Does regime design matter?

ANALYZING SUCCESS AND FAILURE OF INTERNATIONAL COOPERATION IN REDUCING POLLUTION OF THE RIVERS ELBE AND RHINE

Martin Köppel

Schriftliche Arbeit zur Erlangung des Akademischen Grades "Magister Artium" an der
Fakultät für Sozial- und Verhaltenswissenschaften
der
EBERHARD KARLS UNIVERSITÄT TÜBINGEN

Vorgelegt bei:
Prof. Dr. Andreas Hasenclever
Dr. Detlef Sprinz, Ph.D

Tübingen, Dezember 2006

Zusammenfassung

In der vorliegenden Magisterarbeit werden Theorien über die Effektivität von Regimen im Bereich der Internationalen Umweltpolitik, insbesondere im Hinblick auf die Umweltqualität, empirisch überprüft. Hierbei wurde auf Daten über BSB_5, Cadmium und Nickel zurückgegriffen. Dies sind wichtige Indikatoren sowohl für die Wasserqualität als auch für die Verschmutzung mit Schwermetallen. Der empirische Schwerpunkt dieser Arbeit liegt auf der grenzüberschreitenden Wasserverschmutzung des Rheins in den Jahren 1954 bis 1999 und der Elbe in den Jahren 1985 bis 2004. Es werden drei Initiativen, um die Wasserverschmutzung der beiden Flüsse zu verbessern, untersucht: (1) Die Rheinkonvention, die 1963 unterzeichnet wurde und 1965 in Kraft getreten ist. (2) Das Übereinkommen zum Schutz des Rheins gegen chemische Verunreinigung, das auf der Rheinkonvention aufbaut, 1976 unterzeichnet wurde und 1979 in Kraft getreten ist. (3) Schließlich die Elbe Konvention, die 1990 unterzeichnet wurde und 1992 in Kraft getreten ist. Ferner wurden sechs Hypothesen entwickelt, die auf den Theorieschulen des Realismus, Institutionalismus und Kognitivismus basieren.
Unsere Ergebnisse sind die folgenden: Erstens besitzt die Variable, die vom Realismus abgeleitetet worden ist, die geringste Erklärungskraft. Zweitens konnte die Behauptung, dass das „Design“ eines Regimes ein wichtiger Faktor im Hinblick auf die Effektivität eines Regimes ist, untermauert werden. Besonders der Grad der Präzision der vertraglichen Verpflichtungen hat sich als ein wichtiger Faktor bewiesen. Die empirischen Belege unterstützen die hypothetisch angenommene Bedeutung der Erhöhung der Verhaltensklarheit und der Verringerung des Spielraums für Interpretation. Schließlich haben sich auch die Variablen, welche vom Kognitivismus abgeleitet worden sind, als höchst relevant im Bezug auf die Effektivität von Regimen im Bereich der Internationalen Umweltpolitik herausgestellt. Vor allem die Variable des Ausmaßes der wissenschaftlichen Kenntnisse über das Problem hat sich als hoch signifikant erwiesen.

Abstract

We empirically test existing theories on the effectiveness of international environmental regimes, in particular on environmental quality, using data on BOD_5, cadmium and nickel concentrations which are important indicators for water quality and the pollution with heavy metals in particular. The empirical focus is on transboundary water pollution in the Rhine and Elbe rivers from 1954-1999 for the Rhine and from 1985-2004 for the Elbe. Being more precise, we select three initiatives in order to improve the water quality of the two rivers: (1) The *Rhine Convention* that was signed in 1963 and went into effect in 1965. (2) The *Rhine Chemical Convention*, the follow-up of the Rhine Convention that was signed in 1976 and went into effect in 1979 and (3) The *Elbe Convention* that was signed in 1990 and entered into force in 1992. We develop six hyotheses derived from the Realist, Institutionalist as well as Cognitivist school of thought. The results are as follows: First, we find that the Realist variable has least explanatory power. Second, we provide additional support for the claim that regime design matters. Particularly, the amount of precision of the obligations proves to be of high relevance. The empirical evidence supports the hypothesized importance of enhancing behavioral clarity and narrowing the scope for interpretation. Finally, Cognitivist variables prove to be of high relevance as well. Particularly, the extent of scientific knowledge about the problem has proven as highly significant.

Contents

List of Figures, Tables and Maps

FIGURES

TABLES

MAPS

List of Abbreviations

APE	Action Program Elbe
ARGE	Arbeitsgemeinschaft zur Reinhaltung der Elbe
BOD_5	Biochemical Oxygen Demand After Five Days
BUND	Bund für Umwelt- und Naturschutz Deutschland
EC	Elbe Convention
EKC	Environmental Kuznets Curve
EEA	European Environmental Agency
EEC	European Economic Community
EU	European Union
FAO	Food and Agriculture Organization
GDR	German Democratic Republic
GFR	German Federal Republic
IAWR	International Association of Waterworks in the Rhine Basin
ICPE	International Commission for the Protection of the Elbe
ICPR	International Commission for the Protection of the Rhine
IEA	International Environmental Agreement
IGO	International Governmental Organizations
LAWA	Working Group of the German Federal States
MdPA	Mines des Potasse d'Alsace
NABU	Naturschutzbund Deutschland
NR	No-Regime Counterfactual
OECD	Organization for Economic Cooperation and Development
RAP	Rhine Action Program
RC	Rhine Convention
RCC	Rhine Chemical Convention
RIWA	Association of Rhine and Meuse Water Supply Companies (Rijncommissie Waterleidingbedrijven)
WWF	World Wildlife Fund

Hiermit versichere ich, dass ich diese Arbeit selbständig verfasst habe und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe. Die Stellen, die dem Wortlaut oder dem Sinne nach anderen Werken oder dem Internet entnommen sind, habe ich in jeden Fall durch Angabe der Quelle als Entlehnung kenntlich gemacht

_____

"We can hope and work for a day when all nations and their citizens are sufficiently concerned about peace, economic well-being, human rights, and the environment that we will not need international law to criminalize the behavior threatening those values and to dictate more benign behaviors. Until then, however, careful crafting and recrafting of international treaties provides one valuable means of managing the various problems facing the nations of the world."(Mitchell 1994b, 458)

1. Introduction

How should treaties be designed for being effective? What elements should a treaty contain so that the involved actors change their behavior as the treaty intends them to? The effects of the design of international regimes on environmental quality have received only little attention in the political science literature. It remains an "underexplored field of inquiry despite its great benefit to scholars and political decision-makers alike" (Sprinz and Kaan 2006, 1). Thomas Bernauer (1995, 377) stated in this regard:

"Unfortunately, however, we cannot offer good policy advice before we clearly understand the causal relationships between institutional design options and the performance of institutions. So far, we have not reached this point".

The vast majority of studies has concentrated so far on whether or not international regimes[1] matter (for instance: Haas 1989; Keohane 1993; Stein 1983). Nevertheless, this debate is as many scientists agree upon essentially over what opens up

"a large and important research agenda for those interested in the roles that institutions play in international society. While regimes matter, the ways in which they matter, the extent to which they matter, and the conditions under which they matter are variables whose values range widely over the universe of cases" (Young 2004, 3).

International Rivers and especially the issue of their pollution provide some exceptional cases in this regard. First, they involve an upstream-downstream problem. So called 'upstream/downstream problems' seem to be among the hard to solve problems in the realm of international relations. On the one hand, there are usually no direct benefits from cooperation involved for the upstream country that has the positional power to stop polluting the river. And even after an agreement was made, there are still very strong incentives (and the ability as well) to defect for the upstream country. On the other hand, the downstream state has an interest in having a 'clean' river but has not the positional power to stop "importing" pollution (Bernauer 2002, 6-7; Kuhn and Bernauer 2006, 11).

[1] We follow here the *consensus definition* by Krasner (1983, 2): "Regimes can be defined as sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations". However – as other researchers as well – we exclude in our research project the norms and principles included in Krasner's definition of regimes (for example Mitchell 1994a, 4; Wettestad 1999, 7-13). Instead, we follow Wettestad's (1999, 8) assumption that "the main concepts of regimes are rules/procedures and regulations/programmes – which can be termed 'structural' and 'regulative' components of regimes". Following, the terms "regimes" and "institutions" are used interchangeably.

Second, international rivers have rarely been targets of research. Only little empirically-based knowledge has been gained about how to effectively manage international rivers. Marty (2001, 20-21), one of the experts in the field of managing international rivers notes the following:

> *"Apparently, social scientists, and students of international politics and institutions in particular, have not been overly concerned with the problems of international rivers and the ways to cope with them (…) little empirically-based knowledge is available today about strategies to advance cooperation on international rivers and ways to support the effectiveness of institutions in this field"*

This, despite the fact that more than 260 international river basins[2] cover 45% of the Earth's land surface. Freshwater pollution is widely regarded as one of the most essential environmental problems worldwide (Bernauer 2001, 1; Kuhn and Bernauer 2006, 10-11) and as the 'Eurobarometer' from April 2005 reveals, the overall concern across European citizens of the EU-25 is 'water pollution' (European Commission 2005b, 9-11). Uses of these international river basins leads to numerous problems and even conflicts among the riparian states[3] that include disputes over flood protection, navigational issues, dam schemes, water quantity and water quality (Lindemann 2006, 1). Thus it is not surprising that countries have tried to solve these problems by signing (legally binding) treaties. As Simmons et al. (2005, 623) put it, "treaties are the most formal 'language' governments have to focus the expectation of individuals, firms, and other states that they seriously intend to keep their word in a particular policy area." Consequently, more than 3600 international water treaties ranging from AD 805 to 1984 are documented by the FAO (Food and Agriculture Organization 1978). And the spread of transboundary water treaties in Europe shows a "continuous and almost steady growth since 1945" (Lindemann 2006, 2).

From all these international river basins, we select two transboundary European rivers for our study: The Rhine and the Elbe. In relation to them, we will have a closer look at three initiatives in order to improve the water quality of the two rivers:

(1) The *Rhine Convention* that established the International Commission for the Protection of the Rhine (ICPR) in formal and legal terms. This treaty was signed in 1963 and went into effect in 1965.

(2) The *Rhine Chemical Convention*, the follow-up of the Rhine Convention that was signed in 1976 and went into effect in 1979.

---

[2] River basins or catchment areas are defined by "their common mouth, which is either the point where the river flows into the sea or an inland delta" (Lindemann 2006, 1).

[3] A riparian state/country can be defined as such a country which is reliant in some capacity on the river (Dieperink 1997, 2).

(3) The *Elbe Convention* that established the International Commission for the Protection of the Elbe (ICPE). This treaty was signed in 1990 and entered into force in 1992.

The first two treaties – the Rhine Convention and the Rhine Chemical Convention constitute the Rhine regime, the treaty concerning the Elbe, the Elbe regime. We adopt an intentional and pragmatic approach with respect to the selection of cases. This, for several reasons.

First, in both cases, we have found data appropriate to the hypotheses that we evaluate. For the Rhine, data is available for the past 55 years. For the Elbe, data is available for the past 20 years. In general, data is only difficult to obtain and for many other rivers either only available for a very limited period of time, for a limited number of parameters or not available before the regime went into effect. For instance, the first international treaty regulating transboundary water pollution for the river Mosel[4] was signed in 1961 (1961). Nevertheless, data is not available before 1964 and then only for a very limited number of parameters.

Second, these rivers are of great importance for the states through which they flow as well as for their citizens. The Rhine regime is one of the oldest international regimes in general and the "most important inland waterway in Western Europe" (Bernauer 1996, 201). As Lindemann (2006, 15, emphasis in the original) argues, „the Rhine water regime is *the* pioneer effort in the field of international river basin management and serves as the reference point across Europe and the world." The development of the Elbe regime is a relatively recent phenomenon. It is a pioneer effort after the end of the Cold War that brings together countries from Western and Eastern Europe.

Third, pollution of these two rivers – and especially the Rhine – had become so bad in the past, that "by the 1970s the liquid flowing in the riverbed [of the Rhine River; M.K.] was nothing more than a toxic soup of chemicals and raw sewage" (Cioc 2002, 176).

Fourth, by selecting cases that involve exclusively upstream-downstream problems, variation in problem structure is limited.[5]

Finally, there is strong evidence that Rhine pollution has only declined after an additional convention was signed around ten years after the initial agreement had gone into effect. Whereas in the case of the Elbe, the pollution of the river started decreasing shortly after

[4] The riparian states being Germany, France and Luxembourg.

[5] As recent research argued, the "ability to draw compelling conclusions from comparisons of multiple agreements depends, however, on making problem structure central to the analysis" (Mitchell 2006, 75). If more time and resources was available, we could have made further determinants of problem structure such as capacities, information and norms, central to our analysis (Mitchell 2006, 80-81).

the initial agreement was signed. Therefore, the following questions need to be taken under consideration: Why have efforts to clean up the Rhine only been successful after this additional convention was signed? Why have efforts to reduce the amount of pollution of the Elbe been so much more effective than those initial efforts to clean up the Rhine? Is this a matter of treaty design? Are some crucial provisions included in the succeeding Rhine Chemical Convention as well as in the Elbe Convention that the initial Rhine Convention was lacking? And – even more important: What is it that scientists as well as policy makers can learn from these cases? Had the Rhine Convention been more effective or stated differently: Would its amount of pollution have decreased much earlier if it included some of the 'important' provisions from the succeeding Rhine Chemical Convention or the Elbe Convention?

In this thesis we will assess the effects of various political as well as economical variables on environmental quality. In particular, we relate BOD_5, cadmium and nickel concentrations which are important indicators for water quality as well as the pollution with heavy metals in particular to variables suggested by the Institutionalist school of thought after having taken into account the possible effects of rival explanations (from Realism, Cognitivism as well as from alternative assumptions):

(1) the amount of precision of the obligations, i.e. their specificity in terms of goals and implementations
(2) the independence of the secretariat, i.e. the independence of the secretariat according to the latitude the secretariat has when performing its core as well as additional tasks
(3) the degree of treaty-induced involvement of NGOs, i.e. the factual degree of NGOs involvement based on the treaty

The value added of this research is as follows. We will assess the effects of the regime design on environmental quality. Whereas most of the existent studies use changes in human behavior as indicator for assessing regime effectiveness we use the changes in the biophysical environment (environmental quality). As recent research indicated:

> *„If the study of regime effectiveness is to provide important inputs to praxis, it will have to do so first and foremost through producing knowledge that can be used as a basis for designing effective institutions.“ (Underdal 2004, 41)*

Additionally, this research wants to contribute substantial data to existing databases and

might therefore provide the basis for further research.[6]

In the following section, we will establish hypotheses for finding an answer to our research question whether the institutional design of international environmental regimes matters by drawing from three conflicting theories: Realism, Institutionalism and Cognitivism and discuss our understanding of causality (Section 2). In Section 3, we discuss the dataset and operationalize the variables. Section 4 discusses the methodology and introduces our cases. Section 5 presents the evolution of Rhine and Elbe water pollution, empirically evaluates the hypotheses and presents the results of the comparative analysis. In Section 6, we assess the validity and robustness of the results. Section 7 then finally offers some conclusive remarks, open questions and ideas for further research.

2. Theory and Derived Hypotheses: Does Regime Design Matter?

> *"Variation is to the social scientist what money is to a banker or a hoop and ball to a basketball player: the necessary condition for our activity."(Keohane 1996, 7)*

Before moving on to the question of 'regime effectiveness'[7] and 'does regime design matter', we discuss our understanding of causality. The field of political science, of international relations and of international environmental politics is characterized by an epistemological disagreement.[8] In a nutshell, this debate revolves around whether it is possible to explain (erklären) or if we are (only) able to understand (verstehen). The difference between both approaches is that 'explainers' or positivists ask 'causal' questions and 'understanders' - the post-positivists - ask 'constitutive' questions (Wendt 1998, 103). To make things even more confusing a third approach - the 'scientific realist' approach – has emerged. This approach tries to go one step further than positivism. Since the problem of positivism has been causality[9], scientific realists try to explain phenomena via causal

---

[6] One such database for which this research is already contributing important data to is Ron Mitchell's *International Environmental Agreements* database. Available at: http://www.uoregon.edu/~iea/. To the knowledge of the author, no existing database that is freely available to the public contains such data on indicators for water pollution that go beyond water temperature, flow rate and the level of BOD_5 for water pollution yet. In the case of the Rhine, data is available via the ICPR homepage at http://had.bafg.de:8080/iksr-zt/ but this data is restricted to the years 1978-2004. In the case of the Elbe, no data besides the EEA Waterbase Rivers database (http://dataservice.eea.europa.eu/dataservice/metadetails.asp?id=618) is available. The author is thankful to Michael Bergemann from the Wassergütestelle Elbe/ARGE Elbe for providing the data.

[7] Notice, that this analysis is about regime effectiveness and not about regime efficiency. In regard to the latter, Bernauer (1995, 358) explained that the evaluation of efficiency involves "assessing the costs and benefits of establishing and operating an environmental institution and comparing these costs and benefits to those of alternative behavioral options."

[8] For some seminal distributions to this discussion see for example (Bueno De Mesquita 1996; Gaddis 1996; Keat and Urry 1975; Mayer 2003; Neufeld 1993; Nicholson 1996; Wendt 1998).

[9] As Keat and Urry (1975, 27, emphasis in the original) state: "The premises which, for the positivist, constitute the explanans may often be that they only give us good, or conclusive, reasons for believing that the explanandum-event either will or did occur. They do not necessarily tell us *why* that event did or will occur".

mechanisms[10] (George and Bennett 2005, 135-137; Hovi 2004; Keat and Urry 1975, 4-8, 27-45): „For the realist, adequate causal explanations require the discovery both of regular relations between phenomena, and of some kind of mechanism that links them" (Keat and Urry 1975, 30). Despite the acknowledged problem that „there are almost as many versions of scientific realism as there are philosophers calling themselves realists" (George and Bennett 2005, 136) we will consider ourselves as scientific realists. This, because we believe that social science as well as policy practitioners benefit most from stringent empirical evidence that can be realized best with the scientific realist approach. Moreover, because as Breitmeier et al. (2006a, 2) put it "measures of regime effectiveness typically subsume – implicitly if not explicitly – a causal judgment" what rules out other epistemological approaches.

There are many factors one can think of when looking at what could have caused an actor to change his or her behavior in the international arena. Many scientists have elaborated on this (for example: Hasenclever et al. 1997; Keohane and Nye 1977/1989; Miles 2002; Waltz 1979) – especially in more broader terms: How and when is cooperation between countries in an international system that is characterized by anarchy possible? What makes international (environmental) institutions matter and when?

In determining hypotheses in relation to our research question, whether the institutional design of international environmental regimes matters we draw on three conflicting theories or schools of thought: Realism, Institutionalism and Cognitivism (Hasenclever et al. 1996; Hasenclever et al. 1997).[11] These theories - when following the classification of Hasenclever et al. (1997, 1-7) - can be put in order according to the explanatory variables they emphasize as power-based, interest-based and knowledge-based approaches:

> *"Realists, who focus on power relationships; neoliberals, who base their analyses on constellations of interests; and cognitivists, who emphasize knowledge, dynamics, communication and identities." (Hasenclever et al. 1997, 1-2)*

These three opposed theories provide the starting point for our analysis.

2.1 The Realist Assumption: Power and Interests Shape State Behavior

> *"States cooperate when cooperation serves the interests of a dominant power, that takes the lead in creating cooperative arrangements and enforces compliance to their rules." (Lowi 1993, 5)*

---

[10] Nevertheless, there is no agreement yet on an exact definition of 'causal mechanisms' (for example: George and Bennett 2005, 135).

[11] We do so because as past research has argued, "the best that can be done in this connection [the structuring of the database; i.e. the choice of hypotheses and variables; M.K.] is to select variables that are important in terms of major debates among current students of international regimes" (Breitmeier et al. 1996b, 10).

According to Realist theory, the international system is characterized by anarchy. States strive to maximize national security and power: The imperative is "take care of yourself" (Waltz 1979, 107). Behavior of states can be explained best by a state's power and interest. International institutions as well as international regimes are little more than "ciphers for state power" (Koremenos et al. 2004, 2). One classical example of a power-based theory of international regimes that "lies at the core of Realist thought" (Lowi 1993, 5) is the *theory of hegemonic stability*. Here, the existence of international institutions is dependent on the leadership of a single dominant power (the hegemon) in the issue-area in question (Hasenclever et al. 1997, 83-104; Levy et al. 1995, 296-297; Lindemann 2006, 5-6; Lowi 1993, 3-8). Following this logic, the presence of a hegemon[12] is a necessary condition for the formation of international regimes as well as for the effectiveness of the like.[13] Compliance with the rules of a treaty can arise from a powerful state with serious interests in the issue-area in question. The dominant state enforces others to comply with the rules and/or complies itself because it is capable of doing so and is interested in the issue (Hasenclever et al. 1997, 83-104; Mitchell 1996, 11; Simmons 1998, 79-80). Since the issue-area in question is characterized by an upstream-downstream problem, the assumption needs specification. Collective action theory assumes that the only riparian country that could possibly have an interest in changing the behavior of the involved actors is the downstream country:

> *"When the victims of an asymmetric externality are stronger than the perpetrators, the former may simply threaten the latter to compel to mitigate an externality at their own expense" (Mitchell and Keilbach 2001, 902).*

Therefore, our first assumption is:

> *H1: A decline in transboundary water pollution is not caused by the regime (design) if the downstream country compared to the upstream country(ies) is more powerful and more vulnerable.*

In conclusion, it can be said that even though the Realist school of thought does not provide for principles of how to design an effective regime – in other words, on endogenous factors.[14] It still offers an important set of rival hypotheses, which belong to

[12] Be it a benevolent, a coercive, a global or an issue-specific hegemon (for more, see: Haas and Sundgreen 1996, 411-413; Hasenclever et al. 1997, 90-95; Underdal 2002, 29-31).

[13] In regard to international river basin management, some studies have already tried to argue that the existence of a hegemon is necessary condition for the formation of international water regimes (for example: Lowi 1993).

[14] Endogenous factors are factors "which are part of the problem solving process and can also be controlled by the participants in the process" (Marty 2001, 50).

the field of exogenous factors.[15]

2.2 The Institutionalist Assumption: Regime Design Matters

> *"The Institutionalists' disagreement is not that other factors do not cause changes in compliance. Rather they make the narrower claim that treaty rules can also increase compliance. While regimes and treaty rules reflect power and interest, they also have an independent effect on compliance" (Mitchell 1994a, 52).*

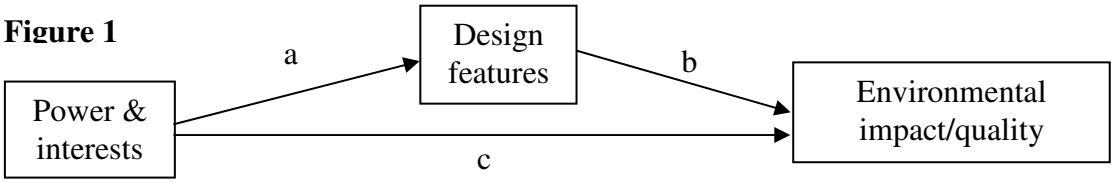
Since realism provides us with an important alternative hypothesis due to its scepticism regarding the question whether regime design matters, we have to take a closer look at what hypotheses can be generated from the *Institutionalist school of thought.*

Institutionalists[16] agree with the Realist claim that the international system is characterized by anarchy and that this has important implications for state behavior. However, they contest that power and interests are able to explain sufficiently state behavior: In some instances, the institutional design of a regime – the institutional features - can explain the variation in state behavior best. As Levy et al. (1995, 299) put it: "The search for endogenous sources of effectiveness is based on the premise that there are good and bad ways of structuring international institutions as well as good and bad ways of administering these arrangements operationally". States would therefore behave differently if treaties did not exist (Krell 2000, 118, 125-143; Mitchell 1994b, 429). Some studies have even tried to prove that the Realist claim that structural power – the participation of a hegemonic power – has „less explanatory leverage than Realists might have us believe" (Mitchell 2002b, 505; Zürn 1998, 625). *Figure 1* illustrates the difference between the Realist and Institutionalist school of thought.[17] Whereas Realists would always argue that a and c are different from zero and that b can only be zero as well or small at best. Institutionalists will always argue that b is different from zero and some Institutionalists will also argue that there is still scope for c being different from zero (personal communication with Detlef Sprinz from August 20th, 2006). For the purpose of this research design, we are mainly interested with b – the effect of certain design features on the environmental quality – while we do also control for the rival explanation c. Since one of the problems of the research on the effects of regime design is that the explanatory variables – the institutional design features – are "analytical constructs with no objectively definable boundaries; cooperative arrangements may be characterized and compared in terms of an almost infinite number of features" (Bernauer 2001, 10) we follow Wettestad (1995, 53) who argued that "I can see no other way to address the tricky question regarding

[15] Exogenous factors are - as well as endogenous factors - part of the problem solving process but in contrast to them they are not controllable by the participants in the process (Marty 2001, 50).
[16] We intentionally exclude all liberal approaches.
[17] I am indebted to Detlef Sprinz for the idea of the specification of theory and a box model.

the impact of regime design and institutional factors than to identify a limited set of 'specific' regime features as point of departure." Above all, these regime design and institutional factors are derived from the treaties we will be analyzing. Factors that vary considerably in regard to the regime design between the three treaties are: The amount of precision of the obligations, the independence of the secretariat and the treaty-induced degree of NGO involvement.

Figure 1



A first factor in regard to the regime design is the *amount of precision of the obligations*. According to Abbott et al. (2000, 401), obligation refers to the fact that states (or other actors) are legally bound "by a rule or commitment or by a set of rules or commitments" whereas precision means that "the rules unambiguously define the behavior they require, authorize, or proscribe."[18] Thus, we need to ask: Do the treaties contain binding obligations on states (and other actors)? Are treaty provisions precise in terms of goals and implementations? Do they contain quantitative targets and do they require the involved actors to achieve such targets within a specific time frame? Are the regime's substantive rules generally precise and easy to interpret? As Mitchell (2001, 228) argues, "the regime needs to provide clarity with respect to 'who must do what.'" In regard to the issue under consideration this could be the question whether the treaty requires the involved countries to reduce their amount of pollution by a certain amount until a certain date, for instance.

This factor seems to be relevant in several ways: First, it is difficult to determine to what degree countries have complied with the obligations when the latter are imprecise. Second, imprecise obligations leave much leeway for signatory states to interpret the obligations the way they like to. Thus, precise obligations narrow the scope for interpretation (Abbott et al. 2000, 412-415; Jacobson and Brown Weiss 1998, 524-525; Marty 2001, 45; Victor et al. 1998a, 4; Wettestad 1995, 43-44). Finally, as Marty (2001, 45) put it: "If a regime is unspecific, those who fall under the jurisdiction of the regime would simply not know how exactly they should behave in order to achieve the goals of the regime". Thus, a high amount of precision of the obligations provides for behavior clarity for the involved actors and therefore should make international cooperation more effective, a low amount of precision should make them less effective. The above-cited arguments lead us to our first

[18] We intentionally exclude the third dimension Abbot et al. (2000) mention - Delegation – since the goal is to measure the amount of precision of the obligations and not 'legalization'.

institutionalism-based hypothesis:

> *H2: Transboundary water pollution will decrease as the amount of precision of the treaty's obligations increases.*

Second, some Institutionalists argue that having an effective and efficient secretariat is an important variable. A secretariat is an international organization established with the goal to assist the member parties in fulfilling the obligations of the treaty (Andresen and Skjærseth 1999, 2-3). Some researchers even claim that the effectiveness of the secretariat is a necessary condition for the effectiveness of a regime (Von Moltke and Young (1995), cited after: Andresen and Skjærseth 1999). Despite the fact that secretariats have been an established part of international (environmental) regimes, not much is known about their magnitude in regard to the effectiveness of these regimes yet[19] (Holtrup 1999, 43; Wettestad 1999) – or stated differently: "they [the secretariats; M.K.] have been largely overlooked in the academic debate on the effectiveness of IEAs" (Andresen and Skjærseth 1999, 2). Since the strength of the secretariat obviously depends on how the treaty is designed it essentially has to do with the "fundamental willingness of nation-states to give up basic control over international decisionmaking processes" (Wettestad 1995, 34).

In addition to their administrative day-to-day tasks, secretariats can be active in consulting with the parties about negotiation requirements, in contributing to the process by selecting participants and in ensuring coordination with relevant international bodies and NGOs. Moreover, secretariats may compile and analyze data/information and monitor adherence to treaty obligations or use the reporting exercise to clarify the obligations of the treaty for the signatory states. Additional tasks of a secretariat may include to comprise the participation in the setting of the agenda and the development of the protocol, public relations and its political role as pusher or laggard for regime evolution/ratification/compliance (Andresen and Skjærseth 1999, 6-10; Breitmeier et al. 1996a, 100; Holtrup 1999, 43-44; Jacobson and Brown Weiss 1998, 526; Wettestad 1999, 26-28). Nevertheless, whether a secretariat performs one or the other task crucially depends on its independence from the regime's members. This leads us to our next hypothesis:

> *H3: Transboundary water pollution will decrease as the independence of the secretariat of a regime (when performing its' core tasks as well as when performing additional tasks) increases.*

Another factor to be considered is the *treaty-induced degree of involvement of NGOs*:

[19] One exception in this regard is the research on the United Nations Secretary-General in international negotiations.

What types of non-state actors are actively involved? What is their factual participation in the issue at hand? And how much of this factual participation of NGOs is attributable to the operation of the regime? Most scholars agree that NGOs can make a difference in International Environmental Politics (for example: Gulbrandsen 2004; Raustiala 2001). As recent scholarship has shown, NGOs promote public opinion, make information about problems available and are thus able to set governments (especially the upstream countries) under pressure (Dieperink 1995, 136; Jacobson and Brown Weiss 1998, 8, 533-534). The underlying argument is that "information generated by transboundary efforts can be used by environmental lobby groups, waterworks, or political authorities to exert pressure on national governments, individual firms, or other actors" (Bernauer and Moser 1996, 398). The signing of a (legally binding) convention indicates a commitment of a country. NGOs can pick up this commitment and point to the signing of a convention as proof that further action is needed (Susskind and Ozawa 1992, 146). This leads us to our final institutionalism-based hypothesis:

H4: Transboundary water pollution will decrease as the treaty-induced degree of involvement of NGOs increases.

2.3 The Cognitivist Assumption: Knowledge and Learning Matter

"In contrast to power- and interest-based hypotheses, knowledge-based approaches to the study of international regimes have so far hardly been applied to the field of international river basin management" (Lindemann 2006, 12)

Whereas Realist approaches claim the predominance of power and interests in explaining international cooperation and Institutionalist approaches emphasize the institutional design of a regime, Cognitivist[20] approaches stress the importance of knowledge and learning as explanatory variables: "Unsatisfied with rationalist (Realist and Institutionalist) theories of international politics, cognitivists generally hold that knowledge and values do not only affect power and shape interests but also play a more independent role in the formation of international regimes" (Lindemann 2006, 11-12).[21] Cognitivists try to illustrate how knowledge can influence the demand for international cooperation. Information and knowledge about what works best in one setting affect the institutional development in another place:

[20] We will restrict ourselves to the strand of the "weak" cognitivists. This, because as Hasenclever et al. (1997, 136-139) argue the concerns of "weak" cognitivists can still be seen as a complementary to extant theorizing about regimes, the concerns of "strong" cognitivists cannot.

[21] Speaking more generally, the field of international relations is divided in two strains: Rationalism and Constructivism/Cognitivsm. Whereas Rationalists assume that international institutions influence behavior through a "logic of consequences", Constructivists/Cognitivists believe that international institutions influence behavior through a "logic of appropriateness". For more concerning this, see: (Mitchell 2002a, 21-22; Sprinz 2003, 256-258).

"Given the large number of international river basin institutions, there is reason to expect a high degree of imitation or learning where information about innovative practices in one international river basin affects policy choices in another (e.g. twinning activities)" (Lindemann 2006, 13).

Moreover, technological progress in wastewater treatment, waste disposal or the production of products may lead to a reduction in water pollution. The existence of new technologies may not only increase the number of parts produced but lead to a decline in pollution or waste produced as well (Tschanz 2001, 22-23).

This leaves us with two possible options. Firstly, non-regime factors that operated outside the regime's environment and are not attributable to the regime's existence were crucial in changing the behavior of the involved actors. Following this logic, the availability of new technologies to cleanup the water from pollution or new technologies to prevent pollution that were developed outside the regime could have helped the involved industries to reduce their amount of pollution. Thus, it was not the design or the existence of a certain treaty but the knowledge that had been produced in the meantime that is responsible for a decline in the amount of pollution of the involved river. The second option is that regime factors are responsible for the existence or the production of new knowledge for tackling the problem. New knowledge gathered through scientific collaboration promoted by the regime (e.g., the creation of ad hoc working groups of experts to develop options for tackling the problem or new options for reducing pollution at lower costs) could be one such factor, for example. The collection and development of knowledge could be another factor (Bernauer and Moser 1996, 398-399; Breitmeier et al. 1996a, 141; Dieperink 1998, 483-484). For resolving this task, we have to ask: Did the information about the options available for tackling the problem change within important states? And how much of this change is attributable to the operation of the regime? The above cited arguments lead us to our first knowledge based hypothesis.

H5: Transboundary water pollution will decrease if the important actors are able to learn (the information about the options available for tackling the problem changed within important states). This can either be caused by regime or non-regime factors.

Moreover, the *extent of scientific knowledge about the problem* seems to be important. Cognitive barriers can arise when there is an inadequate understanding of possible ways of reducing pollution or when a general consensus regarding the nature, causes and consequences of the problem has not been established yet. For example, Dieperink (1997, 4-5) argues that there may simply be not sufficient information about available purification technologies and enough or inadequate knowledge of the nature of the production

processes carried out by the discharging industries. Additionally, the possible costs that the reduction of discharges could produce may be unknown. Following the logic behind this variable, we would expect international cooperation to be more effective if the extent of scientific knowledge about the problem as well as the technical knowledge about its solutions is high (Breitmeier et al. 1996a, 32; Dieperink 1995, 120-121; Mitchell 2002a, 19-20). This leads us to the following hypothesis:

> *H6: Transboundary water pollution will decrease as the extent of scientific knowledge about the problem increases.*

2.4 Alternative Assumptions - The Control Variables

Although we are mainly interested in the design aspect of international environmental regimes, we need to control for a number of other factors that were identified as important determinants by past scholarship. Since the list of possible propositions that could have an influence on the formation and effectiveness of international regimes is long, we have to select the ones that seem to be the most relevant for the purpose of this research design.[22] Nevertheless, due to the fact that our cases are restricted to central Europe, many alternative factors can be eliminated. Such factors are, for example: different political systems, influence of development aid, climate, etc.

One important control variable is the *level of economic integration among the member countries*. This is mainly due to the observation that a high degree of economic integration seems to reduce incentives to substantially cheat on agreements. The involved countries stand in iterated interactions – they meet again and again in many other contexts. In addition to this, economic integration enhances the chances for issue linkages as well as for other types of intertemporal and cross-issue trade exchange (Bernauer 1997, 172-174; Mitchell 2002a, 20). Accordingly, we expect a negative effect of economic integration on pollution.

Furthermore, we include a control variable for *macro changes*.[23] Changes in the industry structure seem to be an important factor since we are making assessments over multiple decades. Even without an agreement, changes in the industry structure and thus a decline in pollution might be occurring. For instance, the end of the Cold War may have lead to such changes in the industry structure. In a very short time period, a whole industrial sector can collapse. And this could then be the cause for a decline in pollution levels.

---

[22] We do also acknowledge that there might be some 'unobservable' factors like "political will", "trust" or negotiation posture (for a discussion concerning 'unobservables', see: Simmons and Hopkins 2005; Von Stein 2005). Moreover, due to time and resource constrains some important variables can not be controlled for. Environmental awareness, for instance, is such a variable.

[23] I am indebted to Detlef Sprinz for the idea of including this variable.

Finally, recent scholarship has proposed another important rival explanation: *The Environmental Kuznets Curve (EKC).* In short, the EKC claims that there is an inverted-U relationship between pollution of a certain environmental good and economic development. At lower income levels, pollution grows rapidly because people are mostly concerned about food, shelter, jobs and other material needs. They are less concerned about environmental quality, about clean air and water, and are less likely to have strong environmental regulation or to have the capacity to afford costly pollution control measures. This alters as income levels increase. Now, people usually value the environment more highly and can afford the costs of higher environmental clean-ups. Consequently, the level of pollution declines (Dasgupta 2002, 147; Kuhn and Bernauer 2006, 18-19; Paudel et al. 2005).

3. Operationalization of Variables and Data

3.1 The Dependent Variable: Water Pollution

> *"Two things make water a unique natural resource. One is that water is essential for human survival. The other is that, unlike renewable natural resources, the total amount of water in the world is constant and can neither be increased (like timber or fish) nor diminished (like petroleum or coal)"(Meybeck et al. 1990, IX).*

The dependent variable for testing all hypotheses is the **amount of water pollution.** As scientists have recently pointed out, in the field of international (environmental) politics, a distinction should be made between three dimensions of a decision-making or a regime-formation process (for example: Mitchell 2002a; Underdal 2002; Underdal and Young 2004; Young 2004). On the one hand, the *output dimension*, being the norms, principles, and rules that are created by this process. This refers more to the performance of an environmental regime. On the other hand, the consequences „flowing from the implementation of and adaptation to that regime" (Underdal 2002, 5-6). Furthermore, in between these consequences – that refer to the effectiveness[24] of a regime - we can discern a further distinction: *Outcome* refers to the regime-induced changes in human behavior (for instance, the implementation of the norms created by the regime in national law). And *impacts* are best thought of as the changes in the biophysical environment itself – the contributions „regimes make to solving the problems that lead to their creation in the first place" (Young 2004, 12-13).

While most studies focus mainly and exclusively on the outcome dimension for measuring the effectiveness of (environmental) regimes, we will concern ourselves with the impact

[24] Effectiveness should not be conflated with compliance. As Raustiala and Slaughter (2002) point out: "[R]egimes can be effective … even if compliance is low. And while high levels of compliance can indicate high levels of effectiveness they can also indicate low, readily met and ineffective standards."

dimension of the regime.[25] The ultimate aim of environmental agreements is not just to "influence the behavior of those who cause or can ameliorate the problem at hand" (Victor et al. 1998b, 4). This outcome dimension is certainly an important step, a necessary condition for the latter. But it is not a sufficient condition:

> *"A regime cannot improve the state of the environment without changing human behavior, but it may well change human behavior – even as intended – without improving the state of the environment" (Underdal 2004, 34).*

Or, to put it differently, "environmental regimes are, at least officially, established to protect some environmental values" (Underdal 2002, 6). Thus, the ultimate interest of environmental agreements concerns the biophysical impact - to solve the problems that motivated their establishment. Therefore, we will use the '*amount of pollution of the river'* as our dependent variable.[26]

In comparison to other pollution problems, the pollution with chemicals and heavy metals in particular seems to be a hard to solve problem. This, because there are many sources and they are very geographically distributed over the whole basin. Moreover, one major part of the pollution is from diffuse sources that are very difficult to locate (Bernauer and Moser 1997, 156-157). Many pollutants exist that could serve as an indicator for water quality. We select BOD_5, cadmium and nickel as our measures.[27] We chose these three measures for the following reasons.

First, they are produced by human activity. Differences in water quality can either have natural reasons or can be caused by human activities. Changes in the water quality caused by natural reasons can occur through natural processes such as chemical reactions between rocks and water or erosion and sedimentation caused by flowing water. The process when human activities change the natural water quality is referred to here as pollution,

---

[25] We acknowledge the methodological problems involved within this approach. Nevertheless, we reply to the difficulty that "the longer the chain of consequences, the more factors there will be to control for in order to assess effectiveness" (Andresen and Skjærseth 1999, 4) with Breitmeier et al. (2006a, 7) who stated that: "In general, it is fair to say, that the shorter the causal chain linking a regime and its effects, the easier it is to demonstrate causality but the less important the results will be in terms of explaining major occurrences in world affairs. Thus, it is easier to draw inferences about outputs than about impacts. Yet it is the impacts of regimes on specific problems that ultimately account for our interest in these arrangements."

[26] Nevertheless, by focusing on the impact dimension of effectiveness, we will not observe the regime-induced changes in human behavior (outcome). With more time and resources, this should ideally be monitored. One possible way how a researcher could perform this is by opening the "black box state", screening national law and looking for variation before and after the (sub-) regimes went into effect. Furthermore, interviews with decision makers could shed a light on the causal impact of the regime on the decision-making process. All this might lead to further insights.

[27] The selection of several measures is in line with past research. For example, Bernauer (1995, 367) argued that "the analyst can select several or all of the goals and aggregate the resulting variables into one or more dependent variables". Moreover, past research in the field proceeded a similar way: (For instance: Kuhn and Bernauer 2006; Kuhn 2004).

particularly when it has detrimental effects[28] (Meybeck et al. 1990, 41-45). It is this pollution that we are using as our dependent variable. *BOD_5* is a typical variable used for describing water quality and among the most common water qualitative measures. Its' levels are easily measured by standard procedures, which helps keeping data quality consistent across countries (Meybeck et al. 1990, 17-20; Sigman 2001, 3). As the European Environmental Agency (EEA) states:

> *The "'Biochemical Oxygen Demand' is a measure of how much dissolved oxygen is being consumed as microbes break down organic matter.[29] A high demand, therefore, can indicate that levels of dissolved oxygen are falling, with potentially dangerous implications for the river's biodiversity". (EEA 2004)*

Cadmium is mainly used for electroplating and in paint pigments, batteries (e.g. nickel-cadmium batteries), plastic stabilizers and alloys (Cioc 2002, 181; IAWR 1982, 55; Stigliani 1994; Umweltbundesamt 2002b, 29-50; Zehnder 1993). Past research showed that the amount of cadmium pollution differs strongly between diffuse and point sources - depending on the measuring station and time period (Behrendt and Fisheries 1993, 36-37). *Nickel* is used in many industrial products such as stainless steel, magnets, batteries (e.g. nickel-cadmium batteries) or special alloys (such as nickel brasses and bronzes) and in consumer products like smaller coins. Furthermore, it is used for plating and as a green tint in glass (Umweltbundesamt 2002b, 51-69).[30]

Second, all three forms of pollution can be influenced by governments if they decide to do so. The discharge of untreated or poorly treated sewage is the major source of organic pollution that leads to low BOD_5 levels. Organic pollution can thus be curbed by the installation of waste water treatment plans or by reducing the amount of sewage discharged into the river. Nevertheless, as Kuhn et al. (2006, 14) put it "doing so is costly". The effects of Cadmium pollution were feared world-wide when the "Itai-Itai disease" in Japan was reported to be associated with this element (Meybeck et al. 1990, 162-163; Zehnder 1993). Moreover, exposure to nickel can cause decreased body weight, heart and liver damage as well as dermatitis (Umweltbundesamt 2002b, 51-69).[31] Finally, as Germany's Federal Ministry for the Environment put it:

---

[28] We follow the more narrow definition of pollution whereas a broad definition would comprehend anthropogenic *and* natural changes in water quality as pollution (Cech 2003, 301; Meybeck et al. 1990, 41-45).

[29] A more thorough explanation can be found in Meybeck et al. (1990, 80): "The decomposition of organic substances of either natural origin (allochthonous terrestrial detritus or autochthonous debris of aquatic plants) or anthropogenic sources (domestic, agricultural and industrial wastes) by aerobic microbes is called the Biochemical Oxygen Demand (BOD), and usually takes place over five days (termed BOD_5) at an incubation temperature of 20°C. "

[30] http://en.wikipedia.org/wiki/Nickel; http://www.epa.gov/ogwdw000/dwh/t-ioc/nickel.html, Rev.17-7-2006.

[31] http://en.wikipedia.org/wiki/Nickel; http://www.epa.gov/ogwdw000/dwh/t-ioc/nickel.html, Rev.17-7-2006.

> *"The input of heavy metals into surface waters represents a serious impairment of the aquatic environment. The reduction of the pollutant input into inland waters and seas is thus an ecological necessity." (Umweltbundesamt 2002a, 4)*

But the reduction of discharges of cadmium and nickel requires knowledge and money (Bernauer and Koubi forthcoming, 10; Kuhn and Bernauer 2006, 13-15).

Third, all indicators are subject to the treaties. Cadmium, for instance, is among the most important substances regulated in the Rhine Chemical Convention. Moreover, it was the first chemical that was suggested from the ICPR for the introduction of limiting values.[32] We intentionally chose cadmium and nickel as our indicators since both are regulated differently under the RCC. Cadmium that belongs to the Annex I substances is to be eliminated from the surface water of the Rhine whereas nickel that belongs to the Annex II substances is to be substantially reduced (see 4.1.1.2 The Chemical Convention (1976)). If regime design matters, then we should observe a difference in both pollutants (i.e. we should observed a large reduction in cadmium and a rather small reduction in nickel, for instance).

Furthermore, we include sulfate as an alternative indicator of the dependent variable as control indicator (King et al. 1994, 223). This, because there might still be a powerful alternative explanation, we do not control for. If we can show that the control indicator does not correlate with the other indicators, we will be more confident that the treaty really caused (at least some of) the involved actors to change their behavior. Sulfate[33] seems to be a reasonable indicator for this task since it is not regulated in any of the involved treaties.

As past research indicated, the amount of pollution varies strongly with the flow rate of a river (for example: Federal Ministry for the Environment 2001a; IAWR 1978, 17-19; Meybeck et al. 1990; Van der Veen 1978, 51-55). The amount of pollution gets quantified with more water flowing into a river. This holds true for all forms of pollution. Therefore, every assessment of water quality is only in so far able to yield reliable results as it uses numerical values that are independent of the flow rate. Therefore, we will operationalize our DV as concentrations divided by flow rate (IKSR 1956, 18).[34] The data for the flow rate, BOD_5, cadmium, nickel and sulfate is taken from two sources. For the Rhine regime,

---

[32] Cadmium (as well as mercury) is among the best-known heavy metals (Cioc 2002, 180-181; IKSR 1983,14; Van der Veen 1978, 35-36).

[33] Sulfates (SO4), also known as sulfur oxides, are the result of municipal or industrial discharges but they can also be naturally occurring. Important point sources include sewage treatment plants and industrial discharges such as tanneries, pulp mills, and textile mills. Diffuse sources include runoff from fertilized agricultural lands. (http://kywater.org/ww/ramp/rmso4.htm, Rev. 18-7-2006; http://en.wikipedia.org/wiki/Sulfates, Rev. 18-7-2006).

[34] I am indebted to Ron Mitchell for the idea of operationalizing my DV as flow rate divided by concentration.

the data is taken from the publications of the ICPR[35]. This data consists of fortnightly or monthly values that have been averaged to annual observations for the years 1954-1990 for BOD_5 and flow rate, for cadmium (1975-2003), for nickel (1974-2003) and for sulfate (1962-2003) respectively. For the Elbe regime, all data was made available to us by Michael Bergemann from the Wassergütestelle Elbe/ARGE Elbe.[36] This data consists of monthly values that we have averaged to annual data for the years 1984-2004 for cadmium, nickel and sulfate, for the flow rate (1985-2004) and for BOD_5 (1985-1993). All data has been collected through standardized procedures. The measurement unit is m^3/s for the flow rate, mg/l and µg/l for BOD_5, cadmium and nickel respectively.

3.2 The Independent Variables[37]

> *"Political scientists and others have put forth a plethora of propositions as to which types of institutions are likely to be more effective. To render meaningful quantitative and qualitative inference about the consequences of institutional design possible, we must focus on a small number of institutional design variables" (Bernauer 1995, 374).*

Realist Variables: Power and Vulnerability

In regard to our hypothesis H1, we operationalize on the one hand *power*. As many authors have stressed, power is notoriously difficult to operationalize (for example: Mitchell and Keilbach 2001, 896). It can either be thought of as control over resources or as control over outcomes. As Keohane et al. (1977/1989, 11) stated three decades ago: "We can look at the initial power resources that give an actor a potential ability; or we can look at that actor's actual influence over patterns of outcomes". For the purpose of our research design and with the aim in mind of keeping it simple, power will be perceived as economic power. Therefore, we need to measure the economic power of the upstream countries (polluter countries) compared to the economic power of the downstream country (victim country). The question we are looking at is the following: Is the riparian country that suffers most from the problem economically more or less powerful than the country(ies) primarily responsible for damages? (Stubbs and Bonjour 2002). Data is taken from the Gledditsch (2002) "Expanded trade and GDP" data set. In short, power is measured as:

Power = Average GDP polluter country(ies) / average GDP victim country

On the other hand, we operationalize what is meant with *'vulnerable'*. With vulnerable, we mean the preferences of a state – independent of its policy position, or being more precise

[35] Those are: (IKSR 1967; IKSR 1976; IKSR 1982; IKSR 1990; IKSR 1996; IKSR 2004).
[36] Michael Bergemann: Michael.Bergemann@arge-elbe.de; Tel. 040 428 54 7776; http://www.arge-elbe.de.
[37] Due to the design of this research project and due to the method used, there are some rival hypotheses that we cannot control for due to lack of time and resources. These alternative explanations include for example: Compliance because states and corporations fear adverse public opinion, compliance because the treaty rules are perceived as fair and legitimate and compliance with a treaty because the government believes that doing so furthers their interest (Mitchell 1996, 7-11). There are also many factors that belong to the domain of "including irrelevant variables: Inefficiency" (King et al. 1994, 182).

the (ecological) vulnerability of a state. As Sprinz and Vaahtoranta (1994) argue, state positions as leaders or laggards can be predicted by looking at the benefits and costs of international regulation for each single state. According to them, we can classify countries in four different categories in regard to their willingness for international regulation of a given environmental problem: "pushers", "intermediates", "draggers" and "bystanders". These four categories are generated based on indicators of a country's ecological vulnerability (low and high) with abatement costs (low and high).[38]

Since the phenomenon we are trying to explain is water pollution, we are concerned with qualitative aspects of water uses and not quantitative ones.[39] Two qualitative issues seem to be of major importance to the countries involved: On the one hand, the use of the river as drinking water. On the other hand, the use of the river for agricultural use (Bernauer 1997, 160-166; Kiss 1985, 625-629; Van der Veen 1981, 42-44). Thus, for the purpose of this thesis, vulnerability is understood as a country's vulnerability to such an increase of pollution of the river that it is neither possible to use its water as drinking water nor to make use of it for agricultural purposes.

In conclusion, there are four possible ways a country can be classified: (1) Pusher: A high dependence of a country on the use of the river as drinking water and/or the use for agricultural purposes as well and low abatement costs; (2) Intermediate: A high dependence of a country on the use of the river as drinking water and/or the use for agricultural purposes as well and high abatement costs; (3) Bystander: Low dependence of a country on the use of the river as drinking water and/or the use for agricultural purposes as well and low abatement costs and (4) Dragger: Low dependence of a country on the use of the river as drinking water and/or the use for agricultural purposes as well and high abatement costs.

Institutionalist Variables: Precision of Obligations, NGOs, Independence of Secretariat

Since the *amount of precision of the obligations* (Hypothesis H3) cannot be measured simply by looking at the average GDP of a given country, we have to estimate it – based

[38] Pushers (high ecological vulnerability and low abatement costs) strive for stringent international regulation while draggers (low ecological vulnerability and high abatement costs) oppose international environmental regulation. Intermediates (high ecological vulnerability and high abatement costs) as well as bystanders (low ecological vulnerability and low abatement costs) seem to be in between the pushers and the draggers: They have some incentives to cooperate but also good reasons (either high abatement costs or low ecological vulnerability) not to (Sprinz and Vaahtoranta 1994, 77 ff). Abatement costs are connected to the extent to which the solutions of the environmental problem impinge on core economic activities and the differences in the expected costs each involved country has to bear (Wettestad 1999, 16-17).

[39] Quantitative aspects understood as the use of water as industrial process water, as cooling water or for shipping, for instance.

on the treaties.[40] In order to accomplish this task, we will analyze the treaties and assess whether provisions are specific in terms of goals and implementations and if they are generally precise and easy to interpret in the sense that they call for well-defined actions and thus don't narrow the scope for interpretation. Following accomplished research on this issue (for instance: Abbott et al. 2000; Breitmeier et al. 1996a, 82; Breitmeier et al. 2006b, Database), this can be done on a one to three scale: 1 = precise and easy to interpret (e.g., precise rules for emission reductions to achieve a percent reduction goal within a certain time frame and calculated from a base year); 2 = Medium (e.g., general exemption clauses specifying certain circumstances under which states will not have to fulfill specific obligations; 3 = Ambiguous and indeterminate (e.g., rules to guarantee "access to appropriate means" for the work of journalists).[41]

Moreover, we will operationalize the *independences of the secretariat* (Hypothesis H4) when performing its core tasks as well as when performing additional tasks.[42] Therefore, we determine the independence of the secretariat according to the latitude the secretariat has when performing its core tasks. These core tasks comprise: consulting with the parties about negotiation requirements, contributing to the process by selecting participants and in ensuring coordination with relevant international bodies and NGOs, compiling and analyzing data/information and monitor adherence to treaty obligations or using the reporting exercise to clarify for government officials what the obligations of the treaty are. Additional tasks comprise the participation in the setting of the agenda and the development of the protocol, public relations and its political role as pusher or laggard for regime evolution/ratification/compliance. Possible results are: (1) Highly independent: The secretariat has broad latitude to take action independent of member approval. Most of the important actions do not need state approval; (2) Medium independence: Between 1 and 3 on the scale; (3) Low independence: The secretariat has some latitude to take action with regard to some, but not all, important issues; (4) No independence: The secretariat has no latitude to take independent action. All action taken by the secretariat must have state approval (Breitmeier et al. 1996a, 100).

---

[40] As past research (for instance: Abbott et al. 2000, 402) has already argued, the 'precision of the 'obligations' cannot be fully operationalized.

[41] We acknowledge that this operationalization lacks specification. Unfortunately, the existing literature has not provided more guidance in this regard so far.

[42] With more time and resources, we could have a closer look at the 'activity' of the secretariat as well. Following Andresen et al's (1999) approach, we could then measure activity by looking at the number of documents that the secretariat prepared for the meetings of the Commission in relation to those prepared by the Contracting Parties and other actors. Unfortunately, at least for the Elbe regime, such data does not exist (e-mail communication with Dr. rer. nat. Slavomír Vosika, the executive director of the ICPE secretariat on 11-14-2006).

For measuring the *degree of involvement of NGOs* (Hypothesis H5), we perform two tasks. First, we try to find out what types of non-state actors were actively involved and their degree of involvement. Possible results are: (1) High involvement: NGOs are considerably involved; (2) Medium involvement: between 1 and 3 on the scale; (3) Low involvement: NGOs appear to be excluded. We restrict our analysis to three different types of non-state actors[43]: National activist interest groups (nonprofit organizations), International activist interest groups (nonprofit organizations) and National industrial organizations (e.g., national trade unions, Chamber of Industry and Commerce, national federation of industries). Moreover, we restrict our analysis to those actors that acted as pushers (an actor that plays an active role in the political process; generates or promotes new ideas, knowledge, or policies; lobbies for political measures at the international level; and plays an advocacy role for regime formation). Second, we try to assess how much of this factual participation of NGOs is attributable to the operation of the regime. Thereby, the former task is a necessary condition. Without any factual participation of NGOs nothing can be attributed to the operation of the regime (theoretically only in a negative sense). Possible results are: (1) Little or no causal impact: Non-regime factors account for virtually all factual participation of NGOs and regime factors do not play a role; (2) Modest causal influence: The regime matters with regard to factual participation of NGOs (i.e. the treaty allows, facilitates or supports the involvement of NGOs), but non-regime factors are more important; (3) Significant causal influence: The regime is more important with regard to factual participation of NGOs (i.e. the treaty allows, facilitates or supports the involvement of NGOs) than are non-regime factors (Breitmeier et al. 1996a, 41).

Cognitivist Variables: Learning, Scientific Knowledge

Here, we operationalize *if the important actors were able to learn* (Hypothesis H6) what can either be caused by regime or by non-regime factors. For performing this, we try to find out whether the information about the options available for tackling the problem changed within important states. This comprises new technology for abatement or pollution preventions or changes in the demand for pollution preventions, for example. The basis for our judgment is taken from documents, articles and books. Possible results can either be 'little or no change', 'medium change' or 'significant change'. Moreover, we try to assess how much of this change is attributable to the operation of the regime. And even more important, we try to assess if certain design features of the treaty seem to have been

[43] Coding is partially adapted from the International Regimes Database (Breitmeier et al. 1996a, 40). More non-state actors could have been included. Since time and resources for this thesis are limited we restrict ourselves to the ones that seem to be most important in the cases under consideration.

crucial for this. Possible results are: (1) Little or no causal impact: Non-regime factors account for virtually all changes and regime factors do not play a role; (2) Modest causal influence: The regime matters with regard to changes in the understanding of the problem and in the understanding of opportunities for problem solving, but non-regime factors are more important; (3) Significant causal influence: The regime is more important with regard to changes in understanding of the problem and in the understanding of opportunities for problem solving than are non-regime factors (Breitmeier et al. 1996a, 32).

Additionally, we operationalize the *extent of scientific knowledge about the problem* (Hypothesis H7). Here, we pose the question: "Is the environmental problem scientifically well understood?" (Stubbs and Bonjour 2002). The basis for our judgment is taken from documents, articles and books. Possible results are: (1) Strongly established understanding: There was general consensus regarding nature, causes, and consequences of the problem, as well as regarding solutions and what should be maximized in the issue area; (2) Partially established understanding: Consensus was partially achieved, either by consensus on some but not all of the different variables (nature, causes, and consequences of the problem as well as solutions and what should be maximized in the issue area) or by generally growing, but still not fully developed, consensus on all of the different variables; (3) Low established understanding: Understanding was only to a small degree established with regard to nature, causes, and consequences of the problem, or to solutions or what should be maximized in the issue area (Breitmeier et al. 1996a, 32).

Control Variables: Economic Integration, Macro Changes, EKC

One control variable we operationalize is the *level of economic integration among the member countries*. This will be measured as "average trade (imports + exports) of each riparian country with all others/ total trade of each". Data is taken from the Gledditsch (2002) "Expanded trade and GDP" data set.

Another assumption we operationalize is the *control variable for macro changes*. Here, we ask the question: How did the state of the world change during this period with respect to changes in the industry structure? The basis for our judgment is taken from documents, articles and books. Possible results are: (1) Significant change: During this period, a significant change with respect to changes in the industry structure happened; (2) Modest change: During this period, a modest change with respect to changes in the industry structure happened; (3) Small/No change: The state of the world changed only to a small degree or stayed the same (Breitmeier et al. 1996a, 138-139).

Moreover, we operationalize economic activity for assessing the relevance of *the Environmental Kuznets Curve.* Here, we follow recent scholarship who used income as

measure for economic growth (for instance: Dasgupta 2002, 147; Paudel et al. 2005, 3, 7-8). We will measure this as per capita Gross Domestic Product (GDP). Data is taken from the Gledditsch (2002) "Expanded trade and GDP" data set.

4. Research Design

> *„It is good to see that many patients get better with a medicine they have been given, but it would be more comforting to know with more certainty that it is the medicine that causes the improvement and not for instance a temporary improvement in the weather" (Wettestad 1999, 13).*

In very general terms, a researcher can use two methods when generating or testing theories: experimentation and observation (Van Evera 1997, 50). While field experiments fell out of social science's „methodological kit bag" (Green and Gerber 2002, 807) as a discipline, observation is the method almost every social scientist uses being engaged in testing theories. In the realm of observation two methods can be distinguished: qualitative (small-n analysis/case studies) and quantitative methods (large-n analysis). According to Mitchell (2004, 123), qualitative research is best distinguished from quantitative research by „the fact that the former examines relatively few units of analysis[44] while the latter examines many". Whereas quantitative methodologists use statistical techniques to analyze the data, qualitative methodologists rely on other techniques. Both methods have their advantages as well as their trade-offs.[45] In a nutshell, the benefits of the quantitative method lie in its ability to estimate the average explanatory effects of variables (Bennett 2004, 45-46), whereas its trade-off is the danger of 'conceptual stretching' and the fact that it cannot explain an individual case convincingly (Hopkin 2002, 258-260; Mitchell 2004, 121-122). The strengths of the qualitative method are the facilitation of the investigation of causal (rather than merely correlational) relationships and a high level of conceptual validity (George and Bennett 2005, 19-20; Mitchell and Bernauer 1998, 1-2). Nevertheless, the trade-offs are the danger of selection bias, problems of generalizability, and the problem of ensuring convincing comparability (Bennett 2004, 19-20; George and Bennett 2005, 22-34, 80-83; Mitchell 2004, 121-122).

In the field of qualitative methods, a further distinction can be made: Comparative and within-case methods. Frequently used methods of within-case analysis comprise process tracing, congruence testing and counterfactual analysis. Methodologists using the

---

[44] 'Units of analysis' being defined as: "The entities or phenomena about which the researcher collects data. Units of analysis, often called cases, are a sample from a population or class of all conceptually-similar units that could have been studied" (Mitchell 2004, 123).

[45] For a thorough discussion about the advantages as well as the problems of the qualitative as well as the quantitative method see: (Hopkin 2002; Mitchell 2004; Mitchell and Bernauer 1998; Van Evera 1997). As some researchers have pointed out, the advantages as well as the limitations of the qualitative method seem to be precisely the opposite of the ones associated with qualitative methods (Bennett 2004, 46).

comparative method may use Mill's method of agreement[46], Mill's method of difference[47] or the structured focused case comparison[48], to name only the most prominent methods (Bennett 2004, 22-39; Hopkin 2002, 252-255; Van Evera 1997, 49-76).

4.1 Case[49] Selection

> *„The demands of a case-study on a person's intellect, ego, and emotions are far greater than those of any other research strategy" (Yin, 1994, 55, cited after: Mitchell and Bernauer 1998).*

For the purpose of this research project, we will choose the qualitative method, due to existing problems with gathering data, the limited number of available cases as well as the complexity of the possible causal mechanisms between the regime design and environmental quality rule out the use of statistical techniques. Furthermore, we choose to analyze multiple agreements. As Ronald Mitchell (2006, 74) argues:

> *"In a single case, it is often difficult to determine which of several institutional features or other factors, all of which were present, actually explains observed outcomes.... Comparing multiple cases, however, increases our ability to identify confidently whether the institution or non-institutional factors caused observed behavioral variation and, if the institution was responsible, which institutional features were 'active ingredients' in the agreement's success and which were superfluous."*

Further reasons for choosing to analyze multiple agreements include the opportunity to assess how institutional influence depend on non-institutional conditions and the possibility to assess the influence of a particular design feature to other features as well as to other rival explanations (Mitchell 2006, 74-75).

Paying tribute to our selection of cases we adopt an intentional and pragmatic approach and chose to study the formation of international water regimes in the Rhine and Elbe basin. This, for several reasons. In both cases, we have found data appropriate to the hypotheses that we evaluate. For many other rivers data is either only available for a limited period of time, for a limited number of parameters or not available in precedence to the regime coming into effect (Lindemann 2006, 15-16; Mitchell and Bernauer 2004, 89). The Rhine regime is one of the oldest international regimes in general and as Lindemann (2006, 15, emphasis in the original) argues, „the Rhine water regime is *the* pioneer effort in the field of international river basin management and serves as the reference point across Europe and the world." Moreover, many experts argue that the Rhine regime is one of the

---

[46] Which corresponds to what is known as the "least similar cases" research design (Bennett 2004, 30-31; Hopkin 2002, 252-255).

[47] Which corresponds to what is known as the "most similar cases" research design (Bennett 2004, 31-32; Hopkin 2002, 252-255).

[48] The method of structured focused case comparison was developed by Alexander George as a response to the shortcomings of Mill's methods and controlled comparison (Bennett 2004, 32-33; George and Bennett 2005, 67-72).

[49] I follow Eckstein's definition of a case as "a phenomenon for which we report and interpret only a single measure on any pertinent variable" (Eckstein 1975, 85).

most successful regimes for the protection of international river basins (Bernauer and Moser 1997, 147).[50] The development of the Elbe regime is in contrast to the Rhine regime a relatively recent phenomenon. It is a pioneer effort after the end of the Cold War that brings together countries from Western and Eastern Europe (Lindemann 2006, 15). Nevertheless, this approach involves a high risk of selection bias.[51] A more extensive analysis on this issue should open up for a more detailed study.

We use the *"before-after" research design* (George and Bennett 2005, 81, 166-167). This, because we want to find out whether our DV as well as our primary IV of interest – 'regime design' or any rival IV has changed its value after the treaties went into effect. In addition to this, we have a strong interest in minimizing the list of possible IVs. And the use of the "before-after" research design allows us to do so. This design enables us to prove that a correlation between the existence of the treaty or certain design elements of it and the amount of pollution (DV) does exist or not. One of the benefits of the „before-after" research design is the possibility to control for many factors.[52] As George et al. (2005, 166) argue: "when this type of quasi-experimental research design is imaginatively and carefully employed, it can be extremely useful in policy evaluation research". Here, we will divide all three single longitudinal cases into several sub-cases and compare them according to Mill's method of difference. Moreover, we make use of two control groups. First is the use of our control indicator sulfates (see Figure 1 and Figure 2). This enables us to compare the regulated with the non-regulated pollutants. Second, the comparison with other national as well as transboundary rivers (see Figure 3). This enables us to control for other major factors that we have not included in our analysis. Consequently, differences in the amount of pollution before and after the treaties went into effect will show whether we are able to find a correlation between the treaty or any rival explanation and our DV.

---

[50] Nevertheless, Bernauer and Moser argue in regard to the RCC that the connections between international cooperation and declining pollution are not straightforward (Bernauer and Moser 1996, 389).

[51] As Collier et al. (1996, 59) pointed out, „selection bias is commonly understood as occurring when some form of selection process in either the design of the study or the real-world phenomena under investigation results in inferences that suffer from systematic error". Possible forms of selection bias include the selection of those cases whose independent and dependent variables vary as the favored hypothesis suggests while ignoring those cases that appear preliminary to contradict the theory, the selection of cases based on extreme values of the variables, selection of cases based on the availability of evidence, or on cases' 'intrinsic' historical importance (Bennett 2004, 40; Collier and Mahoney 1996).

[52] Nevertheless, there are some pitfalls, one should be aware of when using the "before-after" research design. One is – as Campbell and Stanley have already emphasized – to measure the values of the observed variables "not only immediately before and after the event, but also well before and well after it" (George and Bennett 2005, 166).

Second, we make use of the method of controlled comparison.[53] We use the *method of difference* for comparing the Rhine Convention with the Rhine Chemical Convention: There seems to be strong evidence that both cases are very similar but have different outcomes. Ideally, we will be able to observe that our primary IV of interest – 'regime design', or even better some design features - vary while other variables do not. Some preliminary evidence supports the assumption that this could be the case.[54]

Third, for avoiding the fallacy of "attributing causation where only spurious correlation exists" (Mitchell 1994b, 439) as well as the problem of indeterminacy, we will do *process tracing* on these IVs that have shown a covariation with the DV. Since this research design is of a scientific realist nature, the discovery of correlations is an important evidence of causal relations but it is not sufficient for establishing the existence of a causal pathway between an IV and our DV. We need to know the mechanisms at work:

> *„There is a causal relation between two variables if and only if there is a causal mechanism connecting them" (Little 1991, 25).*

Little (1991, 24-25) makes in this regard the distinction between a 'false-positive' and a 'false-negative' error.[55] For avoiding these errors, scientists suggest analyzing the causal mechanisms that connect cause and effect (George and Bennett 2005, 185-188, 205-232; Little 1991, 24-25; Mitchell and Bernauer 2004, 96):

> *„Examining causal pathways helps demonstrate a linkage between an IV and a DV by taking advantage of the fact that a theory regarding an IV usually has several, and often many, observable implications beyond simply the value of the DV" (Mitchell and Bernauer 2004, 96).*[56]

Finally, we use the method of controlled comparison again but this time with the

---

[53] For performing this, we have (at least) two options: We can use the 'method of agreement' and study very different cases that are characterized by the same outcome (DV). Or we can use the 'method of difference' and study cases with different outcomes (DV) but very similar antecedent conditions (Bennett 2004, 30-32; Hopkin 2002, 252-255).

[54] Since the RCC is the follow-up of the RC and thus builds on the institutional foundation of the RC it does not seem to be comparable with the EC (that establishes the institutional foundation of the Elbe regime). Therefore, we will not use the method of agreement for comparing the Rhine Chemical Convention with the Elbe Convention. A comparison between the RC and the RCC as already mentioned below is still possible since the RCC is a stand-alone treaty that adds important features in regard to the regime design.

[55] A 'false-positive' error occurs when concluding that there exists a causal relation between two variables when in fact there is none. A 'false-negative' error would then occur when concluding that there exists no causal relation between two variables when in fact there is one.

[56] With more time and resources process tracing could have been supported via open interviews with decision makers. Since this was not possible, we relied on the analysis of pollution and reviewed the secondary literature.

congruence method[57] between the Rhine Convention and the Elbe Convention for finding out in what way our findings hold true when compared to other transboundary river regimes.[58]

Table 1: Overview of used methods

(1) Before-after research design for RC, RCC and EC
(2) Controlled comparison with method of difference between RCC and RC
(3) Detailed process tracing on these IVs that have shown a covariation with the DV
(4) Controlled comparison with congruence method between RC and EC

Since we have several hypotheses we want to test and even more factors we want to control for, we should be cautious in relation to the problem of *"too many variables, too few observations."* As Mitchell and Bernauer (2004, 87-89) argue, at least two observations are required for identifying the influence of a single independent variable on a dependent variable. In regard to the purpose of this research design, we will overcome this problem by performing the following tasks: First, we will *increase the number of observations by observing more units* (King et al. 1994, 208-228):

> *"We apply the same theory or hypothesis, using essentially the same variables, to more instances of the process which the theories describes" (King et al. 1994, 219).*

We will do this in two ways: (1) *'across space'*. Here, we will make more measures by seeking out similar units.[59] In the case of the RC and RCC, we will use the observations of multiple measuring stations that might give us a hint on the approximate amount of the riparian states. Those gauging stations are[60]: 'Weil am Rhein', 'Lauterborg/Seltz', ‚Koblenz/Rhein', ‚Bimmen/Lobith' and ‚Gorinchem/Vuren' (see Map 1).[61] In the case of

[57] For doing this we have to investigate the cases and try to find congruence or incongruence between values observed on the dependent and the independent variable. If we should find out that the value of the IV is either above or below normal then the value of the DV should also be above or below the norm, naturally in the same direction. If both values are congruent – both are below or above the norm – the theory passes the test. If both values are far above or below normal, we can assume that the theory has "large importance" (Van Evera 1997, 58). And if they are only little above or below the norm, the theory has passed the test but the results suggest that it has only "little importance" (Van Evera 1997, 58-64).

[58] I am indebted to Andreas Hasenclever for the idea of using the congruence method for comparing the RC with the EC.

[59] We acknowledge that the cases may not be entirely independent of each other. Nevertheless, by looking at the different measuring stations we will be able to find out if the involved actors actually changed their behavior. It may well be possible, that Germany in the case of the Elbe has changed its behavior and has reduced the amount of pollution according to the treaty but the Czech Republic has not, for example. Our results would be flawed if we had not looked at both measuring stations.

[60] Consequently, our unit of analysis is the measuring station that is located in an upstream-downstream setting that measures pollution levels.

[61] With more time and resources, a more thorough distinction could be made. Ideally, we would have a situation where the observed river flows from one country x into another country z with at least two measuring stations in-between: One, that is situated right on the border between the two countries measuring the amount of pollution of the upstream country x. The other situated far downstream of the river for measuring the emissions of z. This would make estimating the amount of pollution of each involved country easy since (roughly) no entanglements between them existed. When looking at the Elbe, this seems to be almost the case. In the case of the Rhine things are a bit more difficult. Here, the river forms the border between Germany and Switzerland and after the city of Basel between Germany and France as well.

the Elbe Convention, we will use the observations of two measuring stations: The gauging station 'Schmilka', situated next to the border of the Czech Republic that measures the behavior of the upstream country the Czech Republic (see Map 2) and the gauging station 'Magdeburg', situated in the middle of Germany that measures Germany's distribution as the downstream country involved to the pollution load of the Elbe.

(2) 'Across time': We will make multiple observations over time - before and after the treaty went into effect and additional measures after each passing of five years. Since data is available in the case of the Rhine Convention from 1954 up to 2003, we will make measures in 1958 before the treaty went into effect, in 1963 when the treaty was signed and in 1968, 1973 after the treaty went into effect. Data for assessing the effectiveness of the Rhine Chemical Convention is available from 1954 to 2003 as well with a constraint for heavy metals (cadmium and nickel) where data is available form 1974/1975 to 2003. This allows us to make observations in 1975 before the treaty went into effect, in 1976 when the treaty was signed[62] and in 1981, 1986, 1991 and 1996 after the treaty went into effect.[63] Finally, in the case of the Elbe Convention data is available from 1986 to 2004. Observations can be made in 1986 before the treaty went into effect, in 1990 when the treaty was signed and in 1992, 1997 and 2002 after the treaty went into effect.

Secondly, we will determine *different measures of the same units*:

> *"Additional instances for the test of a theory or hypothesis can be generated by retaining the same unit of observation but changing the dependent variable" (King et al. 1994, 223).*

We use three different dependent variables[64]: BOD_5 in the case of the Rhine Convention and Cadmium, nickel and BOD_5 in the case of the Rhine Chemical Convention as well as the Elbe Convention. Sulfate will serve as a control indicator (untreated control group) in all three cases. Moreover, further indicators such as mercury and lead will be used to strengthen our results (see section 6.2 Assessing the Robustness of Results).

---

[62] In accordance with past research (for instance: Breitmeier et al. 1996a, 5), we date the establishment of a regime from the signing of a document in which the member parties agree to the provisions of the arrangement.

[63] We do not include the year 2001 in our analysis since the New Convention on the Rhine was signed in 1999.

[64] We acknowledge that these measures might not be entirely independent of each other. Nevertheless, there is some variation between the indicators. For instance, when comparing the sources of cadmium and nickel, it becomes obvious that they result partially from different types of industries. Thus, the major sources for cadmium pollution in Germany are the BASF AG, Ludwigshafen (with 235kg in 1985), Berzelius, Duisburg (with 480kg in 1985), the Solvay AG, Rheinberg (with 59 kg in 1992), the Bayer AG, Leverkusen (with 48 kg in 1997), the Bayer AG, Dormagen (with 27kg in 1997), and the Solvay AG, Rheinberg, (with 130kg in 1985). And the major sources for nickel pollution are in Germany the BASF AG, Ludwigshafen (with 10,000kg in 1985), the Bayer AG, Leverkusen (with 32,000kg in 1985, the Badische Stahlwerke, Kehl, (with 1,035kg in 1985), the OMW GmbH, Karlsruhe (with 1,142kg in 1985), and the Hüls AG, Marl (with 1,200kg in 1985) (Deutsche Kommission zur Rheinhaltung des Rheins 1993, 6, 9; Federal Ministry for the Environment 2001b, 27; IKSR 1994, 37).

4.1.1 The Rhine Water Regime

"The river Rhine, it is well known,
Doth wash your city of Cologne,
But tell me, nymphs! What power divine
Shall henceforth wash the river Rhine?"
(Samuel Taylor Coleridge, 1828)

On its 1300 km long journey the Rhine River flows from the Swiss Alps to the North Sea. Being the basin of the third biggest river of Europe, the Rhine covers parts of nine countries that are riparian states of the Rhine: Austria, Belgium, Italy, Liechtenstein and Luxembourg as well as France, Germany, the Netherlands and Switzerland. The latter four are the most involved. Here, the main stem of the Rhine drains some of the most populated and industrialized areas of these countries. Other rivers that possess a similar size as the Rhine are the Northern Dwina in Russia, the Fraser in Canada or the Colorado in the United States (Bernauer 1996, 201-202; Lindemann 2006, 16-17; Van der Veen 1981, 41-42).

Around 55 million people reside and work in the catchment area that has an average population density of approximately 270 persons per square kilometer. Approximately 20 percent of all chemical companies in the western world are located in the Rhine catchment area which makes it one of the most important industrial areas of the world where large chemical industries, potash and coal mines as well as other sources reside. Moreover, the Rhine provides the source for drinking-water production for more than 20 million people (Bernauer and Moser 1996, 401; Dieperink 1997, 1-3; IKSR 1994, 9; International Water Assessment Centre 2001, 35; Lindemann 2006, 16-17; Van der Veen 1981, 41-42). No surprise that by the mid-1970s, levels of water pollution had come to a point where the "artery of Western Europe" (Dieperink 2002: 67) had been turned into the "world's biggest sewer" (Teclaff and Teclaff 1985, 589).

The first attempts to manage the river Rhine can be dated back to as early as 1449. The first treaties that were signed concerning the Rhine go back to the 19th century and mainly concern the regulation of free shipping in the river.[65] For instance, the Central Commission for Rhine Navigation was established to regulate all matters concerning navigation first met on August 5, 1816. Nevertheless, whereas the first international exchange over water quality was made in this time as well, more specific discussions at an international level started not until the early 1950s. This despite the fact that serious pollution of the river started around 1850 (International Water Assessment Centre 2001, 35; Lindemann 2006,

[65] For a more detailed overview, see (Durth 1996, 170-174).

16-17; Van der Veen 1981, 41-50, 81). These discussions were formalized 1963 in a regulatory framework for the protection of the river: the *Convention on the Protection of the River Rhine (Rhine Convention)*.[66] More treaties concerning water pollution were signed in 1976. On the one hand, the *Convention for the Protection of the Rhine against chemical pollution* (1976a). On the other hand, the *Convention for the Protection of the Rhine against Chlorides* (1976b). More recent attempts were made with the Rhine Action Program (RAP) in 1987 and the new Convention on the Rhine in 1999 (1999). Since the Rhine regime, defined here as the ICPR and all associated negotiations and treaties, splits into several treaties and politically binding agreements, we can talk - in line with past research (for instance: Bernauer and Moser 1997, 148, 151) - about sub-regimes. These sub-regimes, here the Rhine Convention and the Rhine Chemical Convention, will be analyzed separately.

Table 2: History of the International Commission for the Protection of the Rhine (ICPR)

1950	Common forum where discussions at an international level started was created
1963	Convention on the Protection of the River Rhine (Rhine Convention/RC)
1976	Convention for the Protection of the Rhine against Chemical Pollution (RCC)
1976	Convention for the Protection of the Rhine against Chloride Pollution
1987	Rhine Action Program (RAP)
1999	New Convention on the Rhine

4.1.1.1 The Rhine Convention (1963)

The *Rhine Convention* is a sub-regime of the Rhine regime. It was signed in 1963 and went into effect in 1965. With its' establishment, the problem of the absence of a framework for discussion was solved. Whereas before the establishment of the Rhine Convention a number of actors from the Rhine catchment area communicated in an informal and initially rather unstructured way on Rhine quality issues, the convention gave this as well as the ICPR a formal structure (Dieperink 1995, 123-124; Dieperink 1997, 3).

Central goals of the Rhine Convention:

- prepare and carry out all necessary research to determine the nature, importance and origin of pollution of the Rhine and put the results of such research to use (1963, Article 2)
- propose measures to Contracting Parties and prepare the basis of possible arrangements (international regulation, agreements, treaties) between the Contracting Parties concerning the protection of the waters of the Rhine (1963, Article 2)

Since precise goals are lacking, we will use BOD_5 as a universal measure for water quality.

[66] The Rhine Convention provides the legal basis for the ICPR. Nevertheless, the ICPR started meeting as early as 1950 after it was established through an exchange of letters between the Governments of Switzerland, the Federal Republic of Germany, France, Luxembourg and the Netherlands. The European Economic Community (that is today the European Union) becomes a member of the ICPR in 1976 with the signing of an additional treaty. For more background information regarding the RC, see: (Dieperink 1995, 124; Dieperink 1998, 479).

4.1.1.2 The Chemical Convention (1976)

The *Rhine Chemical Convention* is a sub-regime of the Rhine regime as well. It is the follow-up of the RC and thus builds on the institutional foundation of this treaty. The RCC was signed in 1976 and entered into force in 1979. Signatory states are Germany, France, Luxembourg, the Netherlands, Switzerland and the European Union. The nascence of the RCC was coined with considerable difficulties. Whereas the Dutch as the downstream country and the initiator of the sub-regime could draw on the support of France, Germany as well as Switzerland opposed the Convention. This, because of the uncertainty regarding the economic as well as political consequences of the treaty.[67] After these difficulties were surmounted, the RCC was shaped as a framework agreement. It distinguishes between black and grey lists of substances (in Annex I and Annex II). One of its' main goals is to eliminate the pollution of Annex I substances like mercury and cadmium and to reduce the pollution of Annex II substances like lead and nickel (1976a, Article 1). Additionally, three protocols – one for cadmium (1983), one for mercury (1985), and one for carbon tetrachloride (1986) – were added (Cioc 2002, 181; http://www.ecolex.org, Rev.10-26-2006). Some first evidence supports the assumption that the RCC has been an effective regime. For instance, the International Water Assessment Center (2001, 35) calls it the "most important convention for the present day management of the river".

The Rhine Chemical Convention was strongly inspired by several treaties or drafts of politically binding agreements: The EEC Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment of the Community, the draft European Convention for the Protection of International Watercourses Against Pollution (which had never been adopted by the member states of the Council of Europe), and the 1974 Paris Convention for the Prevention of Marine Pollution from Land-Based Sources (Dieperink 1995, 127; Kiss 1985, 625).

Central goals of the Rhine Chemical Convention: (www.ecolex.org; Tschanz 2001, 36; 48-49)

- improve the quality of the waters of the Rhine (Article 1): measured with BOD_5
- eliminate pollution of the surface waters of the Rhine basin by dangerous substances in the families and groups of substances appearing in Annex I (Article 1): measured with *Cadmium*
- reduce the pollution of the Rhine by the dangerous substances in the families and groups of substances appearing in Annex II (Article 1): measured with *Nickel*

[67] Especially Germany feared that the competitive position of it's Rhine industry would have to bear considerable competitive discrimination compared to their competitors in Europe and the World and that the costs resulting from the treaty would be too high. Only after the EEC Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment of the Community had been signed in 1976 (76/464/EWG), Germany was willing to sign the RCC as well (Der Rat der Sachverständigen für Umweltfragen 1976, 88-98).

4.1.2 The Elbe Water Regime

"Once the symbol of division of both Germany and the whole European continent, the river Elbe is now considered a bridge between Eastern and Western Europe." (Lindemann 2006, 27)

On its way from the Krkonose mountains/Riesengebirge in the Czech Republic, the Elbe drains the Bohemian chalk basin, leaves the German mountain region behind and passes the North-German lowland until it reaches the North Sea in Cuxhaven. With a total length of 1,091 km and a basin area of 148,268 km², the Elbe is one of central Europe's longest rivers. Despite the fact that Austria, Poland, the Czech Republic and Germany share the basin, more than 99 % of the area belongs to the latter two with Germany (65%) possessing around twice as much as the Czech Republic (34%). Before Germany's reunification in 1990, a substantial amount of the territory of the Elbe basin belonged to the former German Democratic Republic (GDR) (Durth 1996, 204f; International Water Assessment Centre 2001, 45; Krysanova et al. 2005, 22; Lindemann 2006, 27; Stubbs and Bonjour 2002, 1-2).

Around 25 million people reside and work in the catchment area with around 19 million in Germany and approximately six million in the Czech Republic. The water of the Elbe and its tributaries is used for drinking-water supply, industrial water supply, cooling water as well as for irrigation. More than 55 % of the total area is used for agricultural purposes. Moreover, the principle industries in the catchment area include the pharmaceutical and chemical industry; the paper and pulp industry; the metal and mining industry as well as the glass, ceramics, leather and textile industry. No surprise that throughout the 1980s the Elbe was considered as one of the most heavily polluted rivers on the European continent and pollution levels of the Elbe equaled those of the Rhine during the 1970s, during its period of maximum pollution (Holtrup 1999, 178ff; International Water Assessment Centre 2001, 45; Shmueli 1999, 465; Stubbs and Bonjour 2002, 2-6).

In contrast to the Rhine regime, the development of the Elbe regime is a relatively recent phenomenon. Between the years 1949 and 1989 there was almost no cooperation in regard to water pollution issues between the main riparian states.[68] This, despite West Germany's repeated attempts to convince both upstream countries to reduce polluting the Elbe. But neither the GDR nor the then Czechoslovakia[69] was willing to engage in substantial

[68] For more regarding the cooperation between East and West in the realm of international environmental politics, see: (Peitsch 1991).

[69] After the Slovaks and the Czechs agreed to separate peacefully on 1 January 1993, the Czech Republic became the legal successor in regard to the ICPE (Holtrup 1999, 195; International Water Assessment Centre 2001, 45).

international cooperation.[70] This changed with Germany's Reunification and the end of the Cold War.[71] Only five days after Germany's reunification and thereby becoming the first international treaty that the reunified Germany signed, Germany, the then Czechoslovakia and the European Economic Community (EEC) reached agreement on the creation of the *International Commission for the Protection of the Elbe (ICPE)*. Here, the idea to establish an international commission for the protection of the Elbe arose from the positive experiences with the Rhine regime. Thus, it is not surprising that the ICPE was based on the model of the ICPR. Moreover, two Action Plans were subsequently added: The *First Action Plan* (from 1992-1995) that addressed short-term, immediate problems and was directed primarily toward reduction of the heaviest pollution sources and the Second *Action Plan*: 1996-2010 that addresses long-term, continued improvement of the Elbe and its tributaries (Durth 1996, 208ff; Holtrup 1999, 173, 184-190; Lindemann 2006, 28; Shmueli 1999, 465; Stubbs and Bonjour 2002, 8-9).

4.1.2.1 The Elbe Convention (1990)

The establishment of the International Commission for the Protection of the Elbe (ICPE) was signed between the European Economic Community, Germany and the former Czech and Slovak Federal Republic[72] on October 8th 1990 in Magdeburg and went into effect on October 30th 1992. When looking at the institutional design of the ICPE, it becomes evident that the ICPE was institutionally modeled after the ICPR. Here, the contracting parties agreed to cooperate with the goal to prevent and reduce the pollution of the Elbe river (International Water Assessment Centre 2001, 45; Krysanova et al. 2005; Lindemann 2006, 15, 29; www.ecolex.org, Rev. 10-26-2006).

Central goals of the Elbe Convention:

- The principal objective of the Elbe Convention is to prevent the pollution of the Elbe and its drainage area (1990, Article 1).[73]

Here, we use the same indicators for assessing the effectiveness of the Elbe Convention as we use in the case of the Rhine Chemical Convention: *BOD_5, Cadmium and Nickel.*

---

[70] What included the exchange of data on water pollution as well. Nevertheless, the GFR and GDR had concluded bilateral agreements on transboundary water issues with the Czechoslovakia as early as 1974. But these agreements did not lead to any material results on issues related to the Elbe River. For more regarding this, see: (Durth 1996, 213ff; Lindemann 2006, 28).

[71] For example, Shmueli (1999, 463-464) argues that "Reunification of Germany in 1990 and the Czech Republic's desire for good relations with a unified Germany, have provided a political opening for the raising of an Elbe issue that had long been dormant – pollution".

[72] With the Czech Republic being the legal successor (Holtrup 1999, 195; International Water Assessment Centre 2001, 45).

[73] For achieving this, the contracting parties shall endeavor to: a) enable use to be made of the river, in particular the obtaining of supplies of drinking water from bank-filtered waters and the agricultural use of the waters and sediments; b) to achieve as natural an ecosystem as possible with a healthy diversity of species; and c) to reduce substantially the pollution of the North Sea from the Elbe area (1990, Article 1).

5. Empirical Results

5.1 The Evolution of Rhine and Elbe Water Pollution

"You cannot pollute the river and expect to eat fish" (Ruth Carina Feldsberg. cited after: Sprinz 1992)

The Evolution of Rhine Water Pollution

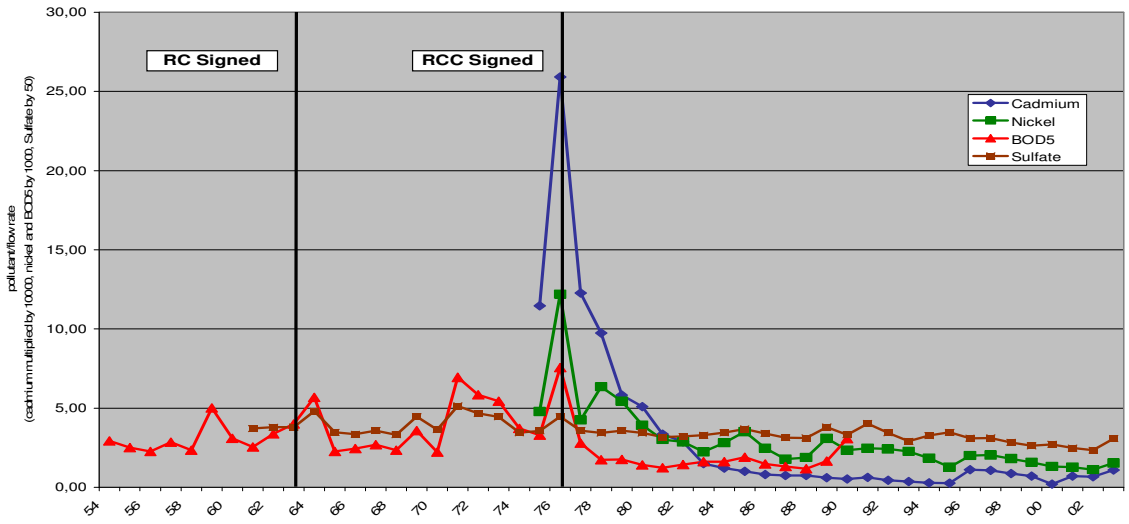
Increasing pollution before 1965

Rhine water quality has increasingly deteriorated since the beginning of the last century. The populations of salmon and shad decreased and the last sturgeon was caught in 1931. After 1933, the water quality continued to decline in the course of the advancing industrialization (Federal Ministry for the Environment 2001c, 127-28). Pollution data shows that the level of BOD_5 increases (with slight declines in-between) until 1964 when it reaches its peak (see Figure 1). A comparison between the years 1958 and 1963 reveals that the amount of BOD_5 increases with more than 70 percent. In 1959 the amount of BOD_5 reaches its first peak. Never before has such a high amount pollution been measured in the Rhine. These results reflect what many students of international environmental regimes observe: Governments usually act when environmental conditions get worse. Thus, it comes at no surprise that the RC was signed in 1963.

Decreasing and Increasing pollution after 1965

After 1965 we can observe a decline of BOD_5 levels. A comparison between the years 1963 and 1968 reveals that the amount of BOD_5 declines with more than 40 percent (see Table 3). Nevertheless, in 1968 only three years after the RC went into effect, the amount of BOD_5 in Rhine water started increasing again and reached its peak in 1971 (see Figure 1). A comparison between the years 1968 and 1973 reveals that the amount of BOD_5 concentrations increased heavily with more than 130 percent. Only 6 years after the RC went into effect, the amount of BOD_5 in Rhine water has more than doubled and thus reached a dimension it had never before. These observations find additional support when looking at another pollutant: Chlorides. Whereas the level of chloride concentrations in Rhine water remained on an almost constant level before 1964, it increased markedly after 1964 and reached one peak after the other until 1974 (with one decline between 1970 and 1974) (Van der Veen 1981, 45). Additionally, these results we observed at Bimmen/Lobith almost parallel those at the other observed measuring stations (see Figure 6).

Figure 1: Rhine Pollution at Bimmen/Lobith



Increasing pollution before 1976

Despite the fact that pollution levels of BOD_5 decreased after 1965, they increased steadily with peak loads when looking at the time period between 1954 and 1976 when levels of BOD_5 in Rhine water were as high as never before (see Figure 1).

A comparison between the years 1975 and 1976 reveals that the amount of cadmium increased heavily with more than 125 percent, the amount of nickel with more than 155 percent (see Table 3). For both pollutants a concentration was measured that had never been as high before and that has never been as high again since. These results reflect again what students of international environmental regimes observe: Governments usually act when environmental conditions get worse. Thus, it comes at no surprise that the Rhine Chemical Convention was signed in 1976.

Significant decline of pollution after 1976

Since 1976, pollution has declined significantly. A very steep decrease from the peak year 1976 until the mid-1980s can be observed (see Figure 1). The pattern of this decrease is basically similar for the observed pollutants BOD_5, cadmium and nickel. When comparing the five-year period between 1976 and 1981, it becomes evident that the concentrations of cadmium and BOD_5 decline with more than 80 percent, the amount of nickel by 75 percent. Only five years after the treaty was signed, the concentrations of cadmium, nickel and BOD_5 are as low as never before. Additional observations with more pollutants like mercury and lead indicate that the pattern of this decrease is not limited to the few pollutants we used but can be observed for (almost) all heavy metals and other chemical pollutants as well (see Figure 4). Moreover, these findings get support from other studies (for instance: Bernauer and Moser 1996, 395-96; Tschanz 2001). Even more important, the amount of pollution remains (almost) at these low levels. Since the mid-1980s, the decline

has slowed down with the pollution stagnating at relatively low levels.[74] Additionally, these results we observed at Bimmen/Lobith almost parallel those at the other observed measuring stations (see Figure 6, Figure 7 and Figure 8). Finally, a distinction between cadmium and nickel becomes evident: The amount of cadmium declines more significantly and is more lasting. Whereas the amount of nickel declines with (only) 17 percent when comparing the years 1981 with 1986, cadmium decreases with almost 80 percent. This observation provides a first indication for the claim that regime design matters: Both pollutants are regulated differently under the RCC. Whereas cadmium belongs to the Annex I substances that are to be eliminated from the surface water of the Rhine, nickel belongs to the latter that are to be substantially reduced.

Table 3: Reductions in Percent at Bimmen/Lobith: Rhine Pollution

Pollutant	*Average values*						*Reductions in percent*				
	1958	**1963**		**1968**		**1973**	**1958-1963**		**1963-1968**		**1968-1973**
BOD_5	2.33	3.99		2.33		5.43	-71.50		41.63		-133.09
Sulfate	-	7.60		6.62		8.90	-		12.86		-34.43
	1975	**1976**	**1981**	**1986**	**1991**	**1996**	**1975-1976**	**1976-1981**	**1981-1986**	**1986-1991**	**1991-1996**
Cadmium	11.47	25.91	3.34	0.8	0.63	1.11	-125.89	87.09	76.18	21.16	-77.36
Nickel	4.78	12.20	3.01	2.47	2.46	2.01	-155.12	75.32	17.94	0.58	18.33
Sulfate	3.30	8.92	6.35	6.81	-	-	-128.78	28.74	-7.21	-	-
BOD_5	7.12	7.55	1.24	1.47	8.05	6.18	-25.21	83.60	-19.12	-18.20	23.21

The Evolution of Elbe Water Pollution

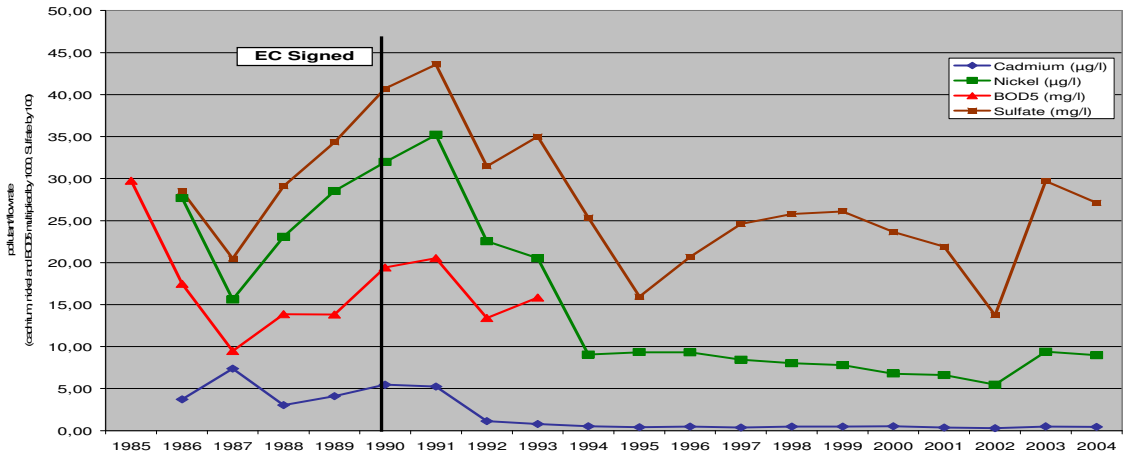
Increasing pollution before 1990

Many experts agree that the situation of the Elbe in the 1990s in regard to the pollution load is comparable with that of the Rhine some 20 years ago (for instance: OECD 1993a, 172). From 1987 until 1990 pollution levels of the Elbe with all observed substances increased steadily with peak loads (see Figure 2). The Elbe became more and more polluted. A comparison between the years 1986 and 1990 reveals that the amount of cadmium increased with almost 50 percent, the amount of nickel with 15 percent and the amount of BOD_5 with 10 percent (see Table 4). The concentration with cadmium peaked in 1987 when 5 µg/l were measured. Moreover, these results we observed at Magdeburg parallel those at Schmilka with one important exception: The observed levels at Schmilka are even higher than those at Magdeburg (see Figure 4). These results reflect again what

[74] Even the critical waterworks conclude that the heavy metal pollution of the Rhine had reached a level in the early 1980s where using it for the production of drinking water is not a problem any more. A regressive tendency has loomed for most of the heavy metals that seems to be even more significant for those heavy metals that are caused mainly through anthropogenic production (IAWR 1982, 52-57).

students of international environmental regimes observe: Governments usually act when environmental conditions get worse.

Figure 2: Elbe pollution at Magdeburg



Significant decline of pollution after 1990

After all observed pollutants peaked in 1991, we can observe a significant decline in the amount of concentration measured in the Elbe (see Figure 2). When comparing concentration levels of 1990 with those of 1995, we can observe a considerable decrease in cadmium with more than 90 percent and nickel with more than 70 percent (see Table 4). Only BOD5 concentrations had decreased with relatively low levels of 18 percent. Only five years after the treaty was signed, the concentrations of cadmium and nickel (already after four years) were as low as ever before. Even more important, the concentrations remained at these low levels. Since the mid-1990s, the decline has slowed down with the pollution stagnating at relatively low levels. Moreover, these results at Magdeburg parallel those at Schmilka (see Figure 4). This means that both involved countries – the downstream as well as the upstream country - have changed their behavior. Both riparian states reduced their polluting behavior to an impressive degree.

Table 4: Reductions in Percent at Magdeburg: Elbe Pollution

Pollutant	Average values					Reductions in percent		
	1986	**1990**	**1992**	**1995**	**2000**	**1986-1990**	**1990-1995**	**1995-2000**
Cadmium	37.24	54.55	11.34	4.14	5.22	-46.46	92.41	-26.17
Nickel	27.67	31.97	22.53	9.34	6.78	-15.53	70.79	27.30
BOD_5	17.50	19.42	13.39	15.85(1993)	-	-10.97	18.38	-
Sulfate	28.50	40.70	31.47	15.96	23.63	-42.82	60.78	-48.07

5.2 The Independent Variables

Realist Variables: Power and Vulnerability

There is one assumption derived from Realism we focus on: The theory of hegemonic stability that splits into the two indicators power and vulnerability. We begin with assessing the former: Power. For explaining the effectiveness of the *Rhine regime* (RC as

well as RCC), we should expect a powerful (downstream) hegemon when following the theoretical predictions of (neo-) Realist scholars.[75] Nevertheless, we found out that empirically, this is clearly not the case (see Table 5). In general, it is difficult to identify a hegemon. But what is evident is that the Netherlands, the downstream country, is certainly not the most powerful country. This observation finds additional support in the literature (for example: Breitmeier et al. 2006b, Database; Durth 1996, 168; Holtrup 1999, 85; LeMarquand 1977, 100-101). Moreover, our analyses support the claim that the constellation between the riparian states in regard to the distribution of power remained on a constant level from 1950 on until (at least) 1991.

Table 5: Power of the Riparian States

Rhine	**1958**	**1963**	**1968**	**1973**	**1975**	**1981**	**1986**	**1991**
Power	1.09	1.15	1.07	1.08	1.04	1.08	1.10	1.08
Elbe	**1987**	**1990**	**1992**	**1997**	**2000**			
Power	0.30	0.30	0.24	0.63	0.62			

Average GDP polluter country(ies) / average victim country

In the case of the *Elbe regime*, we have discovered the reunified Germany as the hegemon among the two main riparian states involved in the river basin. Due to Germany's situation as the downstream country in the Elbe basin, we can expect that it had a strong incentive to make use of its advantage to compensate for its geographically disadvantageous downstream position (Holtrup 1999, 250; Lindemann 2006, 30). Nevertheless, Lindemann (2006, 30) argues:

> *"Germany does not fully match neither the image of a coercive hegemon nor that of a benign hegemon. A coercive hegemon would have used its superior power to impose the institutional arrangements it prefers on the other riparian states – a strategy that does not fit Germany's behavior during the Elbe negotiations (…). One may conclude that Germany acted as a benign hegemon rather than as a coercive hegemon. In this case, Germany would be expected to exercise positive leadership by providing the water regime all by itself. But (…) this is clearly not the case: Both countries pay for the reduction of water pollution on their own territory."*

Empirically, compared to the Czech Republic, Germany is certainly more powerful (see Table 5). But the constellation between the riparian states in regard to the distribution of power changed strongly during the five-year period of 1990 and 1995 and then remained on a constant level: The Czech Republic gained power in regard to Germany. Whereas the ratio of Germany's average GDP compared to that of the Czech Republic amounted to 0,30 in 1992, it more than doubled to 0,63 in 1997. Thus, if power was an important factor in regard to the effectiveness of the EC, then we should expect a similar variation in the amount of pollution (DV). As Realist theory assumes, this change in the DV should be a

[75] Since there is no empirical evidence that the degree of power in the case of the Rhine river has changed significantly, we will treat both sub-regimes together.

negative one (more pollution). Empirically, this is clearly not the case. During this period cadmium declined with more than 90 percent, nickel with 70 percent and BOD_5 with almost 20 percent (see Table 5). Thus, we can conclude that despite Germany's position as a hegemon in regard to Realist theory, power cannot serve as a factor for explaining our DV. Therefore, the posed hypothesis failed the empirical test.

Additionally, we examine the latter: Vulnerability. When looking at the different riparian countries in the *case of the Rhine* it becomes evident that the Netherlands have the greatest interest in and are the most dependent on the quality of the Rhine water.[76] This holds true in relation to the use of the Rhine water as drinking water (see Table 6) as well as the use of the Rhine water for agricultural purposes (see Table 7). Especially the western part of the country is dependent on the use of the Rhine water as drinking water since no alternatives for drinking water production do exist there. Thus, it is at no surprise that the Dutch draw approximately 65 percent of their drinking water from the Rhine. Moreover, the use of the Rhine for agricultural purposes is predominantly a Dutch priority. Due to the country's low situation partly below sea level[77] the water management is extremely sensitive to quantitative and qualitative changes. Additionally, the abatement costs for the Netherlands are low (Bernauer and Moser 1997, 148-149; Dieperink 1997, 1-3; Van der Veen 1981, 42-44). All this makes the Dutch a pusher.[78]

Germany's dependence on the use of the Rhine for drinking water is about almost the same as for the Dutch (see Table 6). The majority of Germany's drinking water is needed in the Rhein-Main area since the supply does not feed the demand there. However, in the case of Germany's dependence on the use of the Rhine for agricultural purposes this seems to be different: Germany is not dependent on the use of the Rhine for agricultural purposes (see Table 7). Nevertheless, costs for meeting high discharge standards for toxic substances fall most heavily on Germany since it has the largest industrial base along the Rhine. Therefore, its abatement costs are high. (Bernauer 1997, 160-162; Bernauer and Moser 1996, 391-392; Kiss 1985, 613f; LeMarquand 1977, 121-122; Van der Veen 1981, 42-43). All this leads up to the conclusion that Germany acted as an Intermediate.

---

[76] Since there is no evidence that the vulnerability in the case of the Rhine River has changed significantly for any of the involved countries over time, and especially before and after the Rhine Chemical Convention went into effect, we will treat both sub-regimes together.

[77] Around half of the Netherlands is below sea level (Dieperink 1997, 2).

[78] This observation finds support in the existing literature. For example, Dieperink (1998, 479) stated that "the Netherlands made the most far-reaching demands, in view of its downstream location. For instance, the Dutch called for the establishment of an International Rhine Commission with extensive powers. They insisted on an early start with controls on the discharge of salts and other chemicals."

France does not use the Rhine as drinking water because it can resort to groundwater which is available in large quantities of good quality in the area of the French bordering the Rhine (see Table 6). Nevertheless, when looking at France's use of the Rhine water for agricultural purposes, it becomes evident that it has a strong interest (see Table 7). But due to its location on the Rhine, France is not strongly affected by toxic pollution. The pollution hazard from the untreated wastes from Switzerland does not amount to a significant degree. Neither is the pollution hazard from Germany since most of the German discharges appear downstream of the border between both countries (Dieperink 1995, 131; Kiss 1985, 613f; LeMarquand 1977, 121). In addition to this, France's abatement costs appear to be low. France was among the major advocates of the Rhine Chemical Convention and Bernauer et al. (1996, 391-392) assume that this was partly due to the fact that cuts in chemical pollution would entail for French industry have been low.[79] Thus, we can conclude that France acted as a Bystander.

Switzerland is not dependent on the use of the Rhine water for agricultural purposes (see Table 7). However, it is somewhat dependent on the use of the Rhine water as drinking water (see Table 6). Nevertheless, due to its location along the Rhine, Switzerland is not affected by toxic pollution. As already stated, most of the German discharges appear downstream of the border between both countries. Finally, Switzerland's abatement costs appear to be low. (Bernauer 1995, 367; Van der Veen 1981, 44) Thus, we can conclude that Switzerland acted a Bystander.[80]

Table 6: Use of Rhine Water as Drinking Water

Use of Rhine water as **drinking water** in the riparian states in million m³ / year: (Van der Veen 1981, 44).		
	1973	Forecast 1980
Switzerland	76	126
France	0	0
Germany	**243**	**363**
The Netherlands	**300**	**305**
Total	*619*	*794*

Table 7: Use of Rhine Water for Agriculture etc.

*Use of Rhine water for **agriculture, shipping canals, sluices etc.** in million m³ / year:* (Van der Veen 1981, 44).		
	1973	Forecast 1980
Switzerland	1.6	1.6
France	**965**	**970**
Germany	2.5	18
The Netherlands	**2,816**	**3,637**
Total	*3,785.1*	*4,626.6*

Germany is highly dependent on the use of the *Elbe River* in regard to the production of drinking water. The river and its basin provide around 80% of the drinking water of the

[79] The other reason Bernauer et al. mention is France's desire to shift the political pressure for environmental protection to other actors (Bernauer and Moser 1996, 391-392).

[80] Empirically, it is difficult to differentiate between changes in each country's dependence on the use of the Rhine for the production of drinking water or for agricultural purposes during the whole period. No particular data on this has been generated so far. Nevertheless, the existing literature allows us to assume that no significant change happened during the observed time period. Therefore, we conclude that this factor has remained constant over time.

former GDR. Moreover, the need for more water has increased over the past years due to the modernization and construction of houses as well as the insouciant behavior of consumers. The high dependence of Germany on the use of the Elbe holds also true for agricultural purposes. Moreover, Germany's abatement costs appear to be high. Especially the former GDR was one of the major polluters of the Elbe before the end of the Cold War (Holtrup 1999, 180; Precht 1994, 27-30; Simon 1991, 207). All this makes Germany an Intermediate.

For the Czech Republic, the use of the Elbe water as drinking water is of particular importance. The Elbe has been a principle source for drinking water for the people in the Czech Republic. This also holds true in relation to the use of the Elbe for agricultural purposes as well. The water of the Elbe is used for the irrigation of plentiful amounts of agricultural lands. But due to its location on the river, the Czech Republic is not affected by toxic pollution (Lindemann 2006, 31-32; Stubbs and Bonjour 2002, 4-5). Additionally, despite the fact that costs compared to those incurred by Germany are relatively small, for the Czech Republic they are "far from negligible in the context of a country in transition" (Lindemann 2006, 31). Thus, it is even more surprising that the Czech Republic has engaged in "costly international water cooperation without receiving adequate financial compensation from Germany" (Lindemann 2006, 31). Nevertheless, we can conclude that the Czech Republic acted as a Dragger.[81]

In conclusion, we found out that our Hypothesis H1 does not hold true in the case of the Rhine Convention as well as the Rhine Chemical Convention. Despite the fact that the Netherlands as the downstream country can be classified as a Pusher and are thus when compared with the other riparian states more vulnerable (Germany can be classified as Intermediate, France and Switzerland as Bystanders). The Dutch are certainly not the most powerful country involved. In regard to the Elbe Convention, Germany as the downstream country is without doubt the most powerful actor here engaged. However, Germany does not fit in the image of a Pusher. Despite its high vulnerability on the use of the Rhine for agriculture purposes as well as for the production of drinking water, Germany's abatement costs are high turning it into an Intermediate (and the Czech Republic a dragger). Thus, Germany does not fully match neither the image of a coercive hegemon nor that of a

[81] Again, it is empirically difficult to differentiate between changes in each country's dependence on the use of the Elbe for the production of drinking water or for agricultural purposes during the whole period. No particular data on this has been gathered so far. Nevertheless, the existing literature allows us to assume that no significant change happened during the observed time period. Therefore, we conclude that this factor has remained constant over time.

benign hegemon. Empirically, we have argued that power cannot serve as a factor to explain our DV. The Hypothesis H1 can therefore be eliminated as an independent variable that contributed to the decline in Rhine as well as Elbe pollution.

Institutionalist Variables: Precision of Obligations, NGOs, Independence of Secretariat

There are three assumptions derived from Institutionalism that we will analyze. These include the amount of precision of the obligations, the role of the secretariat and the treaty-induced degree of involvement of NGOs. First, we will assess the amount of precision of the obligations. In the case of the *Rhine Convention* the obligations are ambiguous and indeterminate. Despite the fact that there are some precise obligations included like Article 6 which declares that the voting rule is unanimity, but unanimity shall not be impeded by the abstention of a single delegation or Article 3, stating that each contracting party may be represented in the Commission by four delegates at most, who may be assisted by experts. And despite the fact that the treaty's goals include the improvement of water quality as well as the protection of the Rhine against pollution and the prevention of further pollution (Breitmeier et al. 2006b, Database: 201A). No precise rules for emission reductions can be found nor are quantitative targets included - the treaty does not require the involved countries to reduce their amount of pollution by a certain amount until a certain date.[82] Only Article 1 states, that:

> *"The Contracting Parties shall continue to collaborate in the question of the protection of the waters of the Rhine below the lower Lake, within the framework of the International Commission for the protection of the Rhine against pollution" (1963, Article 1).*

In the case of the *Rhine Chemical Convention*, the obligations are precise and easy to interpret. They contain concrete directives in relation to the behavior of the member countries: Article 1 obliges the contracting parties to:

> *"a) eliminate pollution of the surface waters of the Rhine basin by dangerous substances in the families and groups of substances appearing in Annex I" and to "b) reduce the pollution of the Rhine by the dangerous substances in the families and groups of substances appearing in Annex II" (1976a, Article 1).*

The treaty obliges the contracting parties to establish national inventories (Article 2) and to establish national programs for the reduction of the pollution within a period of two years from the entry into force of this Convention (Article 6). These national programs shall provide deadlines for the implementation of their goals. Discharges of substances "must be regulated by the national authorities with a view to limiting it strictly" (Article 6). Moreover, the precise directives for behavior include the obligation for the contracting parties to take all legislative and administrative measures to ensure that the "storage and

[82] Since the treaty has not been modified in regard to the obligations, the amount of precision remained constant since it was signed in 1963 and went into effect in 1965.

deposit of Annex I and II substances are so carried out as to entail no danger of pollution to the Rhine" (Article 7). Each signatory Government shall take responsibility for the agreed measuring stations on the Rhine in regard to installing and operating measuring systems and their apparatus for determining the concentrations of such substances (Article 10). Finally, each member country shall regularly inform the International Commission of the results of its monitoring, at least once a year (Article 10). Nevertheless, these rules for emission reductions do not contain a certain time frame and are not calculated from a base year either (1976a, Article 1; Kiss 1985, 627).[83]

In the case of the *Elbe Convention*, the treaty's rules and emission reductions are 'medium'. There are some obligations included that are not precisely formulated. Such are, for instance Article 1 that obliges the contracting parties to:

"(a) to enable use to be made of the river, in particular the obtaining of supplies of drinking water from bank-filtered waters and the agricultural use of the waters and sediments; (b) to achieve as natural an ecosystem as possible with a healthy diversity of species; (c) to reduce substantially the pollution of the North Sea from the Elbe area"(1990, Article 1).

Here, crucial terms are not defined (what does 'substantially' mean, for example?). And thus, precise rules for emission reductions to achieve a percent reduction goal within a certain time frame and calculated from a base year are lacking. Nevertheless, there are also many precise obligations included. Such are, for instance, Article 2 that determines the tasks of the ICPE (that are much more comprehensive than those of the ICPR). Article 5 that fixes the composition of the Commission which shall consist of the delegations of the contracting parties and where each contracting party shall appoint a maximum of five delegates and their deputies. And Article 6 that determines who holds the chairmanship of the Commission. Finally, Article 8 which declares that the voting rule is unanimity.[84]

Second, we determine the amount of <u>independence of the secretariat</u>.[85] The functions of the secretariat are quite narrowly defined in the 'Protocol of signature' of the 1963 Rhine Convention. Its main role is to assist the President and the bodies of the ICPR. The tasks of the secretariat comprise the coordination and issuing of water quality information from the

[83] Again, since the treaty has not been modified, the amount of precision remained constant since it was signed in 1976 and went into effect in 1979.

[84] Again, since the treaty has not been modified in regard to the obligations, the amount of precision remained constant since it was signed in 1990 and went into effect in 1992. The Action Plans are an exception here. As already stated above, they were subsequently added to the EC. With more time and resources, their impact could have been assessed.

[85] Since there is no evidence whatsoever that the independence of the secretariat in the *case of the Rhine river* has changed over time (no additional treaty contains specifications regarding the role of the secretariat - with the exception of the new Convention on the Rhine (1999)) we will treat both sub-regimes together.

measuring stations in cooperation with member states and their provincial governments. And the secretariat prepares the contents of and organizes all meetings of the ICPR as well as it supports the working groups and national organizations in carrying out their research and in putting it into use. Moreover, the secretariat possesses a working group structure that investigates and makes recommendations to the ICPR on a number of issues (1963, 'Protocol of signature', Ad Article 8; Bernauer and Moser 1996, 390; Dieperink 1995, 124; LeMarquand 1977, 110-112; Precht 1994, 93-96). As Bernauer (1996, 390) puts it, "its' [the secretariats'; M.K.] functions are those of an advisory body that has no decision power of its own".[86] Thus, we can conclude that the independence of the secretariat has been low from the outset in 1963 until 1999.

In the *case of the Elbe regime*, the functions of the secretariat are more broadly defined in Article 10 of the 1990 EC. Its task is to support the Commission and the working groups with the preparation and implementation of its work. The secretariat prepares meetings and consultations and deals with the correspondence between the delegations and the commission. Moreover, it coordinates the monitoring network. Therefore, it is not surprising that the secretariat of the Elbe regime has served its function as an important information source from the outset (1990, Article 10; Holtrup 1999, 199-201, 247; Stubbs and Bonjour 2002, 9). Thus, we can conclude that the independence of the secretariat has been medium from the outset in 1990 until today.

Finally, we determine the degree of involvement of NGOs. As Bernauer (1997, 166-167) pointed out, we can observe "considerable nongovernmental activity" in the *case of the Rhine River*: "The environmental movement ensured that upstream governments and industry were kept under continual pressure" (Dieperink 1997, 8). There are some *National activist interest groups* like the Association of Rhine and Meuse Water Supply Companies (RIWA), the Verein Deutscher Gewässerschutz (VDG), the Arbeitsgemeinschaft Rheinwasserwerke (ARW), the Arbeitsgemeinschaft Wasserwerke Bodensee-Rhein (AWBR) and the Dutch Foundation for Nature and the Environment (Stichting Reinwater) (Dieperink 1998, 476-478; Durth 1996, 190-192). Since RIWA and the Dutch Foundation for Nature and the Environment appear to be the most important ones we focus on them. RIWA was established in 1970 to monitor the water quality on all streams that flow through Belgium as well as the Netherlands on their way into the common Rhine-Meuse

[86] Moreover, as experts state, the secretariat suffered from "structural understaffing" (Dieperink 1995, 126). For instance, the secretariat consisted, of only one professional and three administrative employees in 1977 and disposed of a budget of only slightly higher than DM 300,000 (± $130,000) (Kamminga 1978, 65).

delta (Cioc 2002, 178; Dieperink 1995, 125-127; Dieperink 1997, 8-9).[87] As Dieperink (1997, 8) argues, RIWA (and the Dutch environmental movement as well) was "especially instrumental in helping to resolve institutional, cognitive and political barriers to regime development". Additionally, RIWA represents the interests of those Dutch drinking-water companies that were dependent on Rhine water. The Dutch Foundation for Nature and the Environment acts as the "think-tank of the Dutch environmental movement" (Bresser 1997, 118-119). It was established in 1974 and publishes its arguments in newspapers, contacts and lobbies with ministers as well as political parties, and does grassroots work by educating kids at schools (Dieperink 1997, 9). Both groups acted as pushers for a reduction in the pollution of the Rhine.

Moreover, with the International Association of Waterworks in the Rhine Basin (IAWR) there is also one *International Activist Interest Group* involved in the Rhine basin.[88] IAWR was founded in Düsseldorf in 1970 but its secretariat is located in Amsterdam. After there were initially hardly any contacts among the national activist interest groups like RIWA and AWR, for example, they quickly grew into an international consortium that consists today of more than one hundred Rhine waterworks. Today, this basin-wide association of waterworks is an umbrella association whose members are associations of waterworks in Germany (AWR, AWBR), in the Netherlands (RIWA), Switzerland and France. IAWR engaged in lobbying countries at various political levels to introduce measures for improving the water quality of the Rhine. This organization tried to identify the sources of especially harmful substances (the point-source polluters) and put pressure on these sources to stop their emissions. This was possible, because IAWR possesses a large number of measuring stations. In addition to this, IAWR published the Rhine-memorandum in 1973 that became the foundation for the RCC (Bernauer and Moser 1996, 401, 408-409; Cioc 2002, 178; Dieperink 1997, 8; Durth 1996, 190-192, 196; Holtrup 1999, 117-119; LeMarquand 1977, 113-114). To our knowledge, all observers agree on the high effectiveness of the IAWR in regard to influencing public and political opinion in the

[87] Moreover, with the European Community from 1976 on, there has also one *International governmental organization (IGO)* been involved. Since the role of the EEC seems to have changed over time and its' influence as an actor involved is difficult to assess according to experts, we will not include it in our assessment (Bernauer and Moser 1996, 409).

[88] Greenpeace is another International activist interest group involved in the Rhine basin but compared to IAWR its role has been rather small. 'Greenpeace international' was established in 1971, Greenpeace France in 1977, Greenpeace Netherlands in 1979, Greenpeace Germany in 1980 and Greenpeace Switzerland in 1984. Greenpeace started monitoring campaigns on the Rhine to clearly identify specific point sources of pollution. According to observers, Greenpeace succeeded in influencing perceptions concerning the Rhine quality (for example: Dieperink 1997, 8).

riparian states for the protection of the Rhine[89] (for example: Bernauer 1997, 167; LeMarquand 1977, 113; Lindemann 2006, 24; Strübel 1992, 51). Some observers, even call the IAWR the "most powerful pressure group advocating water quality improvement of the river" (LeMarquand 1977, 113). IAWR (as well as Greenpeace) acted as a pusher for a decline in Rhine pollution.

Nevertheless, there are also some *International industrial organizations*. Since these industry-oriented pressure-groups did not act as pushers we will not include them in our analysis.[90]

The operation of the regime seems to have had a modest causal influence on the factual participation of NGOs in the Rhine Convention and the Rhine Chemical Convention as well.[91] NGOs are not official members of the ICPR. Despite this, there is evidence that the operation of the regime has been modestly instrumental for the factual participation of – at least some – NGOs in the issue at hand. The Dutch drinking water industry and its German and French counterparts can serve as an example for now. According to Dieperink (1998, 478), contacts between these industries were established with the aim of investigating water quality long before World War II. Due to the ICPR, these contacts multiplied and government officials exchanged insights (Bernauer and Moser 1996, 389; Dieperink 1995, 131; Holtrup 1999, 196-197). Moreover, there seems to be evidence for the pure existence of the RCC being stimulating for NGO involvement. IAWR as well as RIWA repeatedly used the information and obligations generated by the RCC to exert pressure on national governments, individual firms, or other actors. This becomes evident when looking at IAWR's and RIWA's annual reports (for instance: IAWR 1980, 6-9; IAWR 1982, 50-58; RIWA 1977, 8-11, 29-32).[92] Empirically, it is difficult to differentiate between changes in the degree of involvement of NGO's over the observed time period. Concerning this matter, no particular data has been found so far. Nevertheless, it became evident that none

---

[89] The strong interest and motivation of the waterworks to lobby for a reduction of the pollution load of the Rhine can be explained with the small room to maneuver for the improvement of technology for drinking water production and with the personal responsibility of the directors of the waterworks for the quality of their output: "At least in certain locations, where their water input stems directly from the Rhine or wells in the immediate vicinity, notably in Germany and the Netherlands, the waterworks are strongly affected by the extent of Rhine pollution, and therefore by emissions upstream" (Bernauer and Moser 1996, 408-409).

[90] These International industrial organizations have tried to defend the standpoint of the industry from environmental regulations, especially in Germany. Thus, they acted as laggards for a reduction in the pollution of the Rhine. One of these major German industry lobby groups is the 'Bundesverband der Deutschen Industrie' (BDI) that was founded 1949 in Cologne. This organized lobby of the industry is powerful and well-organized (LeMarquand 1977, 113, 121-122).

[91] Since from looking at and comparing both involved treaties nothing in regard to the involvement of NGOs has changed, we will treat both sub-regimes together here.

[92] I am indebted to Ada Renout (mailto:riwa@riwa.org; Groenendael 6; NL - 3439 LV Nieuwegein) from RIWA for providing me with information regarding this issue.

of the NGOs that acted as a pusher had been involved before 1970. Accordingly, we conclude that the degree of involvement was 'medium' in the RC and 'high' in the RCC.

On the other hand, we can observe a "distinct exclusion of NGO involvement" (Stubbs/Bonjour 2002: 14) in the *case of the Elbe Convention*. NGOs in general have not played an important role in the case of the Elbe. From the side of the Czech Republic, NGOs are only weakly established. In contrast to the Rhine regime, there are no associations of waterworks like the IAWR. Some *National activist interest groups* are involved.[93] There is the Bund für Umwelt- und Naturschutz Deutschland (BUND) that is very politically active on pollution issues as well as in shipping and flood management. Furthermore, there is the Naturschutzbund Deutschland (NABU) that maintains a platform for the promotion of living rivers and that is active particularly in the struggle of the prevention of further constructions. Moreover, there is the Deutsche Vereinigung des Gas- und Wasserfaches (DVGW), which supports technological development and the Bundesverband der Deutschen Gas- und Wasserwirtschft (BGW) that represents about 80% of the German water suppliers. Finally, there is the Association of Water Supply and Sewerage Services (SOVAK) that was established as a voluntary, non-governmental, non-profit organization that supports the water sector in the Czech Republic. All these interest groups acted as pushers for a reduction in the pollution of the Elbe (Krysanova et al. 2005, 38; Stubbs and Bonjour 2002, 11). Greenpeace and the World Wildlife Fund (WWF), in the field of *International activist interest groups,* are among the most active NGOs involved in the Elbe basin. Both acted as pushers for a reduction in the pollution of the Elbe. Greenpeace measured the pollution after the reunification for clearly identifying specific point sources of pollution. Moreover, it published pollution data and mobilized public opinion. In contrast to the Rhine regime, there is no basin-wide association of waterworks in the case of the Elbe regime. One reason for this is that in the case of the Elbe basin, the production of drinking water as well as the dumping of waste often lies in the hands of one corporation. Since these corporations are polluters and victims at the same time, they are in the middle of a potentially conflict of interests. The WWF is particularly involved in the field of securing additional lands for natural floodplain reserves and the provision of information to policy makers and expert opinions (Durth 1996, 225-226; Holtrup 1999, 251; Precht 1994, 133-137; Stubbs and Bonjour 2002, 11). In regard to *International industrial organizations* it can be stated that none is involved in the Elbe

[93] The European Community as the only *International governmental organization (IGO)* has been involved as well. Since its' influence as an actor involved is difficult to gauge, we will not include it in our assessment.

basin. This, because after 1989 most of the industry in the former GDR broke down, was not used to the new market system or helpless in respect to demands from environmental organizations (Durth 1996, 223-224). Empirically, it is difficult to differentiate between changes in the degree of involvement of NGO's over the observed time period. No particular data on this has been found so far. Nevertheless, we can conclude that the degree of involvement has been 'low'.

The operation of the regime seems to have had only little causal impact on the factual participation of NGOs. Non-regime factors seem to account for virtually all of the NGOs participation and regime factors appear not to play a role. In the case of the Elbe River, the flow of information consists of only one press conference that takes place every year and to which NGOs are officially invited.[94] NGOs are not official members of the ICPE. For instance, Stubbs et al. (2002, 14) conclude in their case study about the Elbe river that "this one-way path of information constitutes neither participation nor responsiveness". Thus, it is not surprising that NGO influence and attendance of these press conferences has faded over the past years (Holtrup 1999, 196-197; Stubbs and Bonjour 2002, 14).[95]

Cognitivist Variables: Learning, Scientific Knowledge

In regard to our Cognitivist assumptions, we assess the value of two variables: Learning and extent of scientific knowledge about the problem.

When considering the former, we found out that medium change seems to have happened with the *Rhine Convention*. Before the RC was signed in 1963 there were hardly any data available that could give a hint of the severity of Rhine pollution. A 'cognitive barrier' persisted in the way that the Rhine was assumed to be polluted by a 'cocktail' of chemicals but no one exactly knew what this 'cocktail' contained of or where it came from. Additionally, hardly any flow of information regarding pollution issues of the Rhine existed between the riparian states. And a shared perception of the sources as well as the remedies for Rhine pollution was missing (Bernauer and Moser 1996, 399; Bernauer and Moser 1997, 159-161; Dieperink 1997, 4-6; Lindemann 2006, 23). This observation additionally finds support in the literature (for example: Breitmeier et al. 2006b, Database: 304B,C). Changes in the demand for pollution preventions can be exemplified with the German BASF. Hans Georg Peine, head of the environmental protection and occupational

[94]Qualitative interviews with experts in this field have revealed that there are nevertheless contacts on an individual level between the ICPE and NGO representatives. Thus, a flow of information seems to exist somewhat but due to the fact that it is on the informal level, it is not relevant in regard to the question at hand (Jacobson and Brown Weiss 1998, 533-534; Stubbs and Bonjour 2002, 14).

[95] Whereas on the first press conference of the ICPE in 1990 some of the biggest German as well as international NGOs like WWF, NABU, Greenpeace and others (but none from the Czech Republic) participated their presence faded (Holtrup 1999, 196-197).

safety department at BASF declared in 1976 that "today, a corporation has to address the issues of public more than ever before" (BASF 1977, 65, translation by the author). Thus, it is at no surprise that the expenditures for environmental protection and for water protection in particular rose significantly from 45 million DM in 1971 to 240 million DM in 1975 (BASF 1977, 65-67).

Moreover, we have found evidence to assume that the creation of the regime has been essential for learning. The regime is more important with regard to changes in understanding the problem and in the understanding of opportunities for problem solving than are non-regime factors. Thus, the regime has exerted a significant causal influence. And even more important, certain design features of the RC seem to have been crucial for this.[96] Most experts agree that the Rhine regime, which is understood here as the totality of international agreements and organizations acted as a "learning facilitator" (Bernauer and Moser 1996, 399). With the Rhine Convention, the ICPR was authorized to carry out research into the nature, extent and origin of the pollution of the Rhine (1963, Article 2). An official secretariat at the Bundesanstalt für Gewässerkunde in Koblenz was established and an international measuring program with a net of monitoring stations to measure the concentration of pollutants in the water was set up.[97] New measuring analysis techniques[98] were introduced by the end of the 1960s what enabled a gradual increase in the number of water quality parameters being monitored. Through the harmonization of measuring methods the flow of information was enhanced. Now, with time-series analyses that provided better insights into the development of the pollution as well as with more parameters being continuously monitored, the knowledge base was expanded and gaps in it were being filled (Dieperink 1995, 125-127; Dieperink 1998, 478; Gurtner-Zimmermann 1998, 247; Lindemann 2006, 23). Increases of concentrations in the water were now made possible to be measured. As experts have ascertained, the existence of the publication of pollution data and especially the origins of waste discharges seems to have affected the sanitation program and in particular the behavior of polluters in a favorable manner. The logic behind this argument lies in the involved actors having realized how polluted the

[96] Nevertheless, we have to admit that it is difficult to measure the exact impact of the activities of the sub-regime.

[97] Moreover, verification and monitoring was facilitated along this well-developed measuring-system (Gurtner-Zimmermann 1998, 247).

[98] One of these new measuring analysis techniques was gas chromatography, for instance. Moreover, the ICPR introduced new methods to monitor organic micropollution (Dieperink 1998, 478).

Rhine was[99] and in the dischargers of waste into the Rhine who could no longer assume that the origin of a particular polluting substance would be unknown to the authorities and the general awareness as well.[100] Accordingly, the dischargers had a strong incentive to reduce their pollution of the river (Bernauer and Moser 1996, 399-401; Dieperink 1995, 125-127; Van der Veen 1981, 50-51). As Van der Veen (1981, 50-51) puts it: "'publication of discharge data' is a key concept".

Additionally, through cooperative research under the auspices of the ICPR, a consensus was reached on which of the anticipated 1500 substances should be considered for further regulation and on the degree on to which a particularly substance was toxic, persistent or bio-accumulative (IKSR 1983, 12). Whereas, according to Carel Dieperink (1997, 4), before this consensus a 'cognitive barrier' persisted in the way that the Rhine was said to be polluted by a 'cocktail' of chemicals and no one exactly knew what this 'cocktail' consisted of or where it comes from, this cognitive barrier now disappeared and a 'cognitive consensus' was reached (Dieperink 1997, 5-6; Lindemann 2006, 23).[101]

Moreover, with the existence of the ICPR, the flow of information between the riparian states was facilitated. The Rhine Convention prepared the formal basis so that information on different aspects of Rhine pollution could now be exchanged in the context of working groups. In addition to this, a discussion on the international level occurred concerning threshold values for chemical pollution regarding the Rhine what possibly enlarged the knowledge base between the riparian states in regard to reducing pollution. All this appears to be highly important since the issue of chemical pollution in comparison to other pollution problems like chloride pollution, for example, is a complex and scientifically difficult to understand problem (Bernauer and Moser 1997, 159-161; Dieperink 1995, 123-124; Lindemann 2006, 22). According to Bernauer et al. (1996, 399; 1997, 159-161) the result of this exchange of information is a close and obviously smooth cooperation between the authorities of all riparian states as well as a shared transboundary perception of the sources as well as the remedies for Rhine pollution.

For the *case of the Rhine Chemical Convention* we have determined that significant change seems to have happened here. Before 1976 and even after the RCC had gone into effect, there were hardly any technologies for reducing or eliminating many of the chemicals and

[99] This seems to be one crucial condition for the existence of the RCC as Bernauer (1997, 156-157) indicates: "The existence of published data on chemical pollution from the measuring stations was the triggering momentum for the occupation with this problem as well as for the Rhine Chemical Convention".

[100] For instance, industrial centers such as the German State of Baden-Württemberg, the Ruhr Valley, the Mosel River, and the potassium mines were identified as the main sources of pollution (Dieperink 1997, 5).

[101] This 'cognitive consensus' was also the condition for the determination of the priority substances in Annex I and Annex II of the Rhine Chemical Convention.

chemical classes enumerated in the convention available – what was also one cause for delay in the reduction of pollutants. As Cioc (2002, 181) explains, pulp-and-paper mills – as well as other companies that faced similar problems - could not reduce their output for organic halogenated compounds until they first found a chlorine substituting for bleaching. In general, we can observe a "substantial increase in the recycling of industrial sludges and solid wastes by the metal-producing industries during the 1970s and 1980s" (Stigliani 1993, 789). For example, wastes containing zinc and cadmium from the iron and steel industry were shipped to zinc-cadmium refineries, where the emissions of these metals were reduced. Additionally, the RCC is based on scientific data and policy recommendations that were provided by the ICPR. Therefore, learning efforts from the RC were crucial for the creation of the RCC (Bernauer and Moser 1997, 156-157; Cioc 2002, 177-179; Kiss 1985, 625; Lindemann 2006, 24).[102] This observation is complementary to the consulted literature (for example: Breitmeier et al. 2006b, Database).

Additionally, we found evidence to assume that the operation of the regime has had a significant causal influence for learning. The regime seems to be more important in relation to changes in the understanding of the problem and in the understanding of opportunities for problem-solving than are non-regime factors. Consequently, the regime has exerted a significant causal influence. And even more important, certain design features of the RC seem to have been crucial for this.[103] Almost all of the learning processes seem to stem from the Rhine regime itself. Moreover, the treaty provision of the RCC added an important layer to the RC in regard to the flow of information. This important layer consisted of a further improvement and harmonization of the measurement programs as well as an increase of transboundary information flows. Article 10 of the RCC obliges the riparian states to install and operate measuring systems and apparatus for determining the concentrations of the agreed upon substances and to regularly inform the ICPR of the results of its monitoring (at least once a year). Before this, the measuring system remained patchy and incomplete (Tschanz 2001, 77-79). Article 12 of the RCC obliges the member countries to regularly inform the International Commission of the experience gained in the course of implementing this Convention. Additionally, the ICPR

[102] However, certain elements were also inspired by processes of policy learning from especially the EEC Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment, the draft European Convention for the Protection of International Watercourses Against Pollution (which had never been adopted by the member states of the Council of Europe), and the 1974 Paris Convention for the Prevention of Marine Pollution from Land-Based Sources (Bernauer and Moser 1997, 156-157; Cioc 2002, 177-179; Kiss 1985, 625; Lindemann 2006, 24).

[103] Nevertheless, we have to admit that it is difficult to measure the exact impact of the activities of the sub-regime.

shall draft an annual report that summarized the monitoring results and enabled the progress of the quality of Rhine water to be observed. This increase of transboundary information flow can be observed by an increase of the annually publications of the ICPR. Detailed information about the kind of pollution, its causes as well as its sources that deemed to be confidential if not secret beforehand were now published. As it also had been the case in the 1963 RC, this resulted in a homogenization of perceptions on the problems to be discussed like sensible threshold values for polluting substances, Rhine pollution problems in general, technical possibilities of dealing with the problems at hand and the available technical means to solve these problems. Cognitive barriers disappeared and a cognitive consensus was reached (Bernauer and Moser 1996, 400; Dieperink 1997, 5-6; Lindemann 2006, 24; Tschanz 2001, 78-80).[104] As Bernauer et al. (1996, 400-401) put it:

> *"They helped create a closely connected community of low- to mid-level government officials and scientists. This group has met largely in the working groups of the ICPR to exchange information about new forms of pollution, polluters, sudden increases in pollution due to accidents, measurement methods, pollution abatement technologies, and so forth. As a result, it seems that new information and knowledge has spread virtually as quickly across within national boundaries.*

In conclusion, we have found out that significant change has happened in the case of the RC as well as the RCC and that both sub-regimes have exerted a significant causal influence on these changes. And even more important, certain design features of both treaties seem to have been crucial for this. For the RC, this is Article 2 which authorized the ICPR to carry out research into the nature, extent and origin of the pollution of the Rhine, Article 8 that lead the foundation for the establishment of the secretariat and the establishment of an international measuring program with a net of monitoring stations to measure the concentration of pollutants in the water. For the RCC, this is Article 10 that obliges the riparian states to install and operate measuring systems and apparatus for determining the concentrations of the agreed upon substances, to regularly inform the ICPR of the results of its monitoring (at least once a year) and which asks the ICPR to draft an annual report summarizing the monitoring results and enabling the progress of the quality of Rhine water to be observed.[105]

For the *case of the Elbe Convention* we have found out that only little change seems to have happened here. As already stated, the creation of the EC was heavily inspired by the

---

[104] In addition to this, the "success of the development of the Rhine regime has been recognized internationally". The Rhine regime has itself served as a model for other international river basins across Europe like the ICPE, for example, or even across the world (Dieperink 1997, 8; Lindemann 2006, 24).

[105] Empirically speaking, it appears to be impossible to differentiate between changes in regard to learning as well as the impact of the regime on learning over the observed time period since no data is available whatsoever. Due to this, we assume that learning as well as the impact of the regime on learning has remained constant over time.

learning experiences from the Rhine regime. There is no evidence that the information about the options available for tackling the problem changed within Germany. Nevertheless, there is some evidence that this could have been the case for the Czech Republic. Data that could give a hint of the severity of Elbe pollution has already been available before the EC was signed in 1990. But, hardly any flow of information regarding pollution issues of the Elbe existed between the riparian states.

Moreover, we have found evidence to assume that the operation of the regime has had a modest causal influence for learning. The regime seems to matter with regard to changes in understanding the problem and in the understanding of opportunities for problem solving, but non-regime factors seem to be more important. Thus, the regime has exerted a modest causal influence. Nevertheless, certain design features of the treaty seem to have been crucial for this.[106] With the existence of the ICPE, a channel for direct communication between the two involved governments has been established. Article 2 of the EC asks the ICPE to prepare surveys showing major point sources of discharges of harmful materials, to estimate water pollution from diffuse sources and extrapolate both of these. Moreover it asks the ICPE to provide documentary evidence regarding the ecological importance of the various biotope elements of the waters and proposals regarding the improvement of conditions for aquatic and coastal communities and to promote cooperation in particular on scientific research projects and regarding the exchange of information especially on the state of technology. The ICPE supported discussions and the exchange of ideas between the riparian states and among national government representatives as well (Stubbs and Bonjour 2002, 15-16).[107]

Finally, we assess the extent of scientific knowledge about the problem. In the case of the *Rhine Convention*, we have found a low established understanding. A scientific understanding of the environmental problem was only to a small degree established with regard to nature, causes, and consequences of the problem, or to solutions or what should be maximized in the issue area. As already stated (see above), hardly any data on the pollution of the Rhine with various substances was available before the Rhine Convention was signed in 1963. No consensus existed on which of the anticipated 1500 substances

[106] Nevertheless, we have to admit that it is difficult to measure the exact impact of the activities of the regime.

[107] Empirically, it appears to be impossible to differentiate between changes in regard to learning as well as the impact of the regime on learning over the observed time period since no data is available whatsoever. Accordingly, we assume that learning as well as the impact of the regime on learning has remained constant over time.

should be considered for further regulation and on the degree on to which a particular substance was toxic, persistent or bio-accumulative (Dieperink 1997, 4). Dieperink (1997, 4) spoke of a 'cognitive barrier' that persisted in the way that the Rhine was said to be polluted by a 'cocktail' of chemicals and no one exactly knew what this 'cocktail' existed of or where it comes from, this cognitive barrier now disappeared and a 'cognitive consensus' was reached. This observation finds additional support in the literature[108] (for instance: Breitmeier et al. 2006b, Database).[109]

For the *Rhine Chemical Convention*, we have found a partially established understanding in regard to the scientific understanding of the environmental problem. A consensus was only partially achieved by a generally growing, but still not fully developed, consensus on the nature, causes, and consequences of the problem as well as solutions and what should be maximized in the issue area. In contrast to the RC, the involved actors now knew how polluted the Rhine was. They possessed the results of the measuring stations and they already had agreed upon which pollutants should be eliminated in the Rhine and which should be substantially reduced (Annex I and II of the RCC). Nevertheless, there was still a lack of knowledge in regard to technologies for reducing or eliminating many of the chemicals and chemical classes enumerated in the convention (Cioc 2002, 181; Dieperink 1998, 476-478). This observation finds additional supported in the literature[110] (for instance: Breitmeier et al. 2006b, Database).[111]

In the case of the *Elbe Convention*, we have found a partially established understanding in relation to the scientific understanding of the environmental problem. A consensus was only partially achieved by a generally growing, but still not fully developed, consensus on the nature, causes, and consequences of the problem as well as solutions and what should be maximized in the issue area. Whereas the knowledge of Germany in regard to water pollution issues had grown enormously over the past decades, the understanding of pollution problems was not so entirely understood in the Czech Republic. Thus, it seems important that with the EC (1990, Article 2.1) cooperation on scientific research projects and an exchange of information especially on the state of technology between both

---

[108] But this observation seems to be contested among experts. Whereas Bernauer/Marty reached at similar results than we, Wieriks coded this case as a 'very strongly established understanding'.

[109] Since empirically, it is difficult to differentiate between changes in regard to the extent of scientific knowledge about the problem over the observed time period we assume that it has remained constant over time.

[110] But this observation seems to be contested among experts. Whereas Bernauer/Marty reached at similar results than we, Wieriks coded this case as a 'very strongly established understanding'.

[111] Empirically speaking, it is difficult to differentiate between changes in regard to the extent of scientific knowledge about the problem over the observed time period. In light of that, we assume that it has remained constant over time.

countries was institutionalized (Holtrup 1999, 195).[112]

Control Variables: Economic Integration, Macro Changes, EKC

First, we assess the level of economic integration among the member countries. As Table 8 shows, the level of economic integration between the four riparian states is already on a high level when the *Rhine Convention* was signed in 1963. The average trade of the riparian states amounts to around 30 percent of their total trade. Empirically, the level of economic integration remains on a constant level from 1958 on until 1996. Thus, we are able to conclude that the level of economic integration has been high in the case of the RC as well as the *Rhine Chemical Convention*. The observation that the riparian countries in the case of the Rhine regime are well integrated finds additional support from experts (for example: Lindemann 2006, 25).

Table 8: Level of Economic Integration

	1958	**1963**	**1968**	**1973**	**1975**	**1976**	**1981**	**1986**	**1991**	**1996**
Rhine	0.27	0.32	0.34	0.36	0.33	0.33	0.31	0.34	0.34	0.32
	1986	**1990**	**1992**	**1995**	**2000**					
Elbe	0.07	0.09	0.16	0.15	0.19					

Average trade (imports+exports) among riparian countries/total trade in $

The level of economic integration between the two riparian states in the case of the *Elbe Convention* was and has remained very low until the early 1980s, as Table 8 demonstrates. The average trade of the riparian states amounts to around 7 percent of their total trade. Empirically speaking, we observe here a continuous increase after the end of the Cold War. The level of economic integration almost doubles when comparing the years 1990 and 1992. Nevertheless, the level of economic integration remains – especially when compared with the Rhine regime - on a low to medium level.

Nevertheless, the level of economic integration between the riparian states cannot serve as a rival IV. This, because this variable cannot explain the variation of our DV. In the case of the Rhine regime (RC and RCC) the level of economic integration remains constant while the amount of pollution (DV) declines with more than 70 percent with BOD_5 when comparing the years 1958 with 1963, with more than 133 percent with BOD_5 when comparing the years 1968 with 1973 and with more than 125 percent with cadmium and 155 percent with nickel when comparing the years 1975 and 1976 (see Table 3). For the EC, this observation is not so obvious. Here, the level of economic integration increases as the hypothesis suggests slightly from 9 to 16 percent while the amount of pollution (DV) declines with more than 90 percent with cadmium and more than 70 percent with nickel

[112] Since empirically, it is difficult to differentiate between changes in regard to the extent of scientific knowledge about the problem over the observed time period we assume that it has remained constant over time.

when comparing the year 1990 with 1992 (see Table 4). But, comparing the year 1986 with 1990, then it becomes obvious that the level of economic integration increases slightly from 7 to 9 percent while the amount of pollution (DV) increases as well with more than 45 percent with cadmium and more than 15 percent with nickel when. Since this stands contrary to the hypothesis, we can eliminate the level of economic integration as an independent variable that was responsible for the decline of Rhine as well as Elbe pollution.[113]

Second, we assess the variable for macro changes. In the case of the *Rhine Convention*, only small change appears to have happened. The state of the world seems to have changed only to a small degree with respect to changes in the industry structure. During this period, Germany's industry (as the major polluter) enjoyed spectacular growth as one of the leading forces in the 'Wirtschaftswunder' (Allen 1989, 159-164). No data could be found that indicates more than a small degree with respect to changes in the industry structure. Thus, we assume that it has not changed significantly over time.

Table 9: Industrial Production in Selected Countries

	1970	1975	1980	1985	1990
France	77	84	102	100	114
Germany	80	82	96	100	118
Netherlands	71	84	95	100	110
Switzerland	87	85	97	100	115

Production indices (1985=100); Source: (OECD 1993b, 239)

For the *Rhine Chemical Convention*, things are a bit different. During this period, modest change seems to have happened with respect to changes in the industry structure. For instance, there is evidence that structural changes in the major polluting industries occurred. Through these changes older technologies were replaced by cleaner industrial processes. As one example for this, Stigliani et al. (1993, 789) cite the switch from thermal smelters to electrolytic refineries for zinc and cadmium production. Moreover, experts ascertain that the metal refining industries as well as the iron, steel/coke factories that were responsible for some of the majority of point sources in their peak years had reduced their emissions dramatically by 1988. As reasons for this, the implementation of good housekeeping practices, the introduction of cleaner processes, and the installation of waste-water treatment as well as a change of what is considered as a valued resource (for example cadmium in zink refineries) are named (Bernauer and Moser 1996, 396; Stigliani

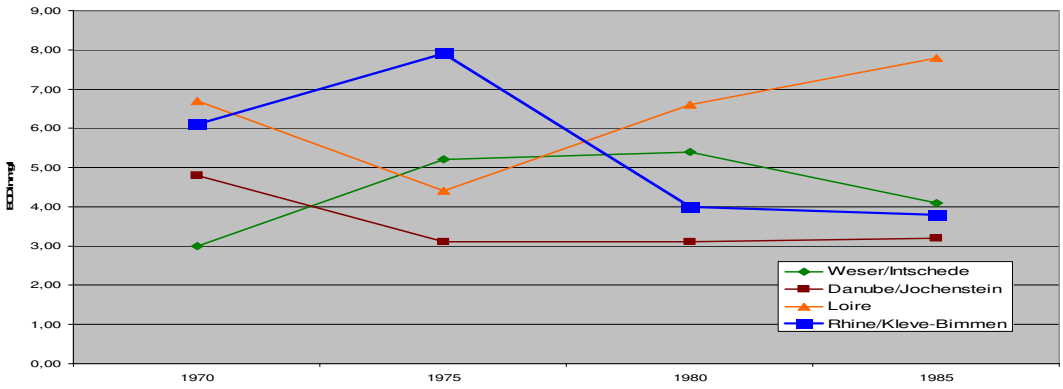
[113] Nevertheless, it is theoretically possible that the level of economic integration served as a condition of possibility. One could argue that the decline of Rhine and Elbe pollution would not have been possible if the riparian states were not integrated.

1993, 789). As Bernauer et al. (1996, 402) state:

> *"These developments were interpreted by actors potentially affected as a sign of further tightening of environmental regulation in the future. Hence these actors reacted by reducing their pollution in advance of anticipated legally binding laws by installing waste treatment plants or transferring especially polluting activities out of the Rhine catchment area".*

Nevertheless, during this period the industrial production of the involved countries increased significantly (see Table 9) and the number of total sales of the chemical industry in Germany as the major polluter almost tripled (Allen 1989, 159-164).[114] There seems to be some evidence that the RCC might have been important in this regard. For instance, Germany's industry that has "jealously guarded its ability to self-regulate (…) for one hundred years" has begun to face "increasing regulatory scrutiny" (Allen 1989, 173). Gurtner-Zimmermann (1998, 243) underscores this when he argues that during the 1970s and 1980s, recommendations from the ICPR were often used as points of reference in the setting of national water quality standards and objectives. This observation is strengthened by comparing the Rhine with other national and transboundary rivers. In Figure 3, we compare the pollution load with BOD of the Rhine with the French river Loire, the German river Weser and the transboundary river Danube. Only the pollution of the Rhine declines significantly with BOD after 1975 whereas the amount of pollution with BOD of the other rivers either remains constant or even increases.

Figure 3: Pollution of the rivers Weser, Danube, Loire and Rhine with BOD[115]



In the case of the *Elbe Convention*, modest change seems to have happened with respect to changes in the industry structure. After Germany's reunification, the permanent or suspended closing of many factories followed.[116] This, as well as the continued technological progress and the positive economic situation can be made responsible for

[114] In regard to the latter, we follow Allen (1989, 161), who compared the year 1972 with 1986.
[115] Source: (OECD 1993b, 59).
[116] Examples are the Buna AG Schkopau, the Filmfabrik Wolfen AG as well as parts of the Chemie Bitterfeld AG (Precht 1994, 29-31).

some of the declines in pollution between 1989 and 1992 on the side of the former GDR. Nonetheless, the following negative economic situation as well as the waning of the upward trend lead to delays in the prevention of water pollution and environmental reformations (Holtrup 1999, 250). And the former GDR was attractive to many chemical firms since the local governments there had a strong interest in reviving the closed factories and were not so strict in handing out pollution-permits:

> *"The outdated heavy industrial centers of former Eastern Germany, with emphasis on chemicals and steel products, paid little attention to pollution caused by their smokestack factories" (Shmueli 1999, 463-464).*

Moreover, on the side of the Czech Republic, these positive effects did, however, not occur. On the contrary, the Czech Republic was attractive to many chemical industries since it did not have the strict environmental regulations of the EC. Especially, the untreated sewage and the industrial waste from Prague and other Czech cities contributed to a good share of the pollution load of the Elbe. Nevertheless, the pollution of the Elbe did not increase despite increasing industrial production (Durth 1996, 222-223; Holtrup 1999, 221, 250; Precht 1994, 21-31; Shmueli 1999, 463-464; Simon 1991, 210-211; Stubbs and Bonjour 2002, 12).

In a nutshell, this factor does not appear to have been significant in regard to the pollution loads of the Rhine and Elbe River. Consequently, it can be neglected.

Finally, we determine the relevance of the Environmental Kuznets Curve (EKC). For the case of the *Rhine regime* (RC and RCC), we can observe a continuous increase. Whereas per capita GDP of the riparian states amounted to $2,103 in 1958, it increased continuously to more than $21,800 in 1996 (see Table 10). Moreover, experts argue that a clear decoupling of economic growth and environmental pressures has been apparent for some time in Switzerland and Germany, for instance (OECD 1993a, 103-104; OECD 1998, 125). For the case of the *Elbe Convention*, we can observe a continuous and parallel increase to the EKC of the Rhine regime (see Table 10). The difference between both lines is only small. Per capita GDP of the riparian states amounted from $13,337 in 1986 to $19,381 in 2000.

Table 10: Environmental Kuznets Curve

	1958	**1963**	**1968**	**1973**	**1975**	**1976**	**1981**	**1986**	**1991**	**1996**
Rhine	2,103	2,798	3,809	5,460	6,420	6,905	10,700	14,322	19,272	21,809
	1986	**1990**	**1992**	**1995**	**2000**					
Elbe	13,337	14,581	14,900	16,614	19,381					

Average per capita GDP of all riparian countries in $

Nevertheless, the EKC cannot be considered as an important IV in explaining our DV.

This, because it cannot explain the variation in our DV. In the case of the Rhine regime the EKC continuously increases while the amount of pollution (DV) declines with more than 70 percent with BOD_5 when comparing the years 1958 with 1963, with more than 133 percent with BOD_5 when comparing the years 1968 with 1973 and with more than 125 percent with cadmium and 155 percent with nickel when comparing the years 1975 and 1976 (see Table 3). Moreover, the same is true for the EC. Here, the EKC continuously increases while the amount of pollution (DV) declines with more than 45 percent with cadmium and more than 15 percent with nickel when comparing the year 1986 with 1990 (see Table 4). Therefore, we can eliminate the EKC as an independent variable that was responsible for the decline of Rhine as well as Elbe pollution.[117]

5.3 Comparative Analysis

> *"The international community's ability to preserve the quality of the planet for future generations depends upon international cooperation. Successful cooperation, in turn, requires effective international institutions to guide international behavior along a path of sustainable development." (Keohane et al. 1993, 4)*

In 5.2 The Independent Variables we have already analyzed the independent variables in regard to their causal impact on the amount of Rhine and Elbe pollution with the before-after method. In relation to our longitudinal comparison, we can constitute that rival explanations of hegemonic stability (H1), the level of economic integration among the member countries, the Environmental Kuznets Curve and the variable for macro changes prove incapable of adequately explaining the observed variation in water pollution. Therefore, we have eliminated them from our analysis. Moreover, the longitudinal comparison supports all other variables since their value matches the observed variation of our DV.

Second, the performance of the controlled comparison with the *method of difference* between the Rhine Chemical Convention and the Rhine Convention leads to the following results. Here, the cognitive variables learning and extent of scientific knowledge about the problem find support but our regime design variables amount of precision of obligations and the involvement of NGOs as well.

Mechanisms of influence:

The 1976 Rhine Chemical Convention appears to have significantly reduced the amount of pollution whereas this is not the case with the 1963 Rhine Convention. The following assessment of the exact means by which the RCC did so reinforces the claim that regime

[117] Nevertheless, it is theoretically possible that the EKC served as a condition of possibility. One could argue, for instance, that the decline in Rhine and Elbe pollution would not have been possible, if the level of per capita GDP had not reached a certain level.

design matters and tries to identify (design) features that might be used to improve the effectiveness of other regimes. The regime did not solely cause the change in the amount of pollution of the Rhine but contributed to a considerable degree. In the following, I shall show how the design of the Rhine Chemical Convention and other important factors caused the decline in water pollution by (1) providing precise obligations (2) involving NGOs based on the treaty (3) institutionalizing learning (4) providing adequate scientific knowledge about the problem.

Enhancing behavioral clarity and narrowing the scope for interpretation

The RCC had one major advantage over the RC in its higher amount of precision of obligations. Whereas the obligations of the RC are ambiguous and indeterminate, the obligations of the RCC are precise and easy to interpret.

Consider both involved treaties. Both required the involved actors to reduce their amount of pollution. Whereas, the RC lacked behavioral clarity and did not narrow the scope for interpretation, the RCC performed both. More precisely, the RC does not contain precise rules for emission reductions nor quantitative targets what left the contracting parties leeway to interpret the obligations the way they liked to. In sum, behavioral clarity was lacking. We can therefore assume that the member countries did not know what the behavioral obligations were in order to achieve the goals of the regime. In contrast, the RCC contains exactly these precise directives concerning the behavior of the member countries: Article 1 obliges the contracting parties to eliminate pollution of the surface waters of the Rhine basin with Annex I substances and to reduce the pollution of the Rhine with Annex II substances. The treaty obliges the contracting parties to establish national inventories (Article 2) and to establish national programs for the reduction of the pollution within a period of two years from the entry into force of this Convention (Article 6). These national programs shall provide deadlines for the implementation of their goals. Discharges of substances “must be regulated by the national authorities with a view to limiting it strictly” (Article 6). Moreover, the precise directives for behavior include the obligation for the contracting parties to take all legislative and administrative measures to ensure that the “storage and deposit of Annex I and II substances are so carried out as to entail no danger of pollution to the Rhine” (Article 7). Each Government concerned shall take responsibility at the agreed measuring stations on the Rhine for installing and operating measuring systems and apparatus for determining the concentrations of such substances (Article 10).

Finally, there seems to be evidence that the RCC has cast a shadow ahead.[118] Only the announcement effect of a tightened environmental regulation seems to have had an announcement effect:

> *"In particular, the establishment of new programs for measuring pollution of the Rhine, the commitment to pollution thresholds in the Bonn Convention [the RCC; M.K.], and the ensuing discussions about them in the 1970s and 1980s have cast a shadow ahead. These developments were interpreted by actors potentially affected as a sign of further tightening of environmental regulation in the future. Hence these actors reacted by reducing their pollution in advance of anticipated legally binding laws by installing waste treatment plants or transferring especially polluting activities out of the Rhine catchment are"[119] (Van der Veen 1981, 43).*

Many of the large point source polluters of the Rhine and especially the big chemical companies such as BASF, Bayer and Hoechst in Germany, Sandoz and Roche in Switzerland transposed their production processes for reducing their emissions in anticipation of future regulation (Bernauer and Moser 1996, 407; IAWR 1982, 50-51). As Bernauer et al. (1996, 407) found out, the above mentioned chemical companies "are no longer passive and reluctant targets of environmental regulations."

Involving NGOs based on the treaty

A greater amount of precision of the obligations appears to have translated into higher levels of effectiveness with the RCC. This is to be understood in addition to the sub-regime's enhancing the involvement of NGOs. There appears to be evidence of NGOs using the information and obligations generated by the treaties to exert pressure on national governments, individual firms and mobilizing public opinion, providing information about problems and thus setting the riparian governments under pressure. For instance, contacts between the Dutch drinking water industry and its German and French counterparts had been established long before World War II with the aim of investigating water quality. Due to the ICPR, these contacts multiplied and government officials exchanged insights. Moreover, the pure existence of the RCC seems to have been stimulating for NGO involvement. IAWR as well as RIWA, two involved NGOs, repeatedly used the information and obligations generated by the RCC to exert pressure on national governments, individual firms and other actors.

---

[118] It is implausible that only the fact that the RCC has cast a shadow ahead contributed to such a degree to the effectiveness of reducing Rhine pollution that the regime design variables become negligible. If it was only the shadow that the RCC has cast ahead then it seems plausible that the riparian states would have changed their behavior again (and polluted more) after the treaty was signed. Empirically speaking, this is clearly not the case. Additionally, the observed variation between the decline in cadmium as Annex I substance and nickel as Annex II substance reinforces the claim that the regime design has been essential in (at least) this regard (see 5.1 The Evolution of Rhine and Elbe Water Pollution).

[119] We have to admit that it is difficult to isolate the exact role of the RCC in this respect. This, since it is difficult to determine what the polluters actually reacted to.

Institutionalizing learning

Another major advantage of the RCC in comparison to the RC was its higher degree of institutionalized learning. Most learning efforts were not made outside the two sub-regimes but within the institutional framework. Whereas the RC introduced the first foundations for institutionalized learning, the RCC built on these while adding some important features. All this appears to be highly important since the issue of chemical and heavy metal pollution in comparison to other pollution problems like chloride pollution, for example, is a complex and scientifically difficult to understand problem

One crucial factor seems to be the flow of information. The RC prepared the formal basis for the flow of information. Due to the existence of the ICPR, the flow of information between the riparian states was facilitated. Working groups were established (Article 7) so that information on different aspects of Rhine pollution could now be exchanged. The RCC built on these foundations of the RC while adding important layers. Thus, the riparian states are obliged to install and operate measuring systems and apparatus for determining the concentrations of the agreed upon substances and to regularly inform the ICPR of the results of its monitoring (Article 10). Additionally, the ICPR is obliged to draft an annual report summarizing the monitoring results and enabling the progress of the quality of Rhine water to be observed (Article 10). This appears to have lead to a further improvement and harmonization of the measurement programs as well as an increase of transboundary information flows.

A final crucial factor in this regard seems to be the establishment of a basis for making learning efforts. As most experts agree upon, the Rhine regime acted as a "learning facilitator". With Article 2 of the RC, the ICPR was authorized to carry out research into the nature, extent and origin of the pollution of the Rhine. An international measuring program with a net of monitoring stations to measure the concentration of pollutants in the water was set up. As it had already been the case with the flow of information, the treaty provisions of the RCC added an important layer to the RC. For instance, Article 12 of the RCC obliges the member countries to regularly inform the International Commission of the experience gained in the course of implementing this Convention.

Providing adequate scientific knowledge about the problem

One final advantage of the RCC in contrast to the RC was its higher amount of scientific knowledge about the problem. In contrast to the RC in which a scientific understanding of the environmental problem was only to a small degree established with regard to nature, causes, and consequences of the problem, or to solutions or possible maximization in the issue area, we found a partially established understanding in regard to the scientific

understanding of the environmental problem with the RCC.

One crucial factor seems to be the availability of data. Whereas hardly any data on the pollution of the Rhine with various substances was available before the RC was signed in 1963, the involved actors knew with the RCC how polluted the Rhine was. They possessed the results of the measuring stations and they already had agreed upon which pollutants should be eliminated in the Rhine and which should be substantially reduced (Annex I and II of the RCC).

Another crucial factor appears to be the question whether a consensus on the nature, causes, and consequences of the problem as well as solutions and what should be maximized in the issue area exists. With the RC, a 'cognitive barrier' persisted. The Rhine was said to be polluted by a 'cocktail' of chemicals but there did not exist any knowledge about the exact contents of this 'cocktail' nor about its origin. No consensus existed with the RC on which of the anticipated 1500 substances should be considered for further regulation and on the degree on to which a particularly substance was toxic, persistent or bio-accumulative. In contrast, with the RCC the cognitive barrier seems to have vanished at least partially. A consensus was partially achieved by a generally growing, but still not fully developed, consensus on the nature, causes, and consequences of the problem as well as solutions and what should be maximized in the issue area.

Finally, we use the *congruence method* between the Rhine Convention and the Elbe Convention for finding out in what way our findings hold true when compared to other transboundary river regimes. This comparison supports the claim that regime design matters as well. Here, the variables precision of obligations and independence of the secretariat find support. Thus, our regime design variable precision of obligations found support from all methods we used. Involving NGOs based on the treaty did not find support by comparing the RC and the EC. Consequently, it can be ruled out as a necessary or sufficient variable. The pollution load of transboundary rivers can be effectively reduced without the involvement of NGOs whether their involvement is based on the treaty or not. The same holds true for the independence of the secretariat since it has not found support from the controlled comparison with the method of difference. Finally, our Cognitivist variable extent of scientific knowledge about the problem found additional support as well. Therefore, the provision of adequate scientific knowledge about the problem found support from all methods we used.

6. Assessing the Validity and Robustness of Results

6.1 Internal and External Validity

"'Internal validity' involves efforts to move beyond the level of correlation (...) and to approach the promised land of causality, so to speak". (Wettestad 1999, 13)

Indeed, *internal validity* refers to "the validity with which statements can be made about whether there is a causal relationship from one variable to another in the form in which the variables were manipulated or measured" (Cook & Campbell 1979, 38, cited after: Sprinz 1997, 13). Recent research has argued that for strengthening internal validity, one has to perform (at least) two tasks. One is to demonstrate for each hypothesized causal relationship that an observed variation in the independent variable correlates with an observed variation in the dependent variable (Mitchell and Bernauer 2004, 84). This is what we have already demonstrated in *5.2 The Independent Variables* and *5.3 Comparative Analysis* and what lead to an elimination of rival explanations of hegemonic stability (H1), the level of economic integration among the member countries, the Environmental Kuznets Curve and the variable for macro changes.

In addition to this, and for strengthening internal validity, we attempt to establish the no-regime counterfactual (NR). Detlef Sprinz and Carsten Helm introduced the 'Oslo-Potsdam Solution' into the field of international environmental politics (Helm and Sprinz 1999; Sprinz and Helm 1999; Sprinz et al. 2004; Sprinz 2004).[120] This approach aims at measuring the effectiveness of international (environmental) regimes. Parts of this solution will be used for establishing the no-regime counterfactual.[121] Here, the NR which estimates the performance in the absence of an international regime needs to be established.[122] Since time and resources for this thesis are limited, we have to restrict ourselves to the changes in the order that seem to be most important. Moreover, it seems to be reasonable to use our control indicator sulfates for the establishment of the no-regime counterfactual.

The NR for *Rhine Convention* does not appear to be so much different than the actual performance: The RC does not seem to have generated any important new obligations

---

[120] With more time and resources, we could assess the collective optimum as well. One possible way how a researcher could do this is by using WHO-standards (WHO 2006). Those are, for instance, for cadmium 0,003 mg/liter and for nickel 0,02 mg/liter.

[121] I acknowledge the feeling of uneasiness of scientists to use counterfactuals (for instance: Bernauer 1995, 360; Tetlock and Belkin 1996). Nevertheless, as past research argued, counterfactual reasoning cannot be avoided in nonexperimental hypothesis testing and is indispensable in any analysis of regime effectiveness (Fearon 1991; Helm and Sprinz 1999, 633; Tetlock and Belkin 1996, 3; Underdal 2002, 7-9). For the methodological challenges involved, see for instance: (Underdal 2004, 38-40).

[122] One convincing way for establishing the "hypothetical state of affairs that would have come about had the regime not existed" (Underdal 2002, 7) is to determine what 'order' would have existed in the absence of the present regime and what would have happened under this previous order. For doing so, we assume that the order that existed immediately prior to the establishment of the present (sub-) regime would have continued unchanged (Underdal 2004, 38-39).

(Bernauer and Moser 1996, 403). NGOs would have been involved in the Rhine basin anyway. Nevertheless, it seems to be unlikely that NGOs would have exerted much pressure on the riparian states. This, because of the fact that before the establishment of the Rhine Convention there were hardly any data on the pollution of the river with various substances available (see learning). Moreover, there is much evidence that learning effects would have occurred much slower. Before the establishment of the RC the understanding in relation to nature, causes, and consequences of the problem, or to solutions or what should be maximized in the issue area was only established to a low degree. Finally, the existence of data on pollution was essential since the dischargers of waste into the Rhine could no longer assume that the origin of a particular polluting substance would be unknown to the authorities and the general awareness. We find support for these observations when looking at our control indicator. While the amount of BOD_5 declined with around 40 percent when comparing the years 1963 and 1968, the amount of Sulfates declined with around 10 percent (see Table 3). Consequently, the difference between the treated and the non-treated group amounts to around 30 percent. Nevertheless, when comparing the years 1968 and 1973 the difference between the two increases significantly but with a negative sign. Here, the amount of BOD_5 increased with more than 130 percent while the amount of Sulfates increased with around 30 percent (see Table 3). The amount of behavioral change amounts thus to 100 percent, but with a negative sign.

For the *Rhine Chemical Convention,* the NR appears to be significantly different than the actual performance. As in the case of the RC, NGOs would presumably have been involved in the Rhine basin without the existence of the RCC as well. Nevertheless, it seems to be unlikely that NGOs would have exerted much pressure on the riparian states.[123] Moreover, there is evidence that the precise and easy to interpret obligations of the RCC narrowed the scope for interpretation and did not leave the contracting parties leeway to interpret the obligations the way they like to (see 5.2 Institutionalist Variables).[124] In addition to this, there is much evidence that learning effects would have occurred much slower without the existence of the RCC. Most learning efforts were not made outside the sub-regime but within the institutional framework. The high degree of institutionalized learning of the RCC appears to have lead to a flow of information as well as to the establishment of a basis for making learning efforts (see 5.2 Cognitivist

[123] There appears to be evidence of NGOs using the information and obligations generated by the treaties to exert pressure on national governments, individual firms and mobilized public opinion, provided information about problems and thus set the riparian governments under pressure (see 5.2 Institutionalist Variables).

[124] In addition to this, there appears to be evidence that the RCC has cast a shadow ahead (see 5.2 Institutionalist Variables).

Variables). These observations find strong support when looking at our control indicator. When comparing the years 1976 and 1981, it becomes evident that the amount of cadmium declined with almost 90 percent, the amount of BOD_5 and nickel with around 80 percent while the amount of sulfates declined with around 30 percent (see Table 3). Consequently, the amount of behavioral change amounts to impressive 60 percent for cadmium and 50 percent for BOD_5 and nickel. This behavioral change declined somewhat when comparing the years 1981 with 1986 but still remains significant for cadmium with more than 80 percent difference between the treated and the non-treated group. In regard to nickel, the difference amounts to around 20 percent. Only in the case of BOD_5 the difference turned into a negative sign with around 10 percent.

For the *Elbe Convention*, the NR appears to be significantly different than the actual performance as well, but to a smaller degree than in the case of the RCC. NGOs in general have not played an important part in the case of the Elbe yet. This would presumably not be different without the establishment of the Elbe Convention. Nevertheless, there is evidence that the medium precise and easy to interpret obligations of the RCC narrowed the scope for interpretation and did not leave the contracting parties leeway to interpret the obligations the way they like to (see 5.2 Institutionalist Variables). Moreover, there is some evidence that learning effects would have occurred much slower. The scientific understanding of this environmental problem was only partially established. Especially in the Czech Republic, the knowledge in regard to water pollution issues was not so entirely understood. Thus, it appears to be important that with the EC (1990, Article 2.1) cooperation on scientific research projects and an exchange of information especially on the state of technology between both countries was institutionalized (Holtrup 1999, 195). These observations find support when looking at our control indicator. When comparing the years 1990 and 1995 it becomes evident that the amount of cadmium declined with more than 90 percent, the amount of nickel with around 70 percent and BOD_5 with around 20 percent while the amount of sulfates declined with around 60 percent (see Table 4). Consequently, the amount of behavioral change amounts to more than 30 percent for cadmium and 10 percent for BOD_5 and nickel. This behavioral change altered when comparing the years 1995 with 2000. The amount of behavioral change for cadmium declined to 20 percent but for nickel it increased to 75 percent.

Another task is to demonstrate plausibly that there are no other variables which could provide a more plausible explanation of the variation in the dependent variable (Mitchell and Bernauer 2004, 84; Wettestad 1999, 14). For ensuring this, we included several variables derived from rival explanations (see 2.1 The Realist Assumption: Power and

Interests Shape State Behavior and 2.3 The Cognitivist Assumption: Knowledge and Learning Matter) as well as control variables (see 2.4 Alternative Assumptions - The Control Variables). Moreover, important rival explanations were held constant by selecting the RC and the RCC, two sub-regimes that are both part of one single regime. Here, all riparian states are Western European democracies with a high level of socioeconomic development. Additionally, we feel on quite safe ground that we selected the regime design variables with a variation between the involved treaties since as experts ascertain, the institutional design of the ICPR is almost identical with that of the ICPE (Lindemann 2006, 29).

In short, *external validity* involves "the extent to which the knowledge produced (...) is also relevant for other environmental regimes and possibly also for other types of regimes" (Wettestad 1999, 14). As past research argued, for maximizing external validity the researcher should identify on the one hand the boundary between the class of cases to which the findings can be validly generalized. On the other hand, the researcher should identify the class of cases beyond which valid generalizations are unlikely (Wettestad 1999, 13). As past research argued, this proceeding requires

> *„Demonstrating that the conditions in the cases studied are sufficiently similar to those in the targeted policy area to warrant the expectation that the same explanatory relationships will operate there" (Mitchell and Bernauer 2004, 84).*

In comparison to other pollution problems, the pollution with chemicals seems to be a very difficult problem where international cooperation is especially unlikely. Additionally, we restrict the dataset to clearly identifiable upstream-downstream setting. Such settings are widely viewed in the environmental policy literature as hard cases[125] for international cooperation (Mitchell and Bernauer 2004, 92-93, 98; Mitchell and Keilbach 2001). Therefore, we have confidence that the knowledge produced in the realm of this research project may also be relevant for other environmental regimes. If regime design influences environmental problem solving in upstream-downstream settings and thus matters, it should do so in more benign settings as well. This seems to be especially true for all other problem types of transboundary Rivers like quantitative aspects, for instance.[126]

---

[125] A hard case in regard to international regimes is one where the conditions are highly unfavourable to the effective operation of a regime. Upstream-downstream problems can be regarded as hard cases since the problem involved seems to be malign in the sense that conflicts of interest are particularly severe here (Breitmeier et al. 1996b, 20).

[126] With more time and resources, a more detailed analysis of the external validity of our results could be made. For instance, cases and observations could be added in which our control variables have different values (Mitchell and Bernauer 2004, 98-99).

6.2 Assessing the Robustness of Results

For assessing the robustness of our results we exposed our findings to extensive tests. First, we used alternative indicators for our dependent variables. Second, we included the results of several more measuring stations along the Rhine and Elbe. Finally, we compared our results with other national and transboundary rivers.

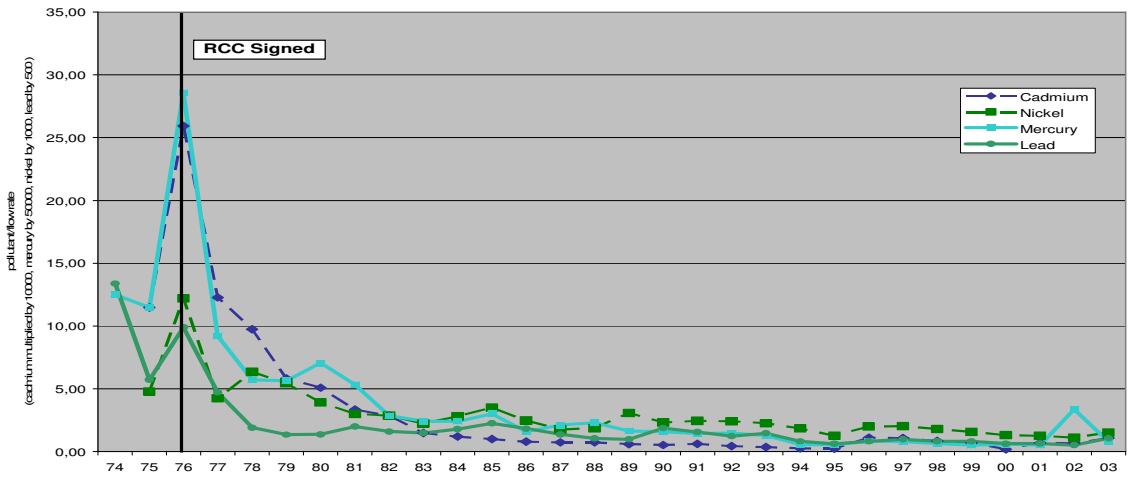
We started by using two alternative indicators: Mercury as alternative indicator for cadmium and lead as alternative indicator for nickel.[127] *Mercury* is mainly used in batteries, for dental amalgam, measuring and control equipment (e.g. thermometers). It is also used as part of the production process by some industrial plants in the chlor-alkali sector, which produces chlorine and caustic soda. Mercury and its compounds can be highly toxic to humans and the environment as well[128] (European Commission 2005a, 2; European Commission 2005c; Umweltbundesamt 2002b, 70-90; Van der Veen 1978, 35-36). Moreover, mercury is regulated in the RCC (as is cadmium) as Annex I substance. *Lead* is primarily used in the automobile industry (for privately owned motor vehicles), for storage batteries and alkyllead fuel additives, cable sheathing and pigments. Detrimental effects on humans (called lead poisoning) can arise when high levels of lead in the human body lead to toxic reactions, brain damage, and death. One disadvantage of using lead as indicator originates from the fact that the major source of lead in the rivers under consideration comes via the atmosphere due to car's exhausting gases.[129] Thus, regulating lead and effectively reducing its' input into the rivers seems to be especially difficult (Cech 2003, 309; Malle 1990, 94; Umweltbundesamt 2002b, 7-28; Zehnder 1993). Nevertheless, lead is regulated in the RCC (as is nickel) as Annex II substance.

[127] Due to time and resource constrains we have not included an alternative indicator for BOD_5. Chemical Oxygen Demand (COD) or nitrates could probably have been one such alternative indicator.

[128] Depending on the dose, high doses of mercury can be fatal to humans, but even relatively low doses can have serious adverse neurodevelopmental impacts as well. Recently, low doses have been linked with possible harmful effects on the cardiovascular, immune and reproductive systems.

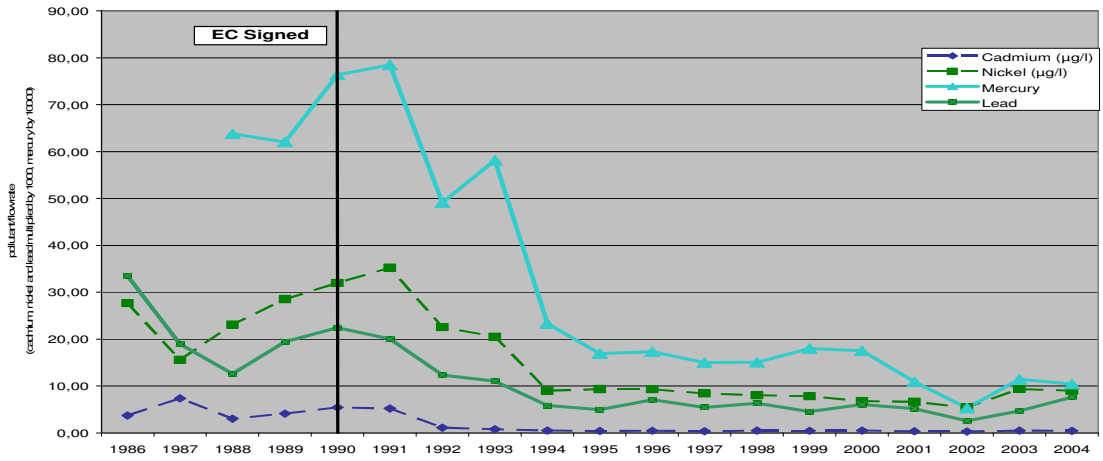
[129] In regard to the question whether lead is mainly caused by diffuse or point sources past research has shown that the majority of lead pollution is caused by diffuse sources. Depending on the measuring station and time period, the mean amount of diffuse source pollution varies around 60 to 70 percent (Behrendt and Fisheries 1993, 36-37).

Figure 4: Rhine Pollution with Alternative Indicators Included at Bimmen/Lobith



Using these two alternative indicators did not produce significant changes in the results in the case of the Rhine as well as the Elbe regime (see Figure 4 and Figure 5).

Figure 5: Elbe Pollution with Alternative Indicators Included at Magdeburg



Then we exposed our results to more measuring stations. We included the following gauging stations in the case of the Rhine regime: 'Weil am Rhein', 'Lauterbourg/Seltz', ‚Koblenz/Rhein', ‚Bimmen/Lobith' and ‚Gorinchem/Vuren' (see Map 1).[130] This did not produce significant changes in the results either (see Figure 6, Figure 7 and Figure 8). In the case of the Elbe regime, we used the observations of two measuring stations: The gauging station 'Schmilka' which is situated next to the border of the Czech Republic and that measures the behavior of the upstream country the Czech Republic and the gauging station 'Magdeburg', situated in the middle of Germany that measures Germany's distribution as the downstream country involved to the pollution load of the Elbe (see Map 2). Once again, this did not produce significant changes in regard to the results (see

[130] As already stated in 4.1 Case Selection, with more time and resources a more thorough distinction could have been made for the Rhine river. This, since the ultimate goal is to determine the contribution of each riparian state to the pollution load of the involved rivers and thus the behavioral change before and after the treaties went into effect.

Figure 9).

Finally, in *5.2 The Independent Variables* we compared the pollution load with BOD of the Rhine with the French river Loire, the German river Weser and the transboundary river Danube (see Figure 3). Only the pollution of the Rhine declines significantly with BOD after 1975 whereas the amount of pollution with BOD of the other rivers either remains constant or even increases.[131] We are therefore on quite safe grounds when concluding that regime design matters.

7. Conclusion

"I refuse to sing
another false paean of praise for you.…
Mine is an obituary for the fish
that have perished on the poisons
that pour into your channel
from sewers aplenty, left and right.…
Not even the ocean welcomes your arrival"
- Willy Bartock (1963) -

Several theories have sought to explain the effectiveness of international environmental regimes. Whereas Realist approaches claim the predominance of power and interests in explaining international cooperation and Cognitivist approaches stress the importance of knowledge and learning, Institutionalist approaches emphasize the institutional design of a regime as explanatory variables.

The empirical focus was on transboundary water pollution in the Rhine and Elbe Rivers from 1954-1999 for the Rhine and from 1985-2004 for the Elbe. Being more precise, we selected three initiatives in order to improve the water quality of the two rivers: (1) The *Rhine Convention* that established the International Commission for the Protection of the Rhine (ICPR) formally and legally. This treaty was signed in 1963 and went into effect in 1965. (2) The *Rhine Chemical Convention*, the follow-up of the Rhine Convention that was signed in 1976 and went into effect in 1979. (3) The *Elbe Convention* that established the International Commission for the Protection of the Elbe (ICPE). This treaty was signed in 1990 and entered into force in 1992. The analysis was based on data for chemical pollution (BOD_5) and heavy metal pollution (cadmium and nickel). The data was obtained from the publications of the ICPR for the Rhine and from Michael Bergemann from the Wassergütestelle Elbe/ARGE Elbe for the Elbe.

Rhine water pollution had increasingly deteriorated since the beginning of the last century.

[131] Ideally, we would have been able to include the indicators cadmium and nickel as well. Unfortunately, no data regarding these indicators seems to be available.

The populations of salmon and shad decreased and the last sturgeon was caught in 1931. This changed slightly after the Rhine Convention was signed in 1965. Nevertheless, only 6 years after the RC went into effect, the pollution of Rhine water (measured with BOD_5) had more than doubled and thus reached a dimension it had never before. Rhine water quality deteriorated and pollution levels peaked until the RCC was signed in 1976. When comparing the five-year period between 1976 and 1981, it becomes evident that the concentrations of cadmium and BOD_5 decline with more than 80 percent, the amount of nickel by 75 percent. Only five years after the RCC was signed, the concentrations of cadmium, nickel and BOD_5 are as low as never before. And even more important, the amount of pollution remains (almost) at these low levels.

The pollution of the Elbe in the 1990s almost equals the pollution of the Rhine some 20 years ago. From 1987 until 1990 pollution levels of the Elbe with all observed substances increased steadily with peak loads. The Elbe became more and more polluted. This did not change until the EC was signed in 1990. After all observed pollutants peaked in 1991, we can observe a significant decline in the amount of concentration measured in the Elbe. When comparing pollution levels of 1990 with those of 1995, we can observe a considerable decrease in cadmium with more than 90 percent and nickel with more than 70 percent. And even more important, the concentrations remained at these low levels.[132] Nevertheless, the impressive decline of Elbe pollution looses some of its significance when looking at our control indicator. When comparing the years 1990 and 1995 it becomes evident that the amount of sulfates declined with around 60 percent.

In short, the amount of Rhine pollution declined significantly after the RCC was signed, but did not decline effectively after the RC was signed. And the amount of Elbe pollution declined significantly after the EC was signed but seems to be less significant when including the control indicator.

From Realist theory we derived the hypothesis that the design features of a regime do not play a significant role if the downstream country compared to the upstream country(ies) is (are) more powerful and more vulnerable. From Institutionalism we derived three hypotheses. Those were first of all that transboundary water pollution will decrease as the amount of precision of the treaty's obligations increases. Second, that transboundary water pollution will decrease as the independence of the secretariat of a regime (when

[132] This observation is supported in the literature. For instance, Stubbs et al. (2002, 16) state: *"Although some of the improvements in the condition of the Elbe over the last 13 years would have occurred without the presence of the ICPE, the extent of improvement achievable would not have been as great and the positive outlook toward continued improvement would not be as definite."*

performing its' core tasks as well as when performing additional tasks) increases. Finally, that transboundary water pollution will decrease as the treaty-induced degree of involvement of NGOs increases. From Cognitivist theory we derived two hypotheses as well. The first one constituted that learning (what can either be caused by regime or non-regime factors) helps in solving international environmental problems. Second, transboundary water pollution will decrease as the extent of scientific knowledge about the problem increases. Finally, we included three control variables. First is the level of economic integration among the member countries. Second, we included a control variable for macro changes and third a rival explanation of the Environmental Kuznets Curve.

The conclusions derived from the Rhine and Elbe case studies can be summarized as follows:

- *The Realist variable* has least explanatory power. The Rhine regime (RC as well as RCC) clearly shows that the downstream country compared to the upstream countries is certainly not more powerful and more vulnerable. Despite the fact that the Netherlands as the downstream country can be classified as a Pusher and are thus when compared with the other riparian states more vulnerable (Germany can be classified as Intermediate, France and Switzerland as Bystanders). The Dutch are certainly not the most powerful country involved.
- *Institutionalist variables* prove to be of high relevance. Particularly, the amount of precision of the obligations found support when performing the before-after research design as well as when comparing the RCC and the RC with the method of difference and the RC with the EC with the congruence method. Thus, the empirical evidence supports the hypothesized importance of enhancing behavioral clarity and narrowing the scope for interpretation. Moreover, additional support can be found when looking at cadmium and nickel, two of the three indicators for water pollution we observed. Both were chosen since they are regulated differently under the RCC.[133] Our thesis in this regard was that if regime design mattered, then we should observe a difference in both pollutants (i.e. we should observed a huge reduction in cadmium and only a little reduction in nickel, for instance). As *Figure 1* as well as *Table 3* show, this is indeed the case: The amount of cadmium declines more significantly and is more lasting. Whereas the amount of nickel declines with (only) 17 percent when comparing the years 1981 with 1986, cadmium decreases with almost 80 percent. In short, transboundary water

[133] Cadmium that belongs to the Annex I substances is to be eliminated from the surface water of the Rhine whereas nickel that belongs to the Annex II substances is to be substantially reduced (see 4.1.1.2 The Chemical Convention (1976)).

pollution seems to decrease as the amount of precision of the treaty's obligations increases. One major advantage of the RCC over the RC lies in its higher amount of precision of obligations what appears to be one of the most important reasons for its higher effectiveness in reducing Rhine pollution. Whereas the obligations of the RC are ambiguous and indeterminate, the obligations of the RCC are precise and easy to interpret. Particularly, the existence of precise rules for emission reductions or quantitative targets seems to be crucial. Omitting may result either in leaving the contracting parties leeway to interpret the obligations the way they like to. Or in the conjuncture that the member countries do not know how exactly they should behave in order to achieve the goals of the regime. Second, the treaty-induced degree of involvement of NGOs found support when using the first two methods but could not be supported by the latter. Consequently, there is considerable evidence that the involvement of NGOs based on the treaty was an important factor in contributing to the decrease of transboundary water pollution with the RCC. A greater amount of precision of the obligations seems to have translated into higher levels of effectiveness with the RCC additionally because the sub-regime enhanced the involvement of NGOs. NGOs seem to have used the information and obligations generated by the treaties to exert pressure on national governments, individual firms and mobilized public opinion, made information about problems available and thus set the riparian governments under pressure. But it is doubtful whether this factor also plays an important role in many other environmental regimes. Finally, the independence of the secretariat of a regime could not be supported when comparing the RC and the RCC with the method of difference but found support when comparing the RC and the RCC with the congruence method. Consequently, this factor certainly is neither a necessary nor a sufficient variable. Nevertheless, it might play a role in some environmental regimes.

- *Cognitivist variables* prove to be of high relevance as well. Learning and the extent of scientific knowledge about the problem found both support when performing the before-after research design as well as when comparing the RCC with the RC with the method of difference. Both seem to be crucial since the issue of chemical and heavy metal pollution in comparison to other pollution problems like chloride pollution, for instance, is a complex and scientifically difficult to understand problem. In regard to the former, we found that the highest learning effort was not made outside the two sub-regimes but within the institutional framework. Thus regime design seems to matter here as well. Whereas the RC led the first foundations for institutionalized learning, the RCC built on these while adding some important features. In particular, we found the

flow of information and the establishment of a basis for making learning efforts being such important features. In regard to the latter, we found out that one final advantage of the RCC in contrast to the RC was its higher amount of scientific knowledge about the problem. In particular, the availability of data on pollution and the question whether a consensus (versus a "cognitive barrier") on the nature, causes, and consequences of the problem as well as solutions and what should be maximized in the issue area exists.

- *Control Variables* prove to be of low relevance. The level of economic integration, the variable for macro changes as well as the Environmental Kuznets Curve cannot serve as rival IVs since they cannot explain the variation in our DV.

In sum, the research results presented in this paper provide additional support for the claim that regime design matters (for instance: Mitchell 1994a; Mitchell 1994b; Sprinz and Kaan 2006). In the Rhine regime, the same governments and corporations changed their behavior significantly only after an additional treaty (the RCC) was signed.[134] Where the realism-based hypothesis of hegemonic power fails to explain this variance, differences in the regime design of the RC and the RCC stand ready to explain why the latter sub-regime made powerful actors change their behavior and reduce their amount of pollution substantially. Particularly the regime design variable amount of precision of the obligations might qualify as a necessary variable for environmental regime effectiveness.

Nevertheless, the research results also demonstrate that our regime design variables represent only some small factors within a broader explanatory framework. Cognitivist variables prove to be of high relevance as well. Particularly, the extent of scientific knowledge about the problem might qualify as a necessary variable for environmental regime effectiveness as well.

Further research needs to assess the significance of these Institutionalist and Cognitivist variables in explaining environmental regime effectiveness in greater depth. It will also have to subject our preliminary findings to more systematic and comprehensive investigations. Especially the performance of qualitative interviews with decision makers seems to be perfectly suited to provide deeper insights. More variables like further determinants of problem structure or more control variables like 'environmental awareness' could be included in our analysis. The regime-induced changes in human behavior (the outpact dimension of regime effectiveness) could be included into our

[134] There is some evidence that the treaty has also cast a shadow ahead. Only the announcement effect of a tightened environmental regulation seems to have had an announcement effect (see also 5.3 Comparative Analysis).

analysis as well. Consequently, the role and behavior of each involved riparian states could be analyzed. For doing this, a more thorough distinction between the amounts of pollution of each riparian state for the Rhine regime might be helpful. And more transboundary water regimes like the rivers Danube, Oder, Mosel and Scheldt, but non-regimes as well could be included. Finally, further research should clarify to what extent our findings are relevant beyond cases of upstream-downstream water pollution.

8. Annex

Figure 6: Comparison: Rhine Pollution with BOD5 Measured at Several Measuring Stations

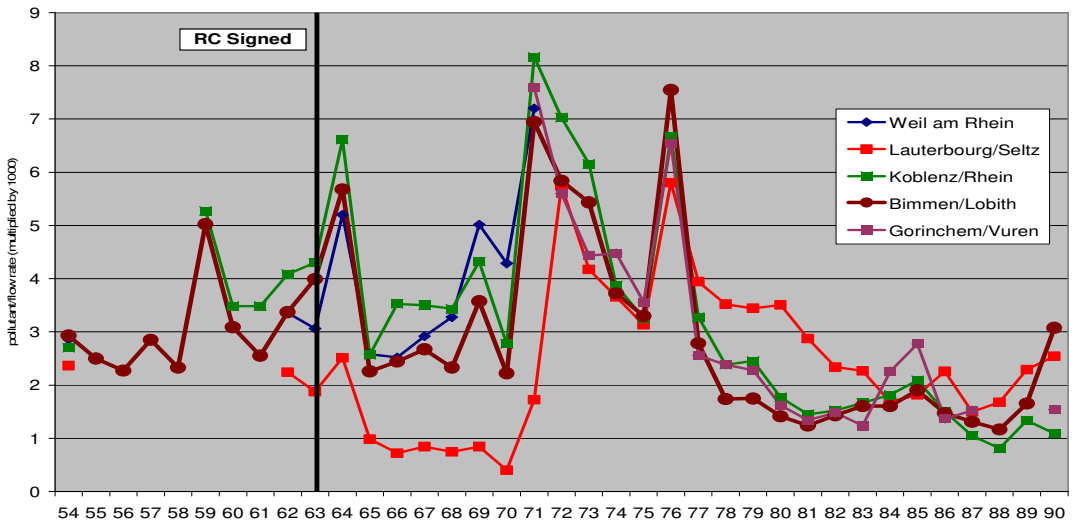


Figure 7: Comparison: Rhine Pollution with Cadmium Measured at Several Measuring Stations

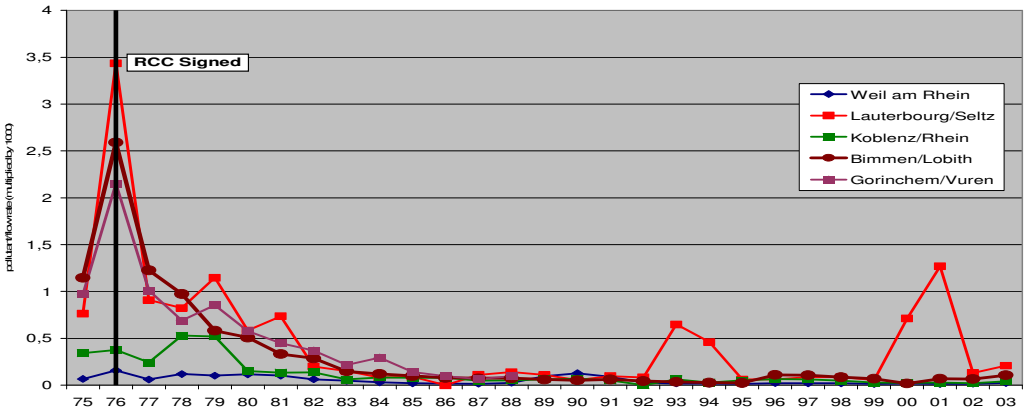


Figure 8: Comparison: Rhine Pollution with Nickel Measured at Several Measuring Stations

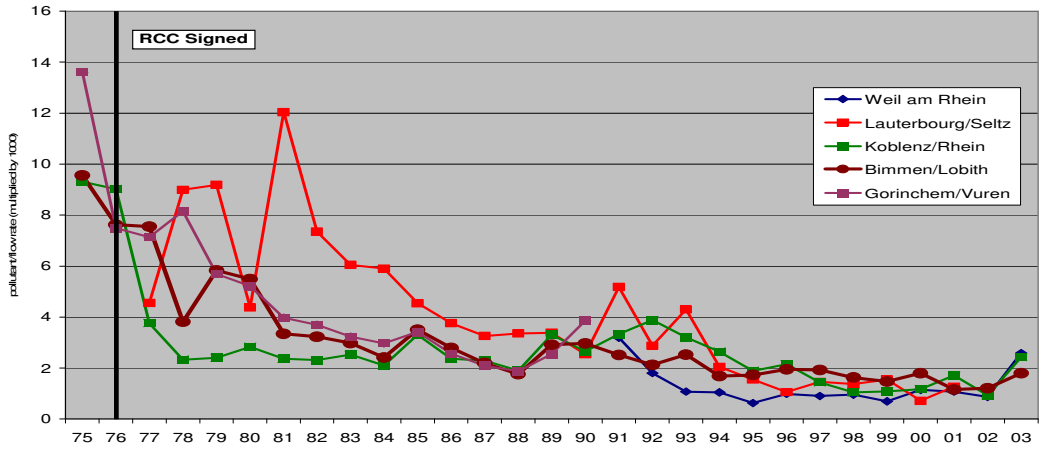
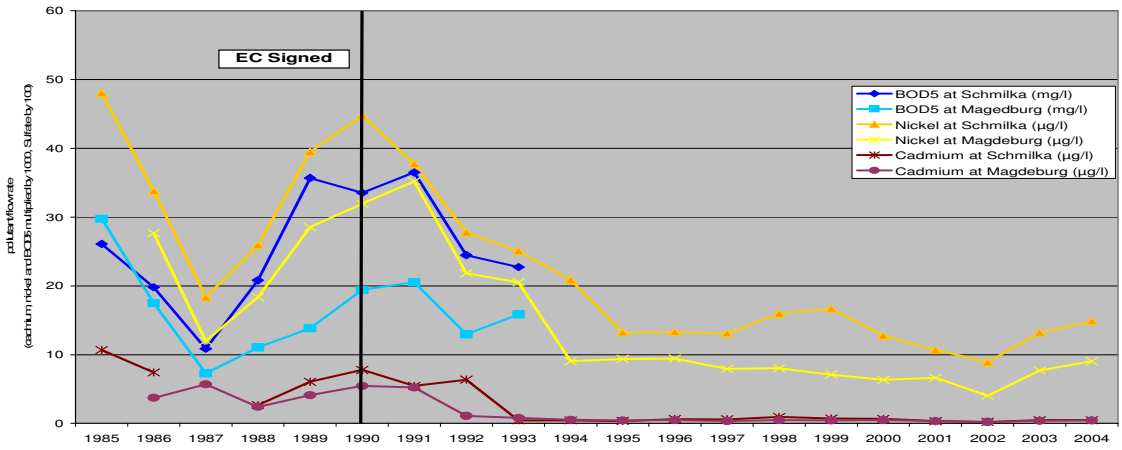
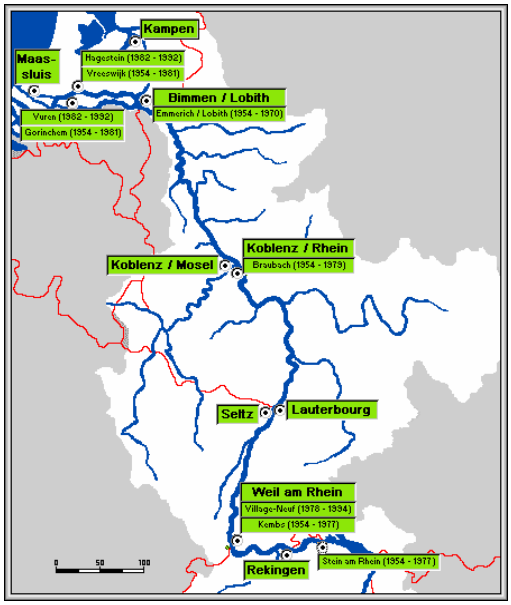


Figure 9: Comparison: Elbe Pollution at Schmilka and Magdeburg



Map 1: Rhine - The Measuring Stations



Map 2: Elbe - The Measuring Stations

9. References

(1961): *Protocol concerning the constitution of an International Commission for the Protection of the Mosel against Pollution*.

(1963): *Agreement concerning the International Commission for the Protection of the Rhine against Pollution*.

(1976a): *Convention for the Protection of the Rhine against Chemical Pollution*.

(1976b): *Convention for the Protection of the Rhine from Pollution by Chlorides*.

(1990): *Convention on the International Commission for the Protection of the Elbe*.

(1999): *Convention on the Protection of the Rhine*

Abbott, Kenneth W, Robert O. Keohane, Andrew Moravcsik, Anne-Marie Slaughter, et al. (2000): 'The Concept of Legalization', *International Organization*, 54 (3): 401-419.

Allen, Christopher S. (1989): Political Consequences of Change: The Chemical Industry, in: Katzenstein, Peter J. (ed.), *Industry and politics in West Germany: Toward the Third Republic*. Ithaca, N.Y., Cornell University Press**:** 157-184.

Andresen, Steinar and Jon Birger Skjærseth (1999): *Can International Environmental Secretariats promote effective co-operation?* Paper presented at the United Nations University's International Conference on Synergies and Co-ordniation between Multilateral Environmental Agreements. Tokyo, Japan.

BASF, Badische Anilin- & Soda-Fabrik - BASF (1977): *Gewässerschutz am Rhein. BASF-Symposium von 12. November 1976 in Ludwigshafen*. Köln, Verlag Wissenschaft und Politik.

Behrendt, Horst and Institute of Freshwater Ecology and Fisheries (1993): *Point and Diffuse Loads of Selected Pollutants in the River Rhine and its Main Tributaries*. Laxenburg, Austria, International Institute for Applied Systems Analysis (IIASA).

Bennett, Andrew (2004): Case Study Methods: Design, Use, and Comparative Advantages, in: Sprinz, Detlef and Yael Wollinski-Nahmias (ed.), *Models, Numbers & Cases. Methods for Studying International Relations*. Ann Arbor, University of Michigan Press.

Bernauer, Thomas (1995): 'The effect of international environmental institutions: How we might learn more', *International Organization*, 49 (2): 351-377.

Bernauer, Thomas (1996): Protecting the Rhine River against chloride pollution, in: Keohane, Robert O. and Marc A. Levy (ed.), *Institutions for environmental aid: pitfalls and promise*. Cambridge, MA, MIT Press**:** 201-232.

Bernauer, Thomas (1997): Managing International Rivers, in: Young, Oran (ed.), *Global Governance*. Cambridge, The MIT Press**:** 155-195.

Bernauer, Thomas (2001): 'Explaining success and failure in international river management', *Aquatic Sciences*,(64): 1-19.

Bernauer, Thomas (2002): 'Explaining success and failure in international river management', *Aquatic Sciences*, 64: 1-19.

Bernauer, Thomas and Vally Koubi (forthcoming): Political Determinants of Environmental Quality. http://e-collection.ethbib.ethz.ch/show?type=incoll&nr=1012

Bernauer, Thomas and Peter Moser (1996): 'Reducing pollution of the Rhine River: the influence of international cooperation', *Journal of Environment and Development*, 5 (4): 391-417.

Bernauer, Thomas and Peter Moser (1997): Internationale Bemühungen zum Schutz des Rheins, in: Gehring, Thomas and Sebastian Oberthür (ed.), *Internationale Umweltregime. Umweltschutz durch Verhandlungen und Verträge*. Opladen, Leske+Budrich**:** 147-163.

Breitmeier, Helmut, Marc A. Levy, Oran R. Young and Michael Zürn (1996a): *International Regimes Database (IRD). Dataprotocol*.

Breitmeier, Helmut, Marc A. Levy, Oran R. Young and Michael Zürn (1996b): *The*

International Regimes Database as a tool for the study of international cooperation. Laxenburg, Austria, International Institute for Applied Systems Analysis.

Breitmeier, Helmut, Oran R. Young and Michael Zürn (2006a): *Analyzing international environmental regimes. From case study to database*. Cambridge, Mass., MIT Press.

Breitmeier, Helmut, Oran R. Young and Michael Zürn (2006b): *Analyzing international environmental regimes. From case study to database: IRD Protocol and Database*. Cambridge, Mass., MIT Press.

Bresser, Hans Th./Loret A. Plattenburg (1997): The Netherlands, in: Jänicke, Martin, Helmut Weidner and Helge Jörgens (ed.), *National environmental policies a comparative study of capacity-building with a data appendix: international profiles of changes since 1970*. Berlin <etc.>, Springer-Verlag**:** 109-132.

Bueno De Mesquita, Bruce (1996): The Benefits of a Social-Scientific Approach to Studying International Affairs, in: Woods, Ngaire (ed.), *Explaining international relations since 1945*. New York, Oxford University Press**:** 49-76.

Cech, Thomas V. (2003): *Principles of water resources: History, Development, Management, and Policy*. New York, Wiley.

Cioc, Mark (2002): *The Rhine: An Eco-Biography, 1815-2000*. Seattle, University of Washington Press.

Collier, David and James Mahoney (1996): 'Insights and Pitfalls: Selection Bias in Qualitative Research', *World Politics*, 49 (1): 56-91.

Dasgupta, Susmita, Benoit Laplante, Hua Wang, David Wheeler (2002): 'Confronting the Environmental Kuznets Curve', *The Journal of Economic Perspectives*, 16 (1): 147-168.

Der Rat der Sachverständigen für Umweltfragen (1976): *Umweltprobleme des Rheins*. Stuttgart and Mainz, Verlag W.Hohlhammer GmbH.

Deutsche Kommission zur Rheinhaltung des Rheins (1993): *Bestandsaufnahme zur Einleitung prioritärer Stoffe im deutschen Rheineinzugsgebiet - Stand 1992 -*, Deutsche Kommission zur Rheinhaltung des Rheins unter dem Vorsitz der Ministerin für Umwelt des Landes Rheinland-Pfalz.

Dieperink, Carel (1995): Between Salt and Salmon, Network Management in the Rhine Catchment Area, in: Glasbergen, P. (ed.), *Managing Environmental Disputes: Network Management as an Alternative*. Dordrecht, Kluwer Academic Publishers**:** 119-136.

Dieperink, Carel (1997): 'International Regime Development: Lessons from the Rhine Catchment Area', *TDRI Quarterly Review*, 12 (3): 27-35.

Dieperink, Carel (1998): 'From open sewer to salmon run: lessons from the Rhine water quality regime', *Water Policy*,(1): 471-485.

Durth, R. (1996): *Grenzüberschreitende Umweltprobleme und regionale Integration: Zur politischen Ökonomie von Oberlauf-Unterlauf-Problemen an internationalen Flüssen*. Baden-Baden, Nomos Verlag.

Eckstein, Harry (1975): Case Study and Theory in Political Science, in: Polsby, Nelson W. and Fred I. Greenstein (ed.), *Handbook of political science*. Reading (Mass.), Addison-Wesley**:** 79-137.

EEA, Europäische Umweltagentur (2004): 'Indicators and Factsheets'. http://themes.eea.europa.eu/Specific_media/water/indicators; Retrieved: 5-31-2006.

European Commission (2005a): *Communication from the Commission to the Council and the European Parliament - Community Strategy Concerning Mercury*. Brussels.

European Commission (2005b): *Eurobarometer: The attitudes of European citizens towards environment*.

European Commission (2005c): *Questions & Answers on the Mercury Strategy*. Brussels.

Fearon, James D. (1991): 'Counterfactuals and hypothesis testing in political science', *World Politics*, 43 (2): 169-195.

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2001a): *Environmental Policy. Water Resources Management in Germany. Part 2 - Quality of Inland Surface Waters*. Bonn, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2001b): *Environmental Policy. Water Resources Management in Germany. Part 3 - Emissions into Surface Waters and the Sea*. Bonn, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2001c): *The German Water Sector - Policies and Experiences*. Bonn, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Food and Agriculture Organization, FAO (1978): *Systematic index of international water resources treaties: Declarations, acts and cases by basin*. Rome, Food and Agriculture Organization of the United Nations.

Gaddis, John Lewis (1996): History, Science, and the Study of International Relations, in: Woods, Ngaire (ed.), *Explaining international relations since 1945*. New York, Oxford University Press**:** 32-48.

George, Alexander and Andrew Bennett (2005): *Case Studies and Theory Development in the Social Sciences*. Cambridge, MA, MIT Press.

Gledditsch, Kristian S. (2002): 'Expanded Trade and GDP Data'. http://weber.ucsd.edu/~kgledits/exptradegdp.html; Retrieved: 9-11-2006.

Green, Donald P. and Alan S. Gerber (2002): Reclaiming the Experimental Tradition in Political Science, in: Katznelson, Ira, Helen V. Milner and American Political Science Association. (ed.), *Political science : State of the Discipline*. New York; Washington, D.C., W.W. Norton; American Political Science Assn.**:** 805-835.

Gulbrandsen, Lars H./Steinar Andresen (2004): 'NGO Influence in the Implementation of the Kyoto Protocol: Compliance, Flexibility Mechanisms, and Sinks', *Global Environmental Politics*, 4 (4): 54-74.

Gurtner-Zimmermann, Arnold (1998): 'The Effectiveness of the Rhine Action Program. Methodology and Results of an Evaluation of the Impacts of International Cooperation', *International Environmental Affairs*: 241-267.

Haas, Peter M. (1989): 'Do regimes matter? epistemic communities and Mediterranean pollution control', *International Organization*, 43 (3): 377-403.

Haas, Peter M. and Jan Sundgreen (1996): Evolving International Environmental Law: Changing Practices of National Sovereignty, in: Keohane, Robert O. and Marc A. Levy (ed.), *Institutions for environmental aid: pitfalls and promise*. Cambridge, MA, MIT Press**:** 401-429.

Hasenclever, Andreas, Peter Mayer and Volker Rittberger (1996): 'Interests, Power, Knowledge. The Study of International Regimes', *Mershon International Studies Review*, 40 (Supplement 2): 177-228.

Hasenclever, Andreas, Volker Rittberger and Peter Mayer (1997): *Theories of International Regimes*. Cambridge, Cambridge University Press.

Helm, Carsten and Detlef Sprinz (1999): *Measuring the effectiveness of international environmental regimes*. Potsdam, PIK - Potsdam Institute for Climate Impact Research.

Holtrup, Petra (1999): *Der Schutz grenzüberschreitender Flüsse in Europa - zur Effektivität internationaler Umweltregime*. Jülich, Germany, University of Bonn.

Hopkin, Jonathan (2002): Comparative Methods, in: Marsh, David and Gerry Stoker (ed.), *Theory and Methods in Political Science*. New York, Palgrave Macmillian**:** 249-267.

Hovi, Jon (2004): Causal Mechanisms and the Study of International Environmental Regimes, in: Underdal, Arild and Oran Young (ed.), *Regime consequences. Methodological Challenges and Research Strategies*. London, Kluwer Academic Publishers**:** 71-86.

IAWR (1978): *Rheinbericht '78*. Amsterdam, Sekretariat der IAWR.

IAWR (1980): *Rheinbericht 1979/80*. Amsterdam, Sekretariat der IAWR.

IAWR (1982): *Rheinbericht 1981/82*. Amsterdam, Sekretariat der IAWR.

IKSR (1956): *Bericht der Expertenkommission über die physikalisch-chemische Untersuchung des Rheinwassers I Juni 1953 - Juni 1954*. Basel and Stuttgart, Birkhäuser Verlag.

IKSR (1967): *Bericht über die physikalisch-chemische Untersuchung des Rheinwassers V. 1961 - 1965*. Basel and Stuttgart, Birkhäuser Verlag.

IKSR (1976): *Bericht über die physikalisch-chemische Untersuchung des Rheinwassers VI. 1966 - 1971*. Basel and Stuttgart, Birkhäuser Verlag.

IKSR (1982): *Zahlentafeln der physikalisch-chemischen Untersuchungen des Rheinwassers -1981*. Koblenz.

IKSR (1983): *Tätigkeitsbericht 1983*. Koblenz, Internationale Kommission zum Schutze des Rheins gegen Verunreinigung.

IKSR (1990): *Zahlentafeln der physikalisch-chemischen Untersuchungen des Rheinwassers - 1989*. Koblenz.

IKSR (1994): *Aktionsprogramm Rhein. Bestandsaufnahme der punktuellen Einleitungen prioritärer Stoffe*. Koblenz, Internationale Kommission zum Schutze des Rheins gegen Verunreinigung.

IKSR (1996): *Zahlentafeln der physikalisch-chemischen Untersuchungen des Rheinwassers - 1995*. Koblenz.

IKSR (2004): *Zahlentafeln der physikalisch-chemischen Untersuchungen des Rheinwassers - 2003*. Koblenz.

International Water Assessment Centre (2001): *Assessment Practices and Environmental Status 10 Transboundary Rivers in Europe*. Lelystad, The Netherlands.

Jacobson, Harold K. and Edith Brown Weiss (1998): Assessing the record and designing strategies to engage countries, in: Brown Weiss, Edith and Harold K. Jacobson (ed.), *Engaging countries: strengthening compliance with international environmental accords*. Cambridge, MA, MIT Press**:** 511-554.

Kamminga, Menno T. (1978): 'Who Can Clean Up the Rhine: The European Community or the International Rhine Commission?' *Netherlands International Law Review*, 25 (1): 63-79.

Keat, Russell and John Urry (1975): *Social theory as science*. London, Routledge & Paul.

Keohane, Robert O. (1993): The Analysis of International Regimes: Towards a European - American Research Programme, in: Rittberger, Volker (ed.), *Regime theory and international relations*. New York, Oxford University Press**:** 23-47.

Keohane, Robert O. (1996): Analyzing the effectiveness of international environmental institutions, in: Keohane, Robert O. and Marc A. Levy (ed.), *Institutions for environmental aid: pitfalls and promise*. Cambridge, MA, MIT Press**:** 3-27.

Keohane, Robert O., Peter M. Haas and Marc A. Levy (1993): The Effectiveness of International Environmental Institutions, in: Haas, Peter M., Robert O. Keohane and Marc A. Levy (ed.), *Institutions for the earth: sources of effective international environmental protection*. Cambridge, MA, MIT Press**:** 3-26.

Keohane, Robert O. and Joseph S. Nye (1977/1989): *Power and Interdependence: World Politics in Transition*. Boston, Little, Brown, and Co.

King, Gary, Robert O. Keohane and Sidney Verba (1994): *Designing social inquiry scientific inference in qualitative research*. Princeton, N.J., Princeton University Press.

Kiss, Alexandre. (1985): 'The protection of the Rhine against pollution', *Natural Resources Journal*, 25 (3): 613-37.

Koremenos, Barbara, Charles Lipson and Duncan Snidal (2004): The rational design of international institutions, in: Koremenos, Barbara, Charles Lipson and Duncan Snidal (ed.), *The rational design of international institutions*. Cambridge, UK New York, Cambridge University Press**:** 1-40.

Krasner, Stephen D. (1983): Structural causes and regime consequences: regimes as intervening variables, in: Krasner, Stephen D. (ed.), *International regimes*. Ithaca, NY, Cornell University Press**:** 1-22.

Krell, Gert (2000): *Weltbilder und Weltordnung. Einführung in die Theorie der internationalen Beziehungen*. Baden-Baden, Nomos-Verlagsgesellschaft.

Krysanova, Valentina, Sarka Blazkova, Romana Koskova, Cornelia Hesse, et al. (2005): *Research and Action Plan for the Elbe Case Study (Elbe RAP)*, paper was handed out to me from Valentina Krysanova from the Potsdam Institute for Climate Impact Research (PIK).

Kuhn, Patrick and Thomas Bernauer (2006): Does Trade Promote Effective International Environmental Problem Solving? *University of Zurich CIS Working Paper No. 13*, Available at SSRN: http://ssrn.com/abstract=900486

Kuhn, Patrick Michael (2004): *Fördert bilateraler Handel zwischenstaatliche Kooperation? Eine quantitative Analyse zum Effekt bilateralen Handels auf die Verschmutzungsproblematik grenzüberschreitender Flüsse in Europa*. Philosophische Fakultät der Universität Zürich. Zürich, Universität Zürich.

LeMarquand, David G. (1977): *International rivers: the politics of cooperation*. Vancouver, BC, Westwater Research Centre, University of British Colombia.

Levy, Marc A., Oran R. Young and Michael Zürn (1995): 'The study of international regimes', *European Journal of International Relations*, 1 (3): 267-330.

Lindemann, Stefan (2006): *Water regime formation in Europe. A research framework with lessons from the Rhine and Elbe river basin*. Forschungsstelle Für Umweltpolitik. Berlin, FU Berlin.

Little, Daniel (1991): *Varieties of social explanation : An introduction to the philosophy of social science*. Boulder, Westview Press.

Lowi, Miriam R. (1993): *Water and power the politics of a scarce resource in the Jordan River basin*. Cambridge, Cambridge University Press.

Malle, K.-G. (1990): 'Vergleich von Elbe und Rhein - Gegenüberstellung der Gütedaten', *UWSF - Z. Umweltchem. Ökotox*, 2 (2): 92-96.

Marty, Frank (2001): *Managing international rivers : problems, politics and institutions*. Bern; New York, Peter Lang.

Mayer, Peter (2003): Die Epistemologie der Internationalen Beziehungen: Anmerkungen zum Stand der "Dritten Debatte", in: Hellmann, Gunther, Klaus Dieter Wolf and Michael Zürn (ed.), *Die neuen Internationalen Beziehungen*. Baden-Baden, Nomos**:** 47-97.

Meybeck, M., Deborah V. Chapman, Richard Helmer, World Health Organization., et al. (1990): *Global freshwater quality: a first assessment*. Oxford, UK; Cambridge, Mass., USA, Published on behalf of the World Health Organization and the United Nations Environment Programme by Blackwell Reference.

Miles, Edward L. (2002): *Environmental regime effectiveness confronting theory with evidence*. Cambridge, Mass., MIT Press.

Mitchell, Ronald (2002a): Of course International Institutions Matter: But When and How?, in: Biermann, Frank, Rainer Brohm and Klaus Dingwerth (ed.), *Proceedings of the 2001 Berlin Conference on the Human Dimensions of Global Environmental Change 'Global Environmental Change and the Nation State'*. Potsdam, Potsdam Institute for Climate Impact Research**:** 16-25.

Mitchell, Ronald B. (1994a): *Intentional oil pollution at sea: environmental policy and treaty compliance*. Cambridge, MA, MIT Press.
Mitchell, Ronald B. (1994b): 'Regime design matters: intentional oil pollution and treaty compliance', *International Organization*, 48 (3): 425-458.
Mitchell, Ronald B. (1996): Compliance theory: an overview, in: Cameron, James, Jacob Werksman and Peter Roderick (ed.), *Improving compliance with international environmental law*. London, Earthscan**:** 3-28.
Mitchell, Ronald B. (2001): Institutional Aspects of Implementation, Compliance, and Effectiveness, in: Luterbacher, Urs and Detlef F. Sprinz (ed.), *International relations and global climate change*. Cambridge, Mass., MIT Press**:** 221-244.
Mitchell, Ronald B. (2002b): International environment, in: Carlsnaes, Walter, Thomas Risse and Beth Simmons (ed.), *Handbook of International Relations*. Thousand Oaks, CA, Sage**:** 500-516.
Mitchell, Ronald B. (2004): A Quantitative Approach to Evaluating International Environmental Regimes, in: Underdal, Arild and Oran Young (ed.), *Regime consequences. Methodological Challenges and Research Strategies*. London, Kluwer Academic Publishers**:** 121-150.
Mitchell, Ronald B. (2006): 'Problem Structure, Institutional Design, and the Relative Effectiveness of International Environmental Agreements', *Global Environmental Politics*, 6 (3): 72-89.
Mitchell, Ronald B. and Thomas Bernauer (1998): 'Empirical research on international environmental policy: designing qualitative case studies', *Journal of Environment and Development*, 7 (1): 4-31.
Mitchell, Ronald B. and Thomas Bernauer (2004): Beyond Story-Telling: Designing Case Study Research in International Environmental Policy, in: Sprinz, Detlef and Wollinski-Nahmias Yael (ed.), *Models, Numbers & Cases. Methods for Studying International Relations*. Ann Arbor, University of Michigan Press**:** 81-106.
Mitchell, Ronald B. and Patricia Keilbach (2001): 'Reciprocity, coercion, or exchange: symmetry, asymmetry and power in institutional design', *International Organization*, 55 (4): 891-917.
Neufeld, Mark (1993): 'Interpretation and the "Science" of International Relations', *Review of International Studies*, 19 (1): 39-61.
Nicholson, Michael (1996): The Continued Significance of Positivism?, in: Smith, Steve (ed.), *International theory positivism and beyond*. Cambridge, Cambridge Univ. Press**:** 128-145.
OECD (1993a): *Environmental performance reviews: Germany*. Paris, OECD.
OECD (1993b): *OECD environmental data: Compendium 1993*. Paris, OCDE.
OECD (1998): *Environmental performance reviews: Switzerland*. Paris, OECD.
Paudel, Krsihna P., Dwi Susanto and Gail Cramer (2005): 'An Empirical Test of Environmental Kuznets Curve for Water Pollution', *Environmental and Resource Economics*, 31 (3): 325-348.
Peitsch, Heike (1991): *Kooperation zwischen Ost und West im Umweltbereich*. Köln**:** VIII, 189.
Precht, Claus (1994): Sozioökonomische und politisch-administrative Voraussetzungen der Elbesanierung, in: Damkowski, Wulf, Claus Precht and Heinz Spilker (ed.), *Rettung eines Flusses zur Politik der Elbe-Sanierung*. Opladen, Leske + Budrich**:** 11-100.
Raustiala, Kal (2001): Nonstate Actors in the Global Climate Regime, in: Luterbacher, Urs and Detlef F. Sprinz (ed.), *International relations and global climate change*. Cambridge, Mass., MIT Press**:** 95-118.
Raustiala, Kal and Anne-Marie Slaughter (2002): International Law. International Relations and Compliance, in: Carlsnaes, Walter, Thomes Risse and Beth A.

Simmons (ed.), *Handbook of International Relations*. London, Sage.
RIWA (1977): *Jahresbericht '76*. Amsterdam, Internationale Arbeitsgemeinschaft der Wasserwerke im Rheineinzugsgebiet.
Shmueli, Deborah F. (1999): 'Water quality in international river basins', *Political Geography*, 18: 437-476.
Sigman, Hilary (2001): *International spillovers and water quality in rivers do countries free ride?* Cambridge MA, NBER.
Simmons, Beth (1998): 'Compliance with International Agreements', *Annual Revue of Political Science*,(1): 75-93.
Simmons, Beth A. and Daniel J. Hopkins (2005): 'The Constraining Power of International Treaties: Theory and Methods', *American Political Science Review*, 99 (4): 623-631.
Simon, M. (1991): 'Die Belastung der Elbe und ihrer Hauptnebenflüsse auf dem Gebiet der ehemaligen DDR', *Wasser + Boden*,(4): 207-221.
Sprinz, Detlef (1992): *Why countries support international agreements: the regulation of acid rain in Europe*. Ann Arbor, MI, University of Michigan.
Sprinz, Detlef (1997): *Empirical quantitative approaches to the study of international environmental policy*. Annual Meeting of the International Studies Association, Toronto.
Sprinz, Detlef (2003): Internationale Regime und Institutionen, in: Hellmann, G., K. D. Wolf and Michael Zürn (ed.), *Die neuen Internationalen Beziehungen - Forschungsstand und Perspektiven in Deutschland [The New International Relations - The State of Research and Perspectives in Germany]*. Baden-Baden, Nomos Verlag**:** 251-273.
Sprinz, Detlef F. (2004): *Absolute "Effectiveness" - The Triad of Domestic, European and International Actors*. Paper presented at the 45th Annual Convention of the International Studies Association. Le Centre Sheraton, Montreal, Quebec.
Sprinz, Detlef and Carsten Helm (1999): 'The Effect of Global Environmental regimes: A Measurement Concept', *International Political Science Review*, 20 (4): 359-369.
Sprinz, Detlef, Jon Hovi, Arild Underdal and Ronald B. Mitchell (2004): *Separating and Aggregating Regime Effects*. Paper presented at the 45th Annual Convention of the International Studies Association, Le Centre Sheraton, Montreal, Quebec.
Sprinz, Detlef and Christopher Kaan (2006): *Designing Effective International Environmental Agreements: Multimethod Results from a Medium-N Dataset*. Paper prepared for the 20th Convention of the International Political Science Association, 09-13 July 2006, International Congress Center, Fukuoka, Japan & the International Conference on Comparative Social Sciences, 15-16 July 2006, Sophia University, Tokyo, Japan.
Sprinz, Detlef and Tapani Vaahtoranta (1994): 'The interest-based explanation of international environmental policy', *International Organization*, 48 (1): 77-105.
Stein, Arthur A. (1983): Coordination and collaboration: regimes in an anarchic world, in: Krasner, Stephen D. (ed.), *International regimes*. Ithaca, NY, Cornell University Press**:** 115-140.
Stigliani, William M./Jaffé, Peter R./Anderberg, Stefan (1993): 'Heavy Metal Pollution in the Rhine Basin', *Environmental Science and Technology*, 27 (6): 786-792.
Stigliani, William M./Stefan Anderberg (1994): Industrial metabolism at the regional level: The Rhine Basin, in: Simonis, Udo Ernst, Robert Underwood Ayres, United Nations University (Tokyo) and International Federation of Institutes for Advanced Study (ed.), *Industrial metabolism restructuring for sustainable development*. Tokyo, United Nations University Press**:** 119-162.
Strübel, Michael (1992): *Internationale Umweltpolitik*. Opladen, Leske + Budrich.
Stubbs, Michelle and Sophie Bonjour (2002): *Case Study: Elbe River*, ETH Zuerich.

Susskind, Lawrence and Connie Ozawa (1992): Negotiating more effective International Environmental Agreements, in: Hurrell, Andrew and Benedict Kingsbury (ed.), *The international politics of the environment: An Introduction*. Oxford, Oxford University Press**:** 142-165.

Teclaff, Ludwik A. and Eileen. Teclaff (1985): 'Transboundary toxic pollution and the drainage basin concept', *Natural Resources Journal*, 25: 589-612.

Tetlock, Philip and Aaron Belkin (1996): *Counterfactual thought experiments in world politics : logical, methodological, and psychological perspectives*. Princeton, N.J., Princeton University Press.

Tschanz, R. (2001): *Gewässerschutz am Rhein: Zur Lösung von grenzüberschreitenden Umweltschutzproblemen*. Swiss Federal Institute of Technology (ETH). Zurich.

Umweltbundesamt (2002a): *Emissions of Heavy Metals and Lindane into River Basins of Germany*. Texte. Umweltbundesamt. Berlin.

Umweltbundesamt (2002b): *Ermittlung der Quellen für die prioritären Stoffe nach Artikel 16 der Wasserrahmenrichtlinie und Abschätzung ihrer Eintragsmengen in die Gewässer in Deutschland*. Texte. Umweltbundesamt. Berlin.

Underdal, Arild (2002): One Question, Two Answers, in: Miles, Edward L., Arild Underdal, Steinar Andresen, Jørgen Wettestad, et al (ed.), *Environmental regime effectiveness: confronting theory with evidence*. Cambridge, MA, MIT Press**:** 3-46.

Underdal, Arild (2004): Methodological Challenges in the Study of Regime Effectiveness, in: Underdal, Arild and Oran Young (ed.), *Regime consequences. Methodological Challenges and Research Strategies*. London, Kluwer Academic Publishers**:** 27-48.

Underdal, Arild and Oran Young, Eds. (2004): Regime consequences. Methodological Challenges and Research Strategies. London, Kluwer Academic Publishers.

Van der Veen, Cornelius (1978): The significance for the river Rhine for the environment and for public health, in: Hueting, R. (ed.), *La pollution du Rhin: aspects juridiques, économiques et techniques [Rhine pollution: legal economic and technical aspects]*. Zwolle, Tjeenk Willink**:** 28-33.

Van der Veen, Cornelius. (1981): 'Facts and figures on Rhine pollution', *International Business Lawyer*, 9 (2): 41-52.

Van Evera, Stephen (1997): *Guide to methods for students of political science*. Ithaca, Cornell University Press.

Victor, David G., Kal Raustiala and Eugene B. Skolnikoff (1998a): *The implementation and effectiveness of international environmental commitments theory and practice*. Laxenburg Austria; Cambridge Mass., International Institute for Applied Systems Analysis; MIT Press.

Victor, David G., Kal Raustiala and Eugene B. Skolnikoff (1998b): Introduction and Overview in: Victor, David G., Kal Raustiala and Eugene B. Skolnikoff (ed.), *The implementation and effectiveness of international environmental commitments theory and practice*. Laxenburg Austria; Cambridge Mass., International Institute for Applied Systems Analysis; MIT Press**:** 1-46.

Von Stein, Jana (2005): 'Do Treaties Constrain or Screen? Selection Bias and Treaty Compliance', *American Political Science Review*, 99 (4): 611-622.

Waltz, Kenneth (1979): *Theory of international politics*. Reading, MA, Addison-Wesley Publishing Company.

Wendt, Alexander (1998): 'On Constitution and Causation in International Relations', *Review of International Studies*, 24 (special issue): 101-118.

Wettestad, Jorgen (1995): *"Nuts and Bolts for Environmental Negotiators?" Designing Effective International Regimes. A Conceptual Framework*. Oslo, Fridtjof Nansen Institutt.

Wettestad, Jørgen (1999): *Designing effective environmental regimes: the key conditions*. Cheltenham, UK, Edward Elgar Publishing Company.

WHO, World Health Organization. (2006): "*Guidelines for drinking-water quality [electronic resource] : incorporating first addendum. Vol. 1, Recommendations. – 3rd ed.*" Retrieved 10/6/2006, from http://www.who.int/water_sanitation_health/dwq/gdwq0506.pdf.

Young, Oran (2004): The Consequences of International Regimes, in: Underdal, Arild and Oran Young (ed.), *Regime consequences. Methodological Challenges and Research Strategies*. London, Kluwer Academic Publishers**:** 3-24.

Zehnder, Alexander J.B. (1993): River Rhine: from sewers to the spring of life, (ed.), *Environmental change and human health*. Chichester ; New York, J. Wiley & Sons.

Zürn, Michael (1998): 'The rise of international environmental politics: a review of current research', *World Politics*, 50 (4): 617-649.