more seriously? Are all the conditions fulfilled for the different statistical methods so that we assume that the results are trustworthy? This is probably the case for the logistic regression in this thesis, since e.g. the time dependence is not given much consideration. Logistic regression is a useful method since it has fewer requirements. However this does not mean that logistic regression models are not also influenced by e.g. autocorrelation and heteroskedasticity. During my work with this thesis I experienced that the conditions for different statistical methods often are not met, e.g. normal distributions, heteroskedasticity, uncorrelated errors among the independent variables etc.. It is extremely difficult to build good models for complex research questions. It seems to be a common challenge in social sciences which really set high

demands on the researcher. On the other hand the aim to reach generalized conclusions can easily drown in all the objections both to design, methods and data used (Dombrowsky, 2007: 120). That is not the purpose. One has to be able to say something about a complex world, but figures from different analyses have to be interpreted with prudence.

7.0 Concluding remarks

In this thesis my focus has been on water and how water might influence both possibilities for conflict, but also cooperation, by looking at the role played by IROs. Scholars have long been interested in understanding the relationship between resources, conflict, and cooperation. A lot of attention has been given to the role of water as a causal factor in conflicts between countries, but scholars still disagree about the importance of water in such conflicts. In general, major obstacles towards cooperation and also incentives for conflicts are due to absence of an authority in an anarchic world system. The lack of definite property rights, information uncertainties, asymmetries, and lack of an external and plausible enforcement authority influence the outcome and limit effective cooperation. Some of these obstacles, however, can be remedied by functional institutions (Dombrowsky, 2007).

The gravity model has proven to be a very robust and useful model for examining international relations. Measures of size and distance have proven to have an important impact on states' interaction, and variables operationalizing these measures should always be present in such models. Other commonly used control variables when investigating conflict and cooperation were almost all, without exception, robust predictors for conflict and cooperation. The gravity model and the other control variables used in my analyses have proven to be long lived and hard to falsify. With this robust model I did not succeed in getting much support for IROs importance to dyads sharing a common water resource. The results from my analyses of IRO's influence provide partial support for only one of my eight hypotheses.

My main goal with this thesis, to explore the role of IROs in the interaction of states, was somewhat ambiguous. But with the increased focus on water resources and establishment of IROs to meet the challenges of water scarcity, it is necessary to start investigating whether these organizations can make a significant difference in conflict reduction and cooperation enhancement. In social sciences the main goal is never only to get significant result, but when significant effects are found, it provides a foundation

for development of new tools for further investigations. To even be able to come forth with political recommendation one really has to base one's research on durable theories and robust meaningful analyses. Sometimes theory is in a position to predict outcomes and point to ways for improvements. The research can identify gaps and point to areas where further research is needed. Other times theory does not hold water when it faces empirical evidence.

In Section 3.2 above I described a scenario where only a few countries might reach an agreement at the expense of other states in a shared water basin. Most IROs are bilateral and many rivers are shared by more than two states. So it is likely that disputes might even increase regarding water resources with the presence of an IRO. Further research might be undertaken to investigate whether there is less conflict and more cooperation between dyads where all states riparian to a river are members of a joint IRO compared to dyads where not all states riparian to the shared water are represented. Another aspect which would be interesting for further elaboration is upstream/downstream scenarios, especially in relation to the geographical location of a more powerful state in the international river basin.

Many IROs have a narrow and sectoral focus, but in these analyses presented here they are all analyzed together. To gain more knowledge about international river organizations' effectiveness it is necessary to be more specific and improve the data being used. There is need for more knowledge about each IRO to assess the effectiveness, and to trace the causal relationships between institutional design and states' interaction. One suggestion is to disaggregate the IRO data even further, and distinguish between different issue areas upon which the different IROs are focused. For instance, some IROs may be very specific, working either with water quality or quantity. Others work only with regulations concerning fisheries and navigation. Analyzing them, while disregarding these differences, might therefore be a weakness in the research design. But with the time frame of this thesis, disaggregating the IRO data further than down to bilateral and multilateral IROs was not possible.

The results in many of the analyses contradict my hypotheses by predicting increased conflicts with the presence of IROs. There might be coherence between establishment of IROs and the history of conflict in specific regions. More IROs might have been established in regions where the conflict level is high and the need for cooperation is pressing. In this perspective my results from the analyses is understandable, but IROs cannot be interpreted as a cause of the conflict. We need more research to elucidate this.

The only significant result supporting one of my hypotheses was in dyads that also recently had experienced water scarcity. This gives an incentive to establish IROs in certain regions vulnerable to drought. States can be rewarded with reduced conflict levels and more peaceful cooperation by establishing a well functioning IRO. In other regions, nothing in my analyses support a conflict reducing effect of IROs.

Conflicts have complex causes and it can be very complicated to distinguish between them. Water is often mentioned as a conflict trigger but hardly any conflicts between states are solely explained by water disagreements. Water interests are often more hidden, like e.g. in the Kashmir conflict between India and Pakistan, and most likely water is a very important cause of China's occupation of Tibet too. In Section 1.3, I cited Gleick's (2008) categorization of different ways in which water is related to conflict. The MID data could be recoded to be better suited to explore water's importance in states' interactions using these categories. Improvement of the data will probably improve the precision and focus on target questions. These important questions should be addressed in more detail in further studies.

Since I could hardly find any significant results to support my hypothesis regarding the importance of IROs in interactions between states, would it be expedient to further institutionalize cooperation over international waters? To this I would nevertheless say yes. The IWRM concept (International Water Resource Management) might be too all-embracing and complicated, but it does not mean the subject matter is not important. The literature on international river management suggests that IROs can play an

important role in bringing about cooperation. However, knowledge about how such institutions is most effective remains limited (Dombrowsky 2007). Ideally a well-functioning institution can help states to share the benefit and costs of shared rivers peacefully, and maybe even more efficiently. To further investigate IROs I would say we need both statistical analyses and in-depth studies to complement each other to develop this research further. Especially important will be comparative studies to find out what institutional features are most successful and what is less so. Building institutions take decades, and each IRO has to adapt to specific circumstances and challenges. There will never be a "one design fits all" for IROs.

Both neomalthusians and cornucopians will probably find some support for their future scenarios. Water is a fundamental resource but also renewable which naturally is likely to booster both friendly and hostile interactions between states sharing international waters.

8.0. References

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Appendix 1: Codebook for the IRO variables

The sources of the following variables are from Dombrowsky (2007: Table A-1, 330–360).

Variables

International river organizations

All the IROs in Table A-1 are coded by number 301 to 399 and 101 to 103. Each organization has its own number. Where a country is member of more than one organization it is given a composite number.For instance, if a country is member of organization 301 and 302 it is given the number 301302. Where a country is member of more than four river organizations they are given one "three digit" joint number. E.g. France is member of five IROs in the Rhine river basin. Instead of a fifteen digit long number (378379380381382383), France is given 385.

The first two variables coded in the dataset show if state a or state b in a dyad (a-b) have membership in an international river organization, and which specific IRO it is.

For instance, if Syria is only member of the Joint Syro-Jordanian Commission, and Jordan is member of the same IRO and in addition a member of the Joint Water Committee, they are given the codes 336 and 336337. By the numbers we can go to Table A-1 and see which specific IRO they belong to. The coding was done this way in order to make it possible to further disaggregate the data into, for instance, the main issue areas of the IROs. From these codes we also know if the IRO is bilateral or multilateral if the same numbers appears for several dyads, or only once.

Year both countries became members of the same International River Organization

This variable is coded with the year both countries in a dyad became members of the same international river organization. It is later recoded into a dichotomous variable and given 1 if it is an IRO both countries are member of in the dyad, and 0 otherwise.

From this variable I coded two variables stating whether both countries in a dyad are members of the same multilateral or bilateral IRO. I did this by looking in Table A-1 for every IRO and found out how many states were member of the IRO, and by looking at the IRO numbers.

First organization founded in the dyad

The first international river organization founded is coded with the foundation year. Sometimes states are members of more than one international river organization. In those cases, the earliest foundation year is chosen. This variable is recoded into a dichotomous variable with the value 1 if there is an IRO in the dyad and 0 otherwise.

Other information regarding the coding

Dyads with the two German states, DDR and GFR: Dombrowsky (2007) does not provide information regarding DDR and GFR. Some information is missing about membership since Dombrowsky (2007) only uses Germany in her Table A-1, even several IROS were established during the Cold War when Germany was divided. I have e.g. coded the organization that was founded in 1974 (German-Czech Commission on Boundary Water) both for DDR and GFR for dyads from 1974 to 1989. For other information missing for DDR and GFR I have used a map to check where the river runs through Germany. If the river runs through both states, both dyads with GFR and DDR are coded, and only for DDR or GFR if the river runs through either one of them.

Table A-1 International River Basin Organizations (from Dombrowsky, 2007)

Int'l River Basin after TFDD*	**IRO Nr.**	**Area**	**Treaty Basins**	**Basin States**	**Organization**	**Foundation**	**Member States**		**Issue Areas**	
	No.	000 km²		No.		Year		No.		No.
Amazon	301	5.866,1	Amazon	8	Amazonian Cooperation Council	1978	Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Surinam, Venezuela	8	Ecology, Economic Development, Water Quality	3
Amur	302	2.085,9	Bulgan, Halah, Bor Nor, Lake, Kerulen/ Herlen He		Joint Committee on Transboundary Waters	1994	China, Mongolia	2	Ecology, Fishing, Flood Control, Infrastructure, Water Quality, Water Quantity	6
Aral Sea	303	1.231,4	Aral Sea, Amu Darya, Syr Darya	8	Interstate Council for the Aral Sea Basin Crisis with Standing Tashkent-based Executive Committee, Coordinating Commission on Water Resources, Commission of Social and Economic Development and Cooperation in Scientific, Technical, and Ecological Spheres	1993	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan; Russia as observer	5	Water Quality, (Water Quantity)	1+
Asi/Orontes	304	37,9	Al Asi, Orontes	3	Joint Technical Committee	1994	Lebanon, Syria	2	Infrastructure, Water Quality	2
Nile	365		Nile	10	Nile Basin Initiative	1999	Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda; Eritrea as observer	9	Ecology, Econ. Development, Erosion Control, Flood Control, Hydropower, Infrastructure, Irrigation, River Regulation	10+
Rhine	378	172,9	Rhine	9	Central Commission for the Navigation on the Rhine	1815/ 1868	Belgium, France, Germany, the Netherlands, Switzerland	5	Navigation	1+
Senegal	394	436,0	Senegal	4	Organization for the Management of the Senegal River	1972/ 1978/ 1982	Mali, Mauritania, Senegal, Guinea as observer	3	Ecology, Economic Development, Hydropower, Irrigation, Navigation, River Regulation, Water Quality, Water Quantity	8

Table A-1 is originally 22 pages long. Listed here are the first IROs (and the IROs mentioned in thesis) in the table in order to show how the variables were coded.

Appendix 2: Additional results from the analyses

Correlation matrix for the independent variables for dyads sharing a river basin for the period 1950–2000 (n=11,111).

Correlations

		peacehis peacehistory	onedemoc	twoautoc	unconsol unconsoli dated	majorpow majorpower	lndistan lndistance	lntotalb lntotalbasin	contigui contiguity	lnsmlpop	lnlrgpop	lnlrggdpcap Log large gdp per capita	lnsmlgdpcap Log small gdp per capita	IROindyad Det er en IRO i dyaden	both_mem begge land medlem av samma IRO	sentrertlbothmeandlntotal basin size and both member	bilat	multilat	lntotaland IROindyad
peacehis peacehistory	Pearson Correlation	1	-,075**	,076**	-,065**	,006	,115**	,076**	-,093**	-,068**	-,026**	,053**	,069**	-,018	-,025**	-,025**	-,033**	,076**	-,008
	Sig. (2-tailed)		,000	,000	,000	,536	,000	,000	,000	,000	,006	,000	,000	,058	,008	,008	,001	,000	,385
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
onedemoc	Pearson Correlation	-,075**	1	-,381**	-,392**	-,015	-,029**	-,111**	-,029**	,042**	,049**	,196**	,145**	,007	-,001	-,001	,010	-,106**	-,011
	Sig. (2-tailed)	,000		,000	,000	,105	,002	,000	,002	,000	,000	,000	,000	,487	,949	,949	,321	,000	,265
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
twoautoc	Pearson Correlation	,076**	-,381**	1	-,412**	-,059**	,074**	,165**	-,063**	-,067**	-,107**	-,373**	-,366**	,004	,022*	,022*	-,084**	,045**	,029**
	Sig. (2-tailed)	,000	,000		,000	,000	,000	,000	,000	,000	,000	,000	,000	,639	,020	,020	,000	,000	,002
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
unconsol unconsolidated	Pearson Correlation	-,065**	-,392**	-,412**	1	,052**	,105**	,037**	,017	,040**	,045**	-,182**	-,210**	-,012	-,005	-,005	-,102**	,027**	-,007
	Sig. (2-tailed)	,000	,000	,000		,000	,000	,000	,076	,000	,000	,000	,000	,192	,591	,591	,000	,005	,473
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
majorpow majorpower	Pearson Correlation	,006	-,015	-,059**	,052**	1	,291**	-,033**	,092**	,276**	,652**	,105**	,123**	,013	,020*	,020*	,011	-,236**	,008
	Sig. (2-tailed)	,536	,105	,000	,000		,000	,000	,000	,000	,000	,000	,000	,156	,034	,034	,263	,000	,413
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
lndistan lndistance	Pearson Correlation	,115**	-,029**	,074**	,105**	,291**	1	,476**	-,281**	,375**	,506**	-,236**	-,303**	-,002	-,024*	-,024*	-,146**	,000	,068**
	Sig. (2-tailed)	,000	,002	,000	,000	,000		,000	,000	,000	,000	,000	,000	,826	,012	,012	,000	,990	,000
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
lntotalb lntotalbasin	Pearson Correlation	,076**	-,111**	,165**	,037**	-,033**	,476**	1	-,208**	,199**	,191**	-,336**	-,333**	-,019	-,031**	-,031**	-,093**	,445**	,133**
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000		,000	,000	,000	,000	,000	,051	,001	,001	,000	,000	,000
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
contigui contiguity	Pearson Correlation	-,093**	-,029**	-,063**	,017	,092**	-,281**	-,208**	1	-,069**	,008	,081**	,172**	,010	,026**	,026**	,154**	-,137**	-,022*
	Sig. (2-tailed)	,000	,002	,000	,076	,000	,000	,000		,000	,423	,000	,000	,289	,006	,006	,000	,000	,023
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
lnsmlpop	Pearson Correlation	-,068**	,042**	-,067**	,040**	,276**	,375**	,199**	-,069**	1	,527**	-,068**	-,075**	-,020*	-,025**	-,025**	,075**	-,019	,008
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000	,000	,000		,000	,000	,000	,033	,008	,008	,000	,051	,423
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
lnlrgpop	Pearson Correlation	-,026**	,049**	-,107**	,045**	,652**	,506**	,191**	,008	,527**	1	-,017	,001	-,012	-,020*	-,020*	,083**	-,115**	,015
	Sig. (2-tailed)	,006	,000	,000	,000	,000	,000	,000	,423	,000		,074	,918	,213	,034	,034	,000	,000	,121
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
lnlrggdpcap Log large gdp per capita	Pearson Correlation	,053**	,196**	-,373**	-,182**	,105**	-,236**	-,336**	,081**	-,068**	-,017	1	,872**	,011	,012	,012	,238**	-,155**	-,041**
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000	,000	,000	,000	,074		,000	,229	,202	,202	,000	,000	,000
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
lnsmlgdpcap Log small gdp per capita	Pearson Correlation	,069**	,145**	-,366**	-,210**	,123**	-,303**	-,333**	,172**	-,075**	,001	,872**	1	,013	,014	,014	,280**	-,090**	-,038**
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000	,000	,000	,000	,918	,000		,164	,146	,146	,000	,000	,000
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
IROindyad Det er en IRO dyaden	Pearson Correlation	-,018	,007	,004	-,012	,013	-,002	-,019	,010	-,020*	-,012	,011	,013	1	,577**	,577**	-,006	-,029**	,980**
	Sig. (2-tailed)	,058	,487	,639	,192	,156	,826	,051	,289	,033	,213	,229	,164		,000	,000	,557	,003	,000
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
both_mem begge land medlem av samma IRO	Pearson Correlation	-,025**	-,001	,022*	-,005	,020*	-,024*	-,031**	,026**	-,025**	-,020*	,012	,014	,577**	1	1,000**	,012	-,034**	,560**
	Sig. (2-tailed)	,008	,949	,020	,591	,034	,012	,001	,006	,008	,034	,202	,146	,000		,000	,218	,000	,000
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
sentrertlbothmeandlntotal basin size and both member	Pearson Correlation	-,025**	-,001	,022*	-,005	,020*	-,024*	-,031**	,026**	-,025**	-,020*	,012	,014	,577**	1,000**	1	,012	-,034**	,560**
	Sig. (2-tailed)	,008	,949	,020	,591	,034	,012	,001	,006	,008	,034	,202	,146	,000	,000		,218	,000	,000
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111
bilat	Pearson Correlation	-,033**	,010	-,084**	-,102**	,011	-,146**	-,093**	,154**	,075**	,083**	,238**	,280**	-,006	,012	,012	1	-,161**	-,018
	Sig. (2-tailed)	,001	,321	,000	,000	,263	,000	,000	,000	,000	,000	,000	,000	,557	,218	,218		,000	,070
	N	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420
multilat	Pearson Correlation	,076**	-,106**	,045**	,027**	-,236**	,000	,445**	-,137**	-,019	-,115**	-,155**	-,090**	-,029**	-,034**	-,034**	-,161**	1	,038**
	Sig. (2-tailed)	,000	,000	,000	,005	,000	,990	,000	,000	,051	,000	,000	,000	,003	,000	,000	,000		,000
	N	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420	10420
lntotalandIROindyad	Pearson Correlation	-,008	-,011	,029**	-,007	,008	,068**	,133**	-,022*	,008	,015	-,041**	-,038**	,980**	,560**	,560**	-,018	,038**	1
	Sig. (2-tailed)	,385	,265	,002	,473	,413	,000	,000	,023	,423	,121	,000	,000	,000	,000	,000	,070	,000	
	N	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	11111	10420	10420	11111

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

This correlation matrix is meant as an example. I ran correlation tests for all my analyses. In addition I ran VIF and tolerance tests.

Tolerance test analyses for Model 7 (Section 5.2.1):

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,037	,038		,987	,324		
	peacehis peacehistory	-,268	,006	-,395	-44,815	,000	,934	1,071
	onedemoc	,015	,007	,032	2,364	,018	,406	2,461
	twoautoc	,020	,008	,041	2,602	,009	,295	3,393
	unconsol unconsolidated	,025	,007	,053	3,540	,000	,322	3,110
	majorpow majorpower	-,026	,007	-,042	-3,580	,000	,522	1,917
	lndistan lndistance	-,034	,003	-,137	-11,372	,000	,497	2,013
	lnsmlpop	,012	,002	,068	6,643	,000	,692	1,446
	lnlrgpop	,014	,002	,097	6,970	,000	,375	2,668
	lnlrggdpcap Log large gdp per capita	,009	,004	,040	2,233	,026	,223	4,487
	lnsmlgdpcap Log small gdp per capita	-,020	,004	-,088	-4,519	,000	,192	5,203
	lntotalb lntotalbasin	-4,6E-005	,001	,000	-,036	,971	,681	1,468
	contigui contiguity	-,006	,006	-,010	-1,077	,281	,855	1,170

a. Dependent Variable: fmidonse fmidonset

Correlation matrix; independent variables shared basin and Contiguity:

Correlations

		sharedba sharedbasin	contigui contiguity
sharedba sharedbasin	Pearson Correlation	1	,822**
	Sig. (2-tailed)		,000
	N	84517	84517
contigui contiguity	Pearson Correlation	,822**	1
	Sig. (2-tailed)	,000	
	N	84517	84517

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation matrix; independent Inter-capital distance and Contiguity:

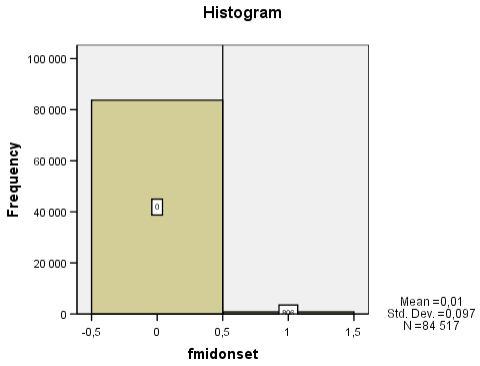
Correlations

		lndistan lndistance	contigui contiguity
lndistan lndistance	Pearson Correlation	1	-,281**
	Sig. (2-tailed)		,000
	N	11111	11111
contigui contiguity	Pearson Correlation	-,281**	1
	Sig. (2-tailed)	,000	
	N	11111	11111

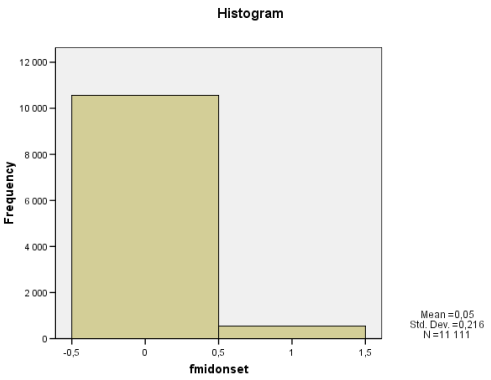
**. Correlation is significant at the 0.01 level (2-tailed).

Frequencies of dependent variables:

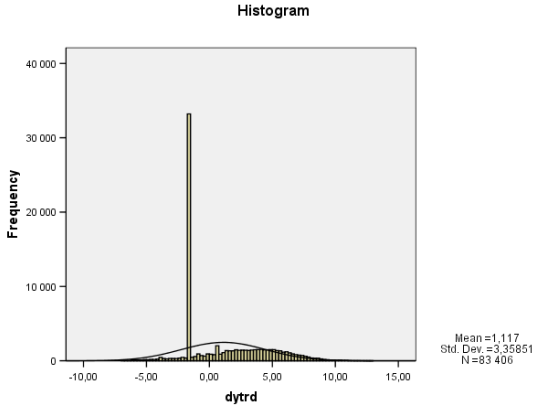
Conflict, MID onset, all dyads 1950–2000:



Conflict, MID onset, all dyads 1950–2000, with Shared basin:



Cooperation, Dyadic trade, all dyads 1950–2000:

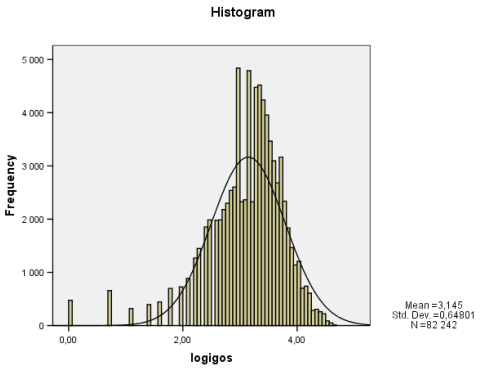


Statistics

dytrd

N	Valid	83406
	Missing	2077
Mean		1,1170
Median		-,0854
Skewness		,593
Std. Error of Skewness		,008
Kurtosis		-,677
Std. Error of Kurtosis		,017

Cooperation, IGO membership, all dyads 1950–2000:

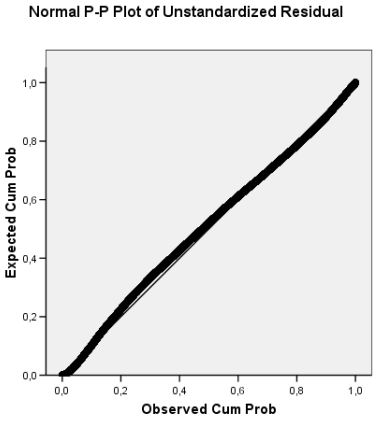


Statistics

logigos

N	Valid	82242
	Missing	3241
Mean		3,1450
Median		3,2189
Skewness		-1,332
Std. Error of Skewness		,009
Kurtosis		3,827
Std. Error of Kurtosis		,017

Normal distribution of the residuals variable. All independent variables in OLS regression with Dyadic trade as dependent variable (1950–2000):



Normal distribution of the residuals variable. All independent variables in OLS regression with IGO membership as dependent variable (1950–2000):