The Impact of International and Domestic Factors on the Regulation of Acid Rain in Europe: Preliminary Findings

by

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Abstract

Studies of international environmental regulation have traditionally focused on transboundary pollution as the major explanation of international regulation. As a consequence, domestic sources of international environmental regulation were neglected. In this paper, the domestic and international sources of international environmental regulation are outlined and their effects tested for the international regulation of acid rain in Europe.

In the analysis, the complex interdependence approach and the foreign environmental policy approach represent the major theories in the tradition of the international sources of international environmental regulation. Among the domestic factors, a range of elite attitudes are evaluated as well as economic and technological factors. The results from the empirical analysis generally shows minor support for those theories which stress the importance of the international sources of regulation, while the cost of regulation and access to technology are more strongly associated with a country's support for international environmental regulation.

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1. Introduction

International environmental problems, like the enhanced "greenhouse effect" or transboundary acid rain, have gained increased attention among elites and mass publics. Because of the international character of these environmental problems, international treaties are seen as a way to limit the degradation of the international environment. The purpose of this article is to examine why some countries support international environmental regulations and why other countries avoid resource commitments. Specifically, I will use the example of the transboundary acidification problem in Europe to test hypotheses regarding the domestic and international sources of environmental regulation.

In the following section, I will briefly review the various strands of literature on the international and domestic sources of environmental regulation (Section 2) which will be followed by a brief overview of European-wide acid rain regulations (Section 3). In Section 4, the hypotheses regarding a country's probability to support strict international agreements are outlined; this will be followed by a description of the data sources (Section 5). The results of the empirical test will be presented (Section 6), and the findings will be evaluated in the concluding section (Section 7).

2. Why Regulate the International Environment? - The Theoretical Debate

2.1. Overview

International environmental regulation can be understood as the consequence of international and domestic factors which operate on different levels of analysis. In particular, these environmental problems are created by transboundary pollutants and constitute an infringement on the sovereignty of a country to determine its environmental quality. In their study on "complex interdependence", Keohane and Nye suggest that this vulnerability of a country, i.e., the "relative availability and costliness of the alternatives that various actors face", influences state behavior (Keohane/Nye 1989, 13). In this article, I will test if these propositions are reflected in actual state behavior and which additional factors should be included in a more comprehensive analysis.

Rather than choosing a systemic approach (Keohane/Nye 1989), I locate theories and their empirical tests at the unit or country level, and I will shed light on the question if pollution exchange shapes a country's preferences for international regulation. Thus, I will build on the

tradition of the "environmental foreign policy" ("Umweltaußenpolitik") approach developed by Prittwitz (1984).

In addition to international factors, I will introduce a subset of crucial domestic factors of international environmental regulation. In this part of the analysis, I will attend to societal factors, such as elite perspectives on environmental regulation, as well as the role which abatement costs and technology play. Thus, I will provide empirical evidence on the link of (aggregated) domestic factors to a country's participation in international environmental regulation.

In summary, pollution-based explanations of a country's support for international environmental regulation will be evaluated as well as the impact which societal and economic/technological factors exert.

2.2. International Determinants of Environmental Regulation

In "Power and Interdependence", Keohane and Nye develop an opposite ideal type to the realist paradigm, namely "complex interdependence" (Keohane/Nye 1989). For them, "interdependence refers to situations characterized by reciprocal effects among countries or among actors in different countries" (ibid.). These effects have to involve costs, especially if they are broken up, such as international trade links. However, "[i]t is *asymmetries* in dependence that are most likely to provide sources of influence for actors in their dealing with one another" (ibid.). Keohane and Nye distinguish between sensitivity and vulnerability interdependence. They define "[s]ensitivity [as the] liability to costly effects imposed from outside before policies are altered to try to change the situation. Vulnerability can be defined as an actor's liability to suffer costs imposed by external events even after policies have been altered" (ibid., 13). Because the effects of international pollution are often long-term in nature, this analysis will restrict itself to the vulnerability dimension of ecological interdependence. The economic dimension of international environmental regulation will be dealt with separately further below. Since the vulnerability of states to international pollution will most often be *asymmetrical*, we will gain first order predictions of state behavior towards international environmental regulation: The most vulnerable countries should pursue policies of stringent environmental regulation.

Building on "complex interdependence", Prittwitz developed his "foreign *environmental* policy approach" (Prittwitz 1990b),. This approach assumes (i) the existence of a common threat which is perceived by countries (ibid., 5) and (ii) "*problem pressure*" exerted by the effects of pollutants on political actors (Prittwitz 1990a, 103-105). This environmental threat is a result of

mutual, transboundary pollution and leads (i) the victim of unidirectional pollution exchange to demand the reduction of polluting activities in the emitting country (or the installation of abatement technology) and (ii) to mutual interests to reduce emissions in the case of reciprocal pollution (Prittwitz 1984, 17-18).

Since international environmental problems often result from human activities associated with unwanted side-effects (externalities), Prittwitz assumes that the aggregate interests of a country is determined by the composite of its

- *polluter* interests, i.e., the advantages gained from the continuation of polluting activities,
- *victim* interests, i.e., the perceived adverse impacts of pollutant activities undertaken in one's own country or abroad, and
- *third party* interests, i.e., the interest of producers of abatement as well as substitution technologies (Prittwitz 1990b, 7).[1]

In his analysis, "[p]olluter and victim interests are opposed to each other, whereas third party interests are in a double bind: they are based on the continued existence of environmental problems, as well as on the political will to fight pollution" (ibid.) As a consequence, countries have particular profiles across these three interest dimensions and adopt foreign environmental policies in congruence with these interests (Prittwitz 1990a, 102). Particularly, countries with dominant polluting interests are not likely to agree to international environmental regulation, whereas the opposite is true for countries which have strong victim interests.

The foreign environmental policy approach helps us to understand how pollution interests are linked to a country's position with respect to international environmental regulation. Like structural theories which emphasize issue-specific power over outcomes, the foreign environmental policy approach provides us with a simplified set of expectations regarding a state's preferences for international environmental regulation. While it fails to derive a way to aggregate so-called "national" interests, this approach points to the domestic sources of international regulation in general and to the interests of "third parties" in particular. We will pursue this latter aspect further below.

Several independent syntheses of the complex interdependence and the foreign environmental policy approach have been developed during the recent years. First, Sætevik develops a scheme which relates state preferences for the regulation of an (international)

[1] The nuclear power industry is an example of a substitution industry for fossil fuel-fired power plants (which emit acidifying pollutants). However, the nuclear power industry generates a different type of waste which has long-term, environmental, and political consequences.

common property resource to policy outcomes (Sætevik 1988); second, in a similar effort, Sprinz and Vaahtoranta relate a country's environmental vulnerability and the costs of abatement to the behavior of states during negotiations on international environmental regulation (Sprinz/Vaahtoranta forthcoming). These two approaches show that (i) emissions are a source of power in international environmental relations, and (ii) asymmetrical pollution exchanges (or emissions), are associated with varying state positions with respect to international environmental regulation. Therefore, these approaches provide a parsimonious first-order prediction for state behavior in the international environmental relations.

In her work on the international regulation of pollutants found in the North Sea, Sætevik assumes that regulatory preferences of the littoral states are shaped by a country's ecological vulnerability and the asymmetry in pollution exchange (or the pollution trade *balance*). In turn, these preferences of states, in conjunction with the (i) state's ability to promote its own preferences as well as (ii) institutional constraints, are assumed to explain policy outcomes, namely the international regulations which have been concluded. Thus, Sætevik combines a power-based explanation (the ability to promote one's own preferences) with an interest-based explanation derived from complex interdependence (state preferences and institutional constraints) (Sætevik 1988, 16-31). In her analysis of the various conventions signed to protect the North Sea, she finds that net pollution exchange, such as the position of a net exporter or net importer of pollutants, better explains state preferences than ecological vulnerability does (ibid., 97). Overall, she finds that her model yields good "postdictive" power: Net importers of pollution favor stricter international environmental regulation than net exporters of pollutants (ibid., 94-97). It has to be noted that a net exporter position does not assure protection of one's own environment.

A second line of argument was pursued by Sprinz and Vaahtoranta in comparing the determinants of state behavior towards the regulation of international air pollution (Sprinz/Vaahtoranta forthcoming). They postulate that, in a simplified manner, a state's preference for international environmental regulation are predominantly determined by ecological vulnerability and the costs of abatement. They assert that

> [b]y combining abatement costs (low and high) with indicators of a country's vulnerability (low and high),..., countries can be classified into four categories: 'pushers', 'intermediates', 'draggers', and 'bystanders' " (ibid.).

Sprinz and Vaahtoranta hypothesize that "pushers" are more willing to engage in international environmental regulation than "intermediates" or "bystanders" do; in turn, members of the latter two groups are more likely to be in favor of international regulation than "draggers"

are. Comparing the cases of the regulation of the depletion of the stratospheric ozone layer (the Montreal Protocol) and transboundary acidification in Europe (e.g., the Helsinki or Sulfur Protocol), they find substantial support for their classification scheme in both cases for the postdiction of positions taken by countries during the negotiations as well as for acceptance of the specific international treaty.[2] However, they agree with Sætevik that unit-level or domestic factors might be introduced into the analysis to better explain the change in position over time of some crucial countries.

In conclusion, the complex interdependence approach, the foreign environmental policy approach and more recent approaches suggest a set of hypotheses about the *international* sources of environmental regulation. In addition, I will also focus on the domestic sources of international environmental regulation in the next section.

2.3. Domestic Determinants of International Environmental Regulation

While pollution-based explanations of international environmental regulation are likely to offer a first approximation of the international position of a country with respect to the protection of its environment, domestic sources are likely to account for a substantial proportion of the variance found across countries with respect to their willingness to agree to costly international regulation (Sætevik 1988; Sprinz/Vaahtoranta forthcoming). Particularly, domestic factors may, in the extreme, account for a variety of state behavior not easily predicted by a more static pollution-based approach. For example, some countries may not undertake remedial action in view of extreme ecological vulnerability even in the absence of the cooperation problem in world politics (Axelrod 1984); conversely, some governments may undertake remedial action in their own country far beyond cost-effective levels because its "lead country" status may appease domestic constituents. A third group of countries may not have ecological reasons to sign international environmental treaties, however, and they may sign such a treaty because of the nominal costs involved. In conclusion, I expect that the pollution-based predictions will only partially account for the variation found in support for international environmental regulation.

Drawing on the contemporary literature in comparative politics, I will review the research on mass public as well as elite attitudes on the environment. In addition, I will

[2] Note that the Montreal Protocol enjoys universal support whereas the Helsinki Protocol only received partial support by Western, Central, and Eastern European countries (Sprinz/Vaahtoranta forthcoming, 28).

emphasize the role which economic and technological factors play with respect to environmental regulation.

2.3.1. Postmaterialism and Interest Representation

Building on comparative politics theory of cleavage structures among the mass publics in Western societies, Inglehart suggests that the emergence of postmaterialism (a set of values which comprises aesthetic and intellectual components as well as belonging and esteem) could have a fundamental effect on environmental politics (Inglehart 1977; 1990; 1991). However, since this theory has largely been studied for individuals as the unit of analysis, one may ask why postmaterialism is relevant to the study of international environmental regulation.

It has been suggested that postmaterialism may be associated with the formation and the rise of environmental attitudes among the mass public in industrialized countries, which, in turn, could lead mass publics to demand policies in line with their preferences for environmental quality (see below). Postmaterialists are more likely than materialist to (i) be supporters and members of the environmental movements and (ii) engage in protest behavior. Second, the rise of postmaterialism may have lead to the creation of Green or ecological parties which stress environmental regulation. All of these factors may play an important role in determining national positions in international environmental negotiations. I will turn to each of these two factors below.

First, environmental concern taps the aesthetic dimension of postmaterialism, although it failed to load strongly on the postmaterialist/materialist factor in early research (Inglehart 1977, 42). Equally, research has shown that postmaterialists *approve* of the ecology movements in Western Europe more often than materialists do, however, the association is rather weak (Inglehart 1990, 383).

Second, established parties could not absorb the growing demands of the New Politics agenda of "environmental quality, alternative lifestyles, participation, and social equality" (Dalton 1988). Therefore, support for the new social movements - such as the environmental movement - may lead to support for Green or ecological parties which were founded largely during the 1980s (Müller-Rommel 1989). While Inglehart found that postmaterialists are consistently more supportive of these New Politics parties than materialists are, most postmaterialists still support traditional left parties. As a consequence of value change, traditional left parties, which were used to respond to materialist demands, have been challenged by Green parties.

For reasons of data availability, I will solely focus on the role of environmental interest groups, since they can be interpreted as "institutional" defenders of high environmental quality. Building on an interest-based, endogenous policy model originally developed by Magee, Brock, and Young (1989), I expect members or supporters of the environmental movement to provide support for a pro-environmental party, whereas I expect that representatives of major polluting industries will normally prefer not to be burdened with the additional costs of environmental regulation. While the growing industry of abatement technology providers is unlikely to share the view of major polluting industries, it seems fair to assume that - until the 1980s - the interests of abatement technology producers were less influential in determining national positions on international environmental agreements than those of the abatement technology producers. As a consequence, I expect environmental interest groups and industry peak associations to represent opposite positions on international environmental regulation.[3]

This simple model of conflict of interests may be evaluated with the help of data on the behavior of elites. Despite substantial research on political elites and top-level bureaucrats (Aberbach et al. 1981; Eldersveld 1989; Putnam 1976), relatively little is known about their role in environmental decision-making.

It was previously noted that postmaterialism guides mass public attitudes on the environment. While Inglehart concluded for the candidates to the European Parliament in the 1979 election that "the structure of elite responses [to the postmaterialist battery of questions] is strikingly similar to that of the general public" (Inglehart 1990, 141-142), it is only a study by Milbrath which systematically sheds light on elite (and mass public) attitudes on the environment in three advanced, industrial societies (Milbrath 1984).

Milbrath classifies elites and mass publics as vanguards (vs. rearwards) of a new, ecologically-minded society according to their responses to the items

(i) perceived condition of the environment is a large (vs. small) problem,

(ii) basic change in society (vs. better technology) is needed to solve environmental problems, and

(iii) there are (are *no*) limits to growth.

Milbrath finds that (with the exception of environmentalists and media leaders) most elites (i) come close to the ideal of the rearguard in the USA and Western Germany *or* (ii) gravitate to a middle position between vanguard environmentalists and a rearguard position in the U.K. (ibid., 46-48). In addition, mass publics and environmentalist leaders attribute a higher

[3] For a differentiated review of the literature of the impact of mass public attitudes as well as a more differentiated rational choice model of interest group representation, see Sprinz (1992a, chapters 2 and 3).

urgency to environmental problems than public officials, business leaders, and labor leaders (ibid., 84). The reverse holds for the perceptions regarding the adequacy of governmental actions to deal with environmental problems (ibid., 86). Consequently, environmentalist leaders and mass publics are more easily prepared to resort to direct actions (e.g., demonstrations) in order to influence governmental decisions on the environment than the other three groups of elites do (ibid., 91). However, substantial majorities of all elite groups and the mass public agree that *considerable* change is needed to solve environmental problems (ibid., 125).

In conclusion, the sparse research on the elites' environmental attitudes shows that environmentalist leaders are close to or lead mass publics on environmental questions, whereas public officials, business leaders, and labor leaders are closer to the rearguard on environmental attitudes. Given the lack of more specific results, I will subject the interest-based hypotheses to empirical analyses with elite data (see above).

2.3.2. Economic and Technological Capacity

When reviewing the literature on pollution-based explanations of international regulation, I already pointed to the economic sources of national and international regulation. For example, according to Prittwitz, actors with sufficient resources at hand will be able to undertake environmental policies even without facing severe environmental destruction. This is supposed to hold at the individual level, especially for postmaterialists, and countries at large (Prittwitz 1990a, 112). In addition, the presence of abatement technology (i.e., end-of-pipe technology) or integrated technologies (which avoid or reduce pollution by modifying production processes) may allow countries to adopt policies which led to substantial improvements of the state of their environments (Jänicke 1990).

Although politicians and bureaucrats often emphasize the importance of cost considerations on the scope and degree of environmental regulation, relatively few studies in international relations have actually tested this hypothesis. In their work on the ecological dimension on industrial change, Jänicke and Mönch stress that a combination of *ecological problem pressure* and *the level of wealth* serve as the two most powerful postdictors of effective environmental policies ("wirksame Umweltschutzanstrengungen") in industrialized countries (Jänicke/Mönch 1988, 2). In Jänicke's view, wealthy countries may be the most polluting countries, however, they also have better technological, material, and institutional capabilities to protect the environment (Jänicke 1990, 222).

Specifically, Jänicke and Mönch show for the sulfur dioxide (SO_2) emissions of industrialized countries that relatively poor countries have increased their per-capita emissions

between 1970 and 1985, whereas wealthy countries have reduced their per-capita emissions during the same period (Jänicke/Mönch 1988, 7). However, this does not hold across pollutants. For example, the emissions of nitrogen oxides (NOx) increased for all countries during the period 1970-1985, while the rate of increase seems to decline with rising levels of per-capita wealth (ibid., 8).

In my view, particular attention has to be placed on the dimension of economic wealth and technological access because both dimensions account for the ability of a country to implement substantive environmental policies. While Prittwitz locates these factors at the core of his "capacity hypothesis" (Prittwitz 1990a), Vaahtoranta demonstrates that technological innovations made the radical restrictions on the emissions of chlorofluorocarbons (CFCs) possible in conjunction with new evidence of adverse ecological effects of CFCs on the stratospheric ozone layer (Vaahtoranta 1990). Furthermore, the study by Sprinz and Vaahtoranta shows that *relatively* low abatement costs are strongly and positively associated with support for international environmental agreements (Sprinz/Vaahtoranta forthcoming).

In conclusion, I find that overall wealth of resources, both materially as well as technologically, should be associated with more ambitious environmental policies than is the case for poorer industrialized countries.

2.3.3. Conclusions

In the beginning of this Section, I posed the question, why countries are willing to allocate scarce resources to the protection of the international environment. Various theories of international relations and comparative politics were presented which should, at least in part, account for the strength of support for costly international environmental regulation.

Among the international factors, theories of complex interdependence and the foreign policy approach offered power- or interest-based explanations of anticipated state behavior.

In the domestic arena, the opposing interests of environmental interest groups and industry peak associations were outlined, and particular emphasis was placed on the relationship between economic and technological factors, on the one hand, and a country's propensity to sign international environmental agreements, on the other hand.

In conclusion, I will combine international and domestic factors in the explanation of state support for specific international environmental agreements. Specifically, I wish to explain

the variance found across 24 European countries in support for international agreements on transboundary air pollution in the 1980s. In the following section, I will provide a *brief* overview of these regulations in Europe.[4]

3. The Regulation of Transboundary Air Pollution (Acid Rain) in Europe

As a consequence of suspected strong adverse environmental effects, transboundary acidification ("acid rain") in Europe ranked high on government agendas in many European countries. Since the early 1970s, the scientific discussion on the linkage of acidification to adverse impacts on lakes, forests, soils, monuments, crops, and human health has led to international research efforts sponsored by the Organization for Economic Cooperation and Development (OECD 1979), the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), and research coordinated by the United Nations Economic Commission for Europe (UNECE). One major conclusion of these research efforts was the substantiation of the long-range, transboundary nature of acidification in Europe which made many countries vulnerable to the emission policies of *foreign* countries.

Parallel to improved knowledge of the ecological effects of sulfur and nitrogen oxides as well as volatile organic compounds, international efforts were undertaken to reduce the problem by way of internationally coordinated emission reductions. The 1979 Convention on Long-range Transboundary Air Pollution (LRTAP) (UNECE 1979), a framework convention, had been concluded in 1979 as a result of (i) a Swedish initiative on occasion of the 1972 UN Conference on the Human Environment and (ii) proposals by Secretary General Brezhnev during the Conference on Security and Cooperation in Europe (CSCE) to hold a series of conferences, inter alia, on the European environment. After coming into force in 1983, the LRTAP Convention had been augmented by (i) the 1984 Protocol on the Long-term Financing of the Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) (UNECE 1984), (ii) the 1985 Helsinki Protocol regarding a reduction of sulfur emissions or their fluxes by at least 30% (UNECE 1985), (iii) the 1988 Sofia Protocol on the freeze of the emissions of nitrogen oxides (UNECE 1988), and (iv) the 1991 Geneva Protocol on the Control of Emissions of Volatile Organic Compounds (UNECE 1991).

[4] See Chossudovsky (1989) and Levy (forthcoming) for a detailed overview of the diplomatic history of the international regulations on European acid rain.

The diplomatic process leading to the 1985 Helsinki (or Sulfur) Protocol received much public attention, since this protocol represents the first agreement which requires its signatories to allocate substantial resources towards air pollution abatement. It basically stipulates that signatories have to reduce their national sulfur emissions or their transboundary fluxes by 30% by 1993, using 1980 data as the reference base. The Protocol was signed by all of its supporters on 09 July 1985, and went into force on 09 September 1987. Although the basic provisions may not be considered very demanding from an ecological perspective, a significant subgroup of the signatories of the 1979 LRTAP Convention decided not to sign the Helsinki Protocol.[5] In contrast, the Nitrogen Oxide (NOx) Protocol enjoys close to universal support. It mandates a freeze of nitrogen oxide emissions or their transboundary fluxes to be achieved at the end of 1994 (1987 base year). It was signed by nearly all signatories on 01 November 1988 and went into force on 14 February 1991. However, a small subgroup of countries *also* signed a "Declaration on the 30 Per Cent Reduction of Nitrogen Oxide Emissions" on 31 October 1988 which asks its members to reduce emissions of annual nitrogen oxide in the order of 30% by 1998 (in comparison to any base year chosen between 1980 and 1986). In conclusion, the member countries of the UNECE do not show uniform support for these three international environmental agreements. I suggest that the international and domestic factors reviewed in the previous section partially accounts for the variance found in support for these international environmental agreements.

4. An Overview of the Hypotheses

For several reasons, transboundary air pollution problems in Europe is a fortunate case for testing the theories suggested in Section 2 . First, the Sulfur Protocol and the Nitrogen Declaration are international environmental agreements which require most countries to spend resources on the implementation of international regulation. As a consequence, we do not focus on purely symbolic treaties. Second, due to the suspected effects on lakes, soils, and forests, acidification is considered to be a major environmental problem which has received considerable attention among the mass publics and elites. Third, pollution data and other pertinent data are available for a period spanning a decade. Fourth, transboundary acidification in Europe affects a set of 24 countries (see below) which lets me assess hypotheses across a diverse set of countries with different political and economic histories.[6] As a consequence, the findings of this study may provide some guidance for research on other multinational environmental problems.

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[5] Sprinz/Vaahtoranta (forthcoming) contains a review of the literature on the Sulfur Protocol.

[6] Until the late 1980s, transboundary air pollution also had a political East-West dimension which declined with the political changes in Eastern and Central Europe. However, differences

In particular, I will test the following hypotheses. First, the complex interdependence approach suggests that ecological vulnerability determine a state's position with respect to international environmental regulation. Particularly, it is expected that countries with higher degrees of ecological vulnerability are more likely to support substantive environmental agreements than countries with a low degree of ecological vulnerability.

Second, the foreign environmental policy approach suggests that the (involuntary) "import" and "export" of pollutants determines a country's regulatory position. According to this approach, countries with a high degree of pollution imports will (other things held equal) more often support stringent environmental regulation than countries with a low degree of pollution imports. However, it is expected that the opposite is true for pollution exporters: The more a country is able to export its emissions, the more this country becomes vulnerable to political pressure from abroad. As a consequence, I expect major pollution exporters to support environmental regulation less strongly than importers do.

Third, with respect to elite perspectives on the environment, I will focus on the (i) evaluation of the importance of the acid rain problem in Europe in general as well as (ii) assessment of the impact of environmental groups and industrial interest groups on the regulation of acidifying pollutants. I expect the importance of the acidification issue and environmental group strength to positively covary with support for environmental regulation, whereas strong industrial interests might be associated with the reverse outcome.

Fourth, economic and technological factors are likely to shape the capacity of states to subscribe to internationally harmonized environmental regulation. Particularly, I expect

- high levels of Gross Domestic Product (GDP) per capita,
- low costs of compliance with the environmental agreements,
- presence of indigenously produced abatement technology, and
- a net exporter position on abatement technology

to positively covary with support for international environmental treaties.

These sets of hypotheses will be subjected to a *preliminary* test using a combination of aggregate data and elite interviews as described in the following section.

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in technological and economic capacity persist until today and have a pronounced effect on environmental regulation - despite the increased attention placed on environmental problems by East Central European governments.

5. Data Sources and Operationalization

The data analysis rests on a combination of aggregate data available from public sources, documents supplied by the UNECE (the regulatory body), the RAINS model of acidification developed by the International Institute for Applied Systems Analysis (Alcamo 1988), and a set of elite interviews undertaken by the author in eight European countries. Tables 1 and 2 give an overview of the major variables, their sources, and availability across countries. Throughout this analysis, only country means will be used as data input.[7]

In general, aggregate data have been collected for 24 European countries for which EMEP provides pollution data. Turkey has been omitted from the analysis, since only a small part of this country belongs to the EMEP monitoring area. In the case of the former Soviet Union, only the European part is included in the analysis. Albania and Luxembourg have been omitted form the analysis, since both countries hardly contribute to the European acid rain problem and their pollution data lead to the distortion of measures of central tendency due to rounding problems.

Data reliability is not always warranted for reasons of political deception or lack of adequate measurement. However, this problem is of minor concern for Europe as a whole. Pollution exchange data were computed from the RAINS model which (i) derives emission data from an *independent* energy database and (ii) uses EMEP emitter-receptor relations (Alcamo et al. 1990). While pollution-based indicators were taken for the period preceding the conclusion of international environmental agreements, this was not possible for the physical measures of environmental vulnerability. Since past abatement measures have not yet led to substantial decreases in the vulnerability of ecosystems, present data still reflect the differences of ecological vulnerability of the mid-1980s (Hettelingh et a. 1991).

Costs of abatement were taken from the those IIASA studies published closest to the conclusion of the international agreements so as to assure maximum compatibility with the knowledge decision-makers *could* have had at that point in time. The cost data reported are not the actual costs incurred by signing the protocols, however, the calculations of IIASA use a uniform approach to estimate *comparative* cost estimates (Alcamo et al. 1990). Expressed as a percentage of GDP per year, the cost estimates permit a comparison of the relative efforts to be undertaken if a country would sign a particular agreement. GDP data were derived from a recent publication of the Economist rather than from OECD sources, because the Economist makes a first attempt to deflate the past economic assessments of East Central Europe. Despite

[7] Most of the elite interview data pertain to the Sulfur Protocol, the Nitrogen Protocol, or positions on acid rain policies in general. Please consult Table 2 for details.

the difficulties of estimating the GDP of formerly centrally planned economies, the Economist data seem to reflect the present and past resource constraints of East Central Europe adequately.

While aggregate data are available for all 24 countries considered, elite interviews had been conducted for a subset of eight countries comprising Poland, Sweden, the U.K., the Netherlands, the FRG (in its borders before its enlargement in 1990), Spain, Hungary, and the Czech and Slovak Federal Republic. The target groups consisted of acid rain specialists in government, the major federal legislature, environmental interest groups, industry associations, as well as natural scientists. The specific composition of elite samples varies by country. The countries were selected so as to represent the variation found across the dimension of support for international agreements on acid rain, geographic position, pollution indicators, levels of economic development, and access to technological resources. The author conducted a total of 120 structured oral interviews between November 1990 and July 1991; in addition, 84 of these interviewees returned written questionnaires which are used in the analysis to follow. The variables included in the present analysis are based on 5-point scales and have been aggregated as country means.[8]

In conclusion, a combination of aggregate data, results of simulation models, and elite interviews are involved in this analysis of support for international environmental regulation.

6. Preliminary Findings

For the present analysis, I compare the group of signatory countries with the non-signatory countries. Separate analyses were undertaken for sulfur-based regulation and nitrogen-based regulation. For the regulation of sulfur oxides, countries were grouped according to their ratification status of the Sulfur Protocol (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution 1991).[9] In the case of the regulation of nitrogen oxides, countries were grouped according to their support for the "Declaration on the 30 Per Cent Reduction of Nitrogen Oxide Emissions" (or NOx Declaration) (Ågren 1989).[10] ANOVA-analyses were undertaken to compare the means between the "signatories" to international regulation and the "non-signatories" of the sulfur and nitrogen agreements. For all analyses, the probability of

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[8] The variable reflecting the production of control technology for acid rain pollutants (PRCOTEAR) is based on a 2 point scale (yes/no). However, since we use country means in our analysis, we have a continuous variable which can take values between 0 and 1.

[9] The former GDR is the only country which signed the Sulfur Protocol, and later declined to ratify it. This decision is unrelated to the accession of the former GDR to the territory of the FRG.

[10] The Nitrogen Protocol was not chosen for this analysis, since it enjoys close to universal support among UNECE member countries.

the F-statistic for the likelihood of the *equality* of the means is displayed, the mean variable score for signatories and non-signatories, as well as a judgment about the homogeneity assumption of the variance across groups (see Table 3).[11]

First, the complex interdependence approach suggest that countries with higher ecological vulnerability are more likely to subscribe to international regulation than countries with low degrees of ecological vulnerability. In the analysis, I focused on the *exceedance* of critical loads for domestic ecosystems which are the equivalent of exceedances of the sustainability of ecosystems due to the impact of acidification. The empirical analyses show minor differences between signatories and non-signatories regarding the exceedance of *domestic* critical loads (EXCLDO; see Table 3). In addition, this also turns out to be the case for an analysis of the exceedance of the critical loads of the major country of *destination* of emissions of sulfur and nitrogen oxides (EXCLEXS and EXCLEXN). Subscribers and non-subscribers seem not to show marked differences with respect to mean ecological vulnerability. However, this result may be due to my coding from grouped raw data (Hettelingh et al. 1991). Fortunately, questions regarding the importance of the acidification of aquatic ecosystems, forests, and soils were directed to respondents in the elite questionnaire (CAEFWA, CAEFFO, CAEFSO). ANOVA results from the 8 country dataset support the initial finding that differences in ecological vulnerability are, at best, weakly associated with regulatory differences. In a substantive sense, comparisons of the non-signatories with the signatories shows that the mean ecological vulnerability of the former group is markedly lower than for the latter group. Given my coding scheme, this also applies to the pollution export perspective, where emissions from signatories are received by more vulnerable ecosystems than those from non-signatories.

Second, for adherents of the foreign policy approach, the configuration of air pollution exchange would explain a country's regulatory preferences. Particularly, countries with depositions originating largely from abroad (victims) are supposed to favor environmental regulation, and major exporters of pollution (causers) would favor less regulation. For the victim perspective, the share of "imported" depositions was computed. For the case the regulation of sulfur oxides, we do not only find a 22% difference of the import share between signatories and non-signatories, but this difference in means is also highly statistically significant (PCIMDES5).

[11] In this analysis it turned out that the assumption of homogeneity of variance across groups is violated for a few variables. Empirically, this problem turns up in those cases when signatories to international regulation show nearly no intra-group variation; however, comparison of the means reveal the substantive differences in variable scores between signatories and non-signatories. For the F-statistic, a threshold level for significance of p=0.05 was chosen.

However, this does not hold for the regulation of nitrogen oxides (PCIMDEN5).[12] For the case of the export of sulfur and nitrogen emissions, no statistically significant differences between signatories and non-signatories were found (PCEXEMS5, PCEXEMN5). Given the present state of analysis, the foreign environmental policy approach only receives partial support.

Third, from the elite interviews, I selected variables related to the (i) salience of the acid rain problem in general (IMGEAR) as well as the strength of (ii) environmental and (iii) industry groups with respect to the domestic regulation of acidifying pollutants (STDOENGR, STDOINAS). Statistical differences do not follow a particular pattern, however, signatories always attribute higher importance to the acid rain issue than is the case for non-signatories. Among the subscribers to the 30% NOx Declaration, much more importance is attributed to the acid rain problem than is the case for non-signatories. However, this difference does not hold for the Sulfur Protocol. Environmental groups appear to have been significantly stronger among signatories compared to the non-signatories of the Sulfur Protocol. However, this finding cannot be generalized to the regulation of nitrogen oxides. No statistical significant differences can be found between regulatory support and the strength of industry associations. However, it is noteworthy that industry associations seem to be stronger among the non-signatories.

Fourth, marked differences between signatories and non-signatories of international environmental regulations seem to exist with respect to economic and technological variables. Both, for sulfur and nitrogen regulation, GDP per capita in 1988 (GDPCAP88) is remarkably higher for signatories than for non-signatories . In fact, signatories of the Sulfur Protocol are more than twice as wealthy than non-signatories, and in the case of nitrogen regulation, the ratio is more than 3 to 1. The same sharp differences, both substantively and statistically, are reflected in the costs of implementing the various environmental regulations (COPRSU, COPRNO): Signatories spend, on average, 0.20% of their GDP annually on compliance with the Sulfur Protocol, whereas non-signatories *would* have to spend more than 1.00% of their GDP. While the absolute amounts may not be accurate as described above, the *ratio* of 1 to 5 shows the regulatory advantage of wealthy countries. The equivalent ratio for the NOx Declaration is 1 to 11.[13] Purely economic variables seem to have a pronounced influence on a country's likelihood of subscribing to international environmental regulations. Similar results can be obtained from the elite interviews. Respondents were asked if they perceived their country to have sufficient resources

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[12] Substantive and statistical differences between the results for sulfur and nitrogen oxide regulation are partially due to the differences in the characteristics of the pollutants and differences in the composition of subscribers across pollutants. For example, nitrogen oxides spread more internationally than sulfur oxide, and while Hungary subscribes to the Sulfur Protocol, it does not support the NOx Declaration.

[13] Violation of the homogeneity of variance assumption for the ANOVA analyses results from the high degree of uniformity among signatories of the NOx Declaration.

for the compliance of the respective environmental agreement (RECOMPSU, RECOMPNO).[14] Marked differences were found for the NOx Protocol (RECOMPNO), whereas this does not hold for the Sulfur Protocol (RECOMPSU). The differences in findings across pollutants might be due to the differences in membership of the two groups; particularly, the 11 supporters of the NOx Declaration comprise the wealthy core of Europe, whereas supporters of the Sulfur Protocol also include some East Central European countries. However, the absence of statistical significance in some cases should not obscure the fact that signatories always have better access to resources than their counterparts.

Fifth, while economic resources allow countries to support international environmental regulation, proponents of the foreign environmental policy approach also suggest that domestic production and net export of technology could induce countries to support international environmental regulation. Elites in eight countries were asked if their country produces any control technology relevant to the acid rain problem (PRCOTEAR) and if their country is a net exporter (or importer) of such technologies. Signatories of the NOx Declaration seem to uniformly enjoy domestic production of the relevant technology and the mean for their trade position on technologies points to a minor net exporter position (PRCOTEAR). For sulfur, no significant differences can be found between signatories and non-signatories.

The findings presented in this article should be interpreted with caution. Outliers within samples of 8 to 24 countries may have substantial impact on the statistical results obtained, and bivariate models do not substitute for appropriate directional, multivariate test with logistic regression models. In addition, test with various operationalizations of the same concepts, and interaction effects across concepts were not included in the present analysis. Furthermore, the results obtained should be compared to the international regulation in other domains of international environmental protection (air, water, soil, biodiversity, etc.).

7. Why Regulate? A Few Tentative Conclusions

Given the small sample size and the preliminary nature of this research, none of the hypotheses outlined in Section 2 can easily be rejected. However, some strands of theory seem to provide better explanations than others. For the case of transboundary acidification in Europe, regulatory status is not strongly related to ecological vulnerability, regardless of the fact if the country views

[14] For the case of nitrogen emissions, the resource questions were asked with respect to the NOx Protocol (freeze) rather than the 30% NOx Declaration. Since all signatories of the 30% NOx Declaration belong to the richest countries in Europe, a rephrased question should result in the same substantive differences between signatories and non-signatories.

its own *or* foreign ecosystems as particularly important. Furthermore, pollution exchange may matter in some cases but not in others. Hypotheses derived from the complex interdependence and the foreign environmental policy approach receive only partial support in the context of acid rain regulation in Europe - at least in their present, bivariate specification.

Elite perspectives on the domestic political process reveal that heightened attention to the environmental problem may be associated with international environmental regulation. This might also be the case for the impact of environmental groups, however the impact of industry associations appears not to matter. However, if the major polluters and technology providers are simultaneously incorporated in a logistic regression model of support for international environmental regulation (analysis not shown here), the adversial nature of intra-industry interests and their opposing effects become clearly visible (Sprinz 1992a, ch. 6).

Availability of economic resources and low costs of regulations consistently show strong associations with regulatory behavior. This also holds for some technological variables.

In a larger sense, the preliminary findings from the study on the regulation of transboundary acidification in Europe should be treated with caution. However, I tentatively conclude that we cannot reject the hypothesis that - if an environmental problem has been put on the political agenda - economic feasibility translates into declaratory behavior in the international arena of environmental regulation.

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Table 1: Selected Background Data on the Regulation of Transboundary Acidification in Europe

Country	LRTAP Convention Ratification	SO2 Protocol Ratification	NOx Protocol Signature	NOx Declaration	GDP/capita in 1988 [1985 USD]	Annual % GDP Costs of 30% Reduction of SO2 from 1980 levels	Annual % GDP Costs of 30% Reduction of NOx from 1980 levels	Exceedance of Critical Loads (total acidity, 5th percentile)	Total 1985 SO2 Emissions [kt SO2]	% Imported SO2 Depositions (incl. background)
A	1	1	1	1	9,189	0.04	0.02	6.0	219	92
B	1	1	1	1	8,763	0.00	0.04	6.0	563	74
BG	1	1	1	0	2,091	1.81	1.70	4.2	1,555	58
CS	1	1	1	0	2,619	0.16	0.01	6.0	2,515	57
DK	1	1	1	1	11,823	0.04	0.03	5.7	377	75
SF	1	1	1	1	12,222	0.00	0.11	3.1	469	81
F	1	1	1	1	10,126	0.00	0.02	4.3	1,356	55
D	1	1	1	1	10,919	0.05	0.02	6.0	2,480	61
DDR	1	0	1	0	5,014	0.87	0.02	6.0	4,503	34
GR	1	0	1	0	3,507	0.60	0.50	1.2	846	68
H	1	1	1	0	2,547	0.32	0.02	3.5	1,492	53
IRL	1	0	1	0	5,709	0.14	0.05	4.6	228	59
I	1	1	1	1	8,155	0.01	0.07	2.5	2,687	41
NL	1	1	1	1	9,004	0.05	0.03	6.0	445	87
N	1	1	1	1	14,701	0.12	0.08	3.5	115	93
PL	1	0	1	0	1,662	0.69	0.10	6.0	4,165	56
P	1	0	0	0	2,285	0.22	0.42	2.8	363	46
R	1	0	0	0	1,373	2.42	1.52	3.9	3,321	60
E	1	0	1	0	4,907	0.13	0.27	2.0	3,642	21
S	1	1	1	1	12,845	0.01	0.02	3.8	308	87
CH	1	1	1	1	15,021	0.04	0.01	5.8	83	90
UK	1	0	1	0	9,083	0.04	0.04	2.4	3,804	15
SU	1	1	1	0	3,060	0.39	0.30	3.3	19,207	28
YU	1	0	0	0	2,223	4.36	0.78	3.0	2,393	62
Sum	24	15	21	11					57,136	
Average					7,035	0.52	0.26	4.2	2,381	61
S.D.					4,458	1.01	0.46	1.5	3,862	22

[1] Negative entries ("-") mark *increases* in emissions.

Table 2: **Data Sources**

Variable	Ratification of the Sulfur Protocol	Signature of the 30% NOx Declaration	Exceedance of Domestic Critical Loads	Exceedance of the Critical Loads for the Major Recipient of Sulfur Emissions	Exceedance of the Critical Loads for the Major Recipient of Nitrogen Emissions	Regulatory Effect of Acidification on Lakes and Surface Water
Label	SO2PRRAT	NOXDECLA	EXCLDO	EXCLEXS	EXCLEXN	CAEFWA
source	(UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution 1991)	(Ågren 1989)	(Hettelingh et al. 1991)	(Hettelingh et al. 1991)	(Hettelingh et al. 1991)	(Sprinz 1992b)
Maximum N	24	24	24	24	24	8

Variable	% Imported Depositions of Sulfur in 1985	% Imported Depositions of Nitrogen in 1985	% Exported Emissions of Sulfur in 1985	% Exported Emissions of Nitrogen in 1985
Label	PCIMDES5	PCIMDEN5	PCEXEMS5	PCEXEMN5
source	(Alcamo et al. 1990)	(Alcamo et al. 1990)	(Alcamo et al. 1990)	(Alcamo et al. 1990)
Maximum N	24	24	24	24

Table 2 (cont.):

Variable	General Importance of the Acid Rain Problem in a Country	Domestic Strength of Environmental Groups	Domestic Strength of Industry Associations
Label	IMGEAR	STDOENGR	STDOINAS
source:	(Sprinz 1992b)	(Sprinz 1992b)	(Sprinz 1992b)
Maximum N	8	8	8

Variable	GDP Per Capita in 1988	Costs of Sulfur Protocol (as % of GDP in 1988)	Costs of Nitrogen Declaration (as % of GDP in 1988)	Availabilty of Resources for Compliance with Sulfur Protocol	Availabilty of Resources for Compliance with Nitrogen (Freeze) Protocol	Production of Control Technology (for Acidifying Pollutants)
Label	GDPCAP88	COPRSU	COPRNO	RECOMPSU	RECOMPNO	PRCOTEAR
source:	(Economist 1990)	(Amann/ Kornai 1987; Economist 1990)	(Amann 1989; Economist 1990)	(Sprinz 1992b)	(Sprinz 1992b)	(Sprinz 1992b)
Maximum N	24	24	24	8	8	8

Table 3: One-Way ANOVA Results for the Rgulation of Transboundary Acidification

	SO2 Protocol	NOx Declaration		SO2 Protocol	NOx Declaration		SO2 Proto
Variable	**EXCLDO**	**EXCLDO**		**EXCLEXS**	**EXCLEXN**		
sign. F	0.0888	0.1028		0.4225	0.2499		
Mean Non-Signatories	3.54	3.76		3.64	3.70		
Mean Signatories	4.65	4.79		4.13	4.27		
Homog. of Variances	yes	yes		yes	yes		
N	24	24		24	24		

Variable	**CAEFWA**	**CAEFWA**		**CAEFFO**	**CAEFFO**		**CAI**
sign. F	0.9882	0.0215		0.3492	0.3828		0
Mean Non-Signatories	2.83	2.46		3.02	3.25		
Mean Signatories	2.82	3.43		3.88	4.07		
Homog. of Variances	yes	yes		yes	yes		
N	8	8		8	8		

Variable	**PCIMDES5**	**PCIMDEN5**		**PCEXEMS5**	**PCEXEMN5**		
sign. F	0.0151	0.237		0.0631	0.1509		
Mean Non-Signatories	46.75	74.41		43.78	67.86		
Mean Signatories	68.84	82.31		57.31	78.18		
Homog. of Variances	yes	yes		yes	y		
N	24	24		24	24		

Variable	**IMGEAR**	**IMGEAR**		**STDOENGR**	**STDOENGR**		**STDOI**
sign. F	0.6831	0.0175		0.0353	0.2551		0
Mean Non-Signatories	3.30	3.04		2.87	3.23		
Mean Signatories	3.54	4.14		3.78	3.79		
Homog. of Variances	yes	no		yes	no		
N	8	8		8	8		

Variable	**GDPCAP88**	**GDPCAP88**		**COPRSU**	**COPRNO**		**RECOM**
sign. F	0.0061	0.0000		0.0439	0.0298		0
Mean Non-Signatories	3973	3544		1.05	0.44		
Mean Signatories	8872	11160		0.20	0.04		
Homog. of Variances	yes	yes		no	no		
N	24	24		24	24		

Table 3 (cont.)

	SO2 Protocol	NOx Declaration		SO2 Protocol	NOx Declaration
Variable	**PRCOTEAR**	**PRCOTEAR**		**TRCOTEAR**	**TRCOTEAR**
sign. F	0.5533	0.0034		0.4844	0.0667
Mean Non-Signatories	0.53	0.44		1.87	1.68
Mean Signatories	0.72	1.00		2.66	3.50
Homog. of Variances	yes	no		yes	yes
N	8	8		8	8