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Why countries support international environmental agreements: The regulation of acid rain in Europe

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Why Countries Support International Environmental Agreements: The Regulation of Acid Rain in Europe

by

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List of Acronyms

AEL	Anti-Environmental Lobby
AEP	Anti-Environmental Party
BAT	Best Available Technology
CEC	Commission of the European Community
CIS	Commonwealth of Independent States (partial successor to the former Soviet Union)
CSCE	Conference for Security and Cooperation in Europe
DDR	(former) German Democratic Republic (same as GDR)
DM	Deutsche Mark (German Mark)
EC	European Community
ECE	Economic Commission for Europe (of the United Nations; same as UNECE)
EFTA	European Free Trade Association
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
FRG	Federal Republic of Germany (includes the territory of the former GDR since 03 October 1990)
GDP	Gross Domestic Product
GDR	(former) German Democratic Republic (same as DDR)
GNP	Gross National Product
HC	hydrocarbons
HES	High Environmental Standards of the Pro-Environmental Party (PEP)
IIASA	International Institute for Applied Systems Analysis
kt	Kilotons (1,000 t)
LCP	Large Combustion Plant (Directive of the European Community)
LES	Low Environmental Standards of the Anti-Environmental Party (AEP)
LRTAP	Long-Range Transboundary Air Pollution
ML	Maximum Likelihood (estimation)
N	Nitrogen or Norway (whatever seems to be more appropriate in the context)
NMP	Net Material Product
NOx	Nitrogen Oxides
O_3	Ozone

OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PEL	Pro-Environmental Lobby
PEP	Pro-Environmental Party
PRE	Proportional Reduction in Error
S	Sulfur
SO_2	Sulfur Dioxide
SU	(former) Soviet Union
t	Ton
TAP	Transboundary Air Pollution
UNECE	United Nations Economic Commission for Europe (same as ECE)
USD	United States Dollar
USSR	Union of Soviet Socialist Republics
VOC	Volatile Organic Compound
WLS	Weighted Least Squares

1. The Study of International Environmental Agreements and International Environmental Politics

> *States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own sources pursuant to their own policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states beyond the limits of national jurisdiction.*
>
> Principle 21
> United Nations Conference on the Human Environment
> (Stockholm, 1972)

Perfectly legitimate domestic activities, such as energy production, the provision of transport services, and harvesting of tropical rainforests, result in adverse environmental effects across borders or, in some cases, they even have unwanted ecological effects world-wide. Since international environmental effects are international externalities, i.e., the adverse effects are not solely borne by the polluting country, welfare is redistributed *internationally* - to the advantage of the "aggressor" country and to the detriment of the "victim" country (Björkbom 1988). Because countries find this modern infringement on their sovereignty objectionable, increasing attention has been paid to international environmental diplomacy and the study of international environmental politics. As a consequence of (unwanted) ecological interdependence, national governments, international non-governmental organizations, international governmental organizations, and, in part, industry peak associations alike call for international regulations to reduce environmental degradation. While international environmental agreements have become more prevalent in international politics, not much is known about why countries (i) sign these agreements *and* (ii) why they are willing to allocate substantial resources to the implementation of these treaties. This study hopes to contribute, both theoretically and empirically, to the study of the determinants of support for these international environmental agreements which make *substantial* progress towards enhancing the sustainability of ecosystems.

In the following section, I will provide a brief overview of the emergence of the sub-field of international environmental politics as part of international relations (Section 1.2.). I will then discuss the various approaches taken in international relations to explain the domestic sources of foreign policy. Furthermore, I will outline a *conceptual* model which describes the relationship

between domestic factors and international environmental regulations (Section 1.3.). In the concluding section, I will provide my reasons for choosing transboundary acidification in Europe for the empirical analysis, and this will be followed by an overview of the study (Section 1.4.).

1.1. The Emergence of International Environmental Politics as a Sub-Discipline

Strict international environmental regulation hardly enjoys universal support. This was manifested at the 1972 UN Conference on the Human Environment which is the starting point for the modern study of international environmental regulation (Caldwell 1990). The recent 20th anniversary meeting, the United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro, showed that the old North - South divide, still holds: "Northern" (or industrialized) countries wish to reduce the environmental hazards that they have created as a by-product of industrialization, whereas "Southern" (or less developed) countries wish to prioritize socio-economic development. Springer summarized the positions taken at the 1972 Stockholm Conference as follows:

> The debate at Stockholm centered on the apparent conflict between the still controversial concept of 'permanent sovereignty over natural resources', of such importance to delegates from developing countries, and the responsibility of states to prevent extraterritorial damage, a principle that environmentalists saw as fundamental to any global problem to combat pollution (Springer 1988, 50).

Because countries *continue to violate* Principle 21, adopted at the Stockholm Conference (United Nations Organization 1972, see page 1 of this chapter), the world has ironically become *ecologically* interdependent, i.e., countries deprive each other of environmental quality.[1] While interdependence has positive connotations in the issue-area of international trade because of the potential for the creation of wealth via factor specialization, economies of scale, and the resulting benefits from (voluntary) international trade, this does not hold for ecological interdependence. Consequently, the *study of international environmental policy* is also the study of the failed "nationalization" (or internalization) of otherwise domestic environmental problems.[2] However, to varying degrees, this is also true of the study of international (military) security and international economic relations: International Relations predominantly focuses on the differential growth and re-allocation of welfare among states by way of (i) military force (or the threat thereof), (ii) international rules for trade and money (which have domestic repercussions,

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1 The concept of "interdependence" will be reviewed in detail in Chapter 2.

2 Similarly, "the theory of technological externalities is essentially the foundation of environmental economics" (Lafont 1989, 112).

see Ryan 1992), and (iii) transboundary or world-wide degradation of the quality of ecosystems which are under national jurisdiction.[3] Thus, the emerging field of international environmental politics shares the major defining characteristic, namely the reallocation or differential growth of welfare among countries, with the dominant subfields of the international relations discipline.

Three broader strands of writing have emerged on international environmental politics over the past three decades, namely those concerned with

- the "environmental catastrophe approach",
- the Grotian perspective on international agreements, and the
- domestic sources of international regulations.

Each of these schools will be summarized below.

First, the "environmental catastrophe approach" tries to alert various audiences, in particular the mass public and decision-makers, of the environmental threats which have been overlooked in the past (Brown 1992; Mathews 1991).[4] This warning function is undoubtedly crucial to changing the public agenda (Meadows et al. 1974). The multitude of environmental problems and their interrelatedness is illustrated by way of pending or actual catastrophes. Limitations on knowledge and grossly simplifying modeling assumptions characterize the dilemma of these advocacy approaches (Cole 1974). Either the option of *radical* political-environmental change is called for, or a long list of changes in current policy is suggested. With the noted exception of "Limits to Growth" (Meadows et al. 1974), no consistent positive theory of the "malaise écologique" is presented, and normative proclamations or rich descriptions guide this politically influential literature.

Second, in response to the internationalization of environmental problems (the violation of Principle 21, see above), many nongovernmental organizations (NGOs) and international lawyers began to call for various forms of internationally coordinated responses to the degradation of the international environment. In the Grotian tradition of international relations (Jacobson 1984, 22; Lijphart 1974, 50), international environmental treaties are suggested as a remedy to the global eco-crisis (Springer 1988; World Commission on Environment and Development 1987). Various reform plans are suggested to make the United Nations Organization (UNO) more responsive to pressing international environmental problems (Kimball 1992). Moreover, several writers stress the role of international regimes in regulating the international environment (Keohane forthcoming; Young 1989a; Young 1989b). Because they stress international norms, institutional bargaining, and various forms of leadership, the writers

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3 The continent of Antarctica is a special case, since a series of countries serve as its trustees.

4 The papers of the Worldwatch Institute, Washington D.C., fall largely into this category.

in the Grotian tradition provide a more coherent perspective on international environmental regulation than that which is provided in the environmental catastrophe approach. Grotian theories are only successful in explaining relatively weak institutional arrangements, such as the Vienna Convention for the Protection of the Stratospheric Ozone Layer, the principles endorsed at the 1972 Stockholm Conference on the Human Environment, or the 1979 Convention on Long-Range Transboundary Air Pollution (see Chapter 4). All of these international agreements could, in theory, lead to *substantial* improvements of the state of the environment. However, these agreements often purposefully eschew substantial resource commitments at the same time. Could these theories explain the lack of agreement at the 1992 UN Conference on Environment and Development (UNCED) on specific North-South resource transfers? Doubts abound. If substantive resource transfers - which regularly split the international community of states - are at issue, Grotian perspectives show rather weak explanatory performance. A major reason for this result may be the neglect of a differentiated model of *country-specific* incentives for cooperation. This neglect points to the domestic factors of state action which constrain (or push) national governments in international relations. Since Grotian perspectives often, but not always, suggest a system-level explanation, domestic policies cannot be easily integrated in their models (see below).

As a consequence, a third tier of thought - which cuts across the major traditions in international relations theory - has begun to *re*-emphasize the domestic sources of international politics in general. Unfortunately, in the field of environmental politics, domestic theories have been developed with a focus on domestic regulation. In particular, major emphasis is placed on the role of overall wealth and indigenous pollution abatement technology (Jänicke et al. 1988; Prittwitz 1990a) (see Chapter 2), and the domestic-international link is not specific in these theories.

The more general discussion in the field of international relations on the domestic-international link echoes the German turn of the century debate of the "Primat der Außenpolitik" perspective (primacy of foreign policy, attributed to Leopold von Ranke) versus the "Primat der Innenpolitik" perspective (primacy of domestic policy, attributed to Wilhelm Dilthey; Behrens/Noak 1984, 98).[5] In the USA, the discussion on the "domestic sources of foreign policy" (Rosenau 1967) started roughly a quarter century ago (see also Almond 1989). However, its effect has been dwarfed by the emergence of neo-realism (Waltz 1979). Nevertheless, most recent reflections on the state of the art of international relations theory suggest incorporating domestic factors into explanations of international phenomena (Ferguson/Mansbach 1991; Hermann 1990;

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5 In modern parlance, this dispute reflects the tension between the "second image reversed" perspective (Gourevitch 1978) and the domestic sources of foreign policy (second image perspective) (Rosenau 1967).

Mastanduno et al. 1989). These domestic sources will be reviewed further in Section 1.2. In Section 1.3., a conceptual model of international environmental regulation will be introduced, which accounts for a country's willingness to subscribe to international environmental regulations in terms of domestic and international factors. In the concluding section, I will present the rationale for the selection of transboundary acidification for the test of the conceptual model; this section also offers an overview of the study (Section 1.4.).

1.2. Review of the Role of Domestic Factors in Theories of International Relations

Realists, neo-realists, and neo-liberal institutionslists have dominated the theoretical discussion in international relations during the past two decades.[6] All three strands of theory have been largely oriented to the problem of international security and international economic policies. I will review the varying emphasis which has been placed on domestic sources of foreign policy below.

First, classical realists, such as Morgenthau, emphasize the role of power in international relations. Countries are the major unit of analysis and may be conceived of as aggregates of the so-called "elements of national power", such as natural resources, industrial capacity, and military preparedness (Morgenthau/Thompson 1985, 115-183). In their international relations, nations act as competitors for wealth and power in an international system which is characterized by the absence of an international authority. According to this view of foreign policy, decision-makers in a country can rely on a pool of resources for the pursuit of their foreign policy. As Mastanduno et al. describe this aspect of classical realism,

> the state must draw upon the society and economy or material resources and political support. ... The classical Realists tell us that the state's external power position cannot be divorced from the internal situation and capabilities. The statesman must be an astute diplomat, but he must also be an able student of domestic politics (Mastanduno et al. 1989, 460).

Second, in structural realism, most forcefully advanced by Waltz, the national-international linkage is clearly lost: "It is not possible to understand world politics simply by looking inside of states" (Waltz 1979, 65). According to Waltz, only systemic, as opposed to "reductionist" theories (the latter operating at the individual or national level), provide conclusive

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[6] I do not review the theories of Marx, Lenin, or the dependency school of international relations, since they do not seem to be appropriate for the analysis of international environmental policy.

guidance in explaining international politics (ibid.). Power and wealth matter in this systemic perspective.

Economists, whose theories Waltz emulates, would be irritated if they had to explain the power and wealth of a country without looking at the factor inputs (physical and human capital, incl. the state of technology). For a modern, industrialized country, wealth is the result of aggregate savings or retained profits (the ultimate sources of physical capital) and various forms of human capital (incl. education and the state of technology). The conquest of foreign territories for the exploitation of natural resources (imperialism) has become a less common practice as compared to the 16th through 19th century (Rosecrance 1986). Although powerful countries still have substantial control over the international rules guiding international economic relations or security relations (Keohane/Nye 1989), this influence is, in the long run, positively associated with a country's relative *economic* size.[7] In turn, economic power (on which military strength will have to rest in the long run) is dependent on physical and human capital. For example, the rise of Japan and the Federal Republic of Germany as regional powers cannot be explained by a system-level theory (Organski/Kugler 1980). In addition, the end of the "traditional" form of the late 20th century East-West competition between the USA and the Soviet Union (and their associated alliance partners) is difficult to explain without changes at the unit level, i.e., changes of loyalty by elites and mass publics alike. Whereas Waltz derives parsimonious optimality conditions for a given configuration of the international system, namely stable bipolarity, "reductionist" approaches have a clear comparative advantage in explaining systemic change.[8]

Third, in response to the over-emphasized cooperation problem of countries in a competitive international system, neo-liberal institutionalists have stressed the role which institutional factors, such as international regimes, play in international society (Keohane 1984; Keohane/Nye 1989; Krasner 1983; Young 1989a; Young 1989b). While the international regimes literature represents an alternative rationale for explaining systemic outcomes, it is, first, difficult to derive specific deductions from this body of theory. Second, neo-liberal institutionalists also lack a domestic explanation of international outcomes. The first point may be illustrated by a look at a major recent research effort on international regime formation. Young and his

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7 At first glance, the outcome of the Vietnam War may point to the opposite conclusion. However, the former North Vietnam could never envision to have any major influence on international economic relations, the modern source of wealth. Current attempts by Vietnam to re-establish US-Vietnamese trade relations support this assertion.

8 In essence, Waltz has no theory of system change, since he postulates the stability of bipolarity. Although he outlines the transition of the leadership position held by various countries (from the Ottoman Empire in the 18th century to the preponderant position of the USA in the 20th century) (Waltz 1979, 162), there is no explanation why this succession has happened. The theory of systemic stability is therefore incomplete. See Gilpin for a neo-realist model of differential growth to explain change in international leadership (Gilpin 1981).

collaborators outline a series of power-based, interest-based, knowledge-based, and contextual factors to explain (Arctic) regime formation (Young/Osherenko forthcoming). Each of these four groups (with multiple, specific sub-hypotheses) suggests a particular focus on the role of power, characteristics of bargaining, epistemic communities, and random noise (for contextual factors). However, there is no deductive (or a priori) theory which determines the relative merits of the factors involved in regime creation, although a post hoc model is provided (ibid.).[9] In the positivist tradition, a more parsimonious model would be called for.

In addition, substantial doubts have emerged on the usefulness of the international regimes approach. As Haggard and Simmons conclude,

> little research has addressed whether, and in what ways, regimes 'matter'. Do regimes have independent influence on state behavior and, if so, how? (Haggard/Simmons 1987, 492).

The emerging research on *regime effectiveness* may shed more light on this aspect (Hanf 1991; Jacobson/Weiss 1990; Kay/Jacobson 1983; Wettestad/Andresen 1991) and allow a more stringent test of the validity of the international regime concept.

Regarding the second caveat, neo-liberal institutionalists, like their neo-realist "counterparts', have a major "blind spot": They do *not* "pay sufficient attention to domestic politics" (Keohane 1989, 173). As a consequence of omitting domestic variables, too much explanatory power is conferred on international regimes. To illustrate this point, one may look at the availability of indigenous abatement technology in the field of international environmental politics and the impact which technology has on a country's position in international negotiations. The presence of abatement technology in one country will always provide an incentive to pursue environmental regulation domestically, even if environmental leadership results in an indiscernible (sic!) disadvantage in international trade (Leonard 1988; Murrell/Ryterman 1991; Tobey 1990). Consequently, it is unclear if long-term, cross-national variation of pollution reductions can be sufficiently explained by international regime theory alone. If international regimes, as institutions, do not provide substantial resource transfers for compliance, reluctant (and often poor) states may not be interested in signing strict environmental regulations. A test including regime and non-regime variables would provide a comprehensive evaluation of regime effects.

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9 From a research design perspective, it is clear that the inflation of the number of predictors should lead to a better fit of the model (uncorrected multiple coefficient of determination), whereas a more parsimonious theory would "keep [the model] simple" by emphasizing crucial variables while expecting a lower explanatory power as compared to the former research strategy.

In conclusion, traditional forms of realism, neo-realism, and neo-liberal institutionalism have developed various systemic theories of international relations, however, none of these traditions seems to be able to link important domestic factors to international outcomes. In the following section, recent developments in this field will be reviewed, and I will present a conceptual model for the domestic and international sources of international environmental policy.

1.3. A Conceptual Model of International Environmental Regulation

As discussed above, international environmental politics deals with the fundamental question of the international distribution of entitlements to environmental quality. By way of pollution transport, countries reduce the quality of life in other countries. Up to now, I have assumed that international environmental problems form a homogenous category. Following Mäler, I suggest a distinction between

- *unilateral* externalities (such as an up-stream/down-stream pollution pattern),
- *regional, reciprocal* externalities (such as transboundary acidification in Europe), and
- *global* externalities (such as global warming) (Mäler 1990, 82).[10]

Regardless of the type of pollution pattern, the recipient of pollution is unlikely to accept this infringement on its sovereignty and the degradation of its environment. In order to better understand this response mechanism, I will briefly present the motives underlying national preferences for specific foreign policies, and suggest a framework for the analysis of the regulation of the international environment.

A series of articles in the contemporary debate on theory building in international relations clearly points to a need to provide national-international linkages (Bueno De Mesquita et al. 1991; Ferguson/Mansbach 1991; Haggard/Simmons 1987; Hermann 1990; Mastanduno et al. 1989; Morgan/Campbell 1991; Morrow 1991; Papadakis/Starr 1987; Rosenau 1980). This diverse set of authors shares the basic assumption that

> [i]t is ... evident that the realization of international objectives depends meaningfully on domestic politics and economics (Mastanduno et al. 1989, 458)

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10 Mäler also concludes that, from an analytical standpoint, regional reciprocal externalities resemble the problems of global externalities as long as there are many polluters and many victims of pollution. Therefore, the study of a well-known regional environmental problem may provide guidance for the emerging study of the international relations component of global environmental problems (Mäler 1990).

as well as that

> those who create governmental foreign policy depend for their continuance on the support of certain constituencies ... whose endorsement and compliance are necessary to legitimate and sustain the regime (Hermann 1990, 6-7).

Many of these authors focused on the influence exerted by domestic factors *on* single decision-makers or on decision-making units (Hermann 1990; Mastanduno et al. 1989; Papadakis/Starr 1987). Other authors emphasized the effects of domestic institutions on international phenomena, such as international war (Morgan/Campbell 1991), or on concessions in international arms control negotiations (Morrow 1991). Because a rather large number of domestic factors can be involved in the shaping of foreign policy (Rosenau 1980, 388), I wish to sharply limit the focus to domestic factors relevant to the study of international *environmental* regulation. In particular, previous research on domestic and international environmental regulation has emphasized the role of

- environmental damages and the perception thereof,
- societal actors in the form of interest groups (such as environmental groups, green or ecological parties, and industry associations), and
- resources at the disposal of countries (such as wealth and technology) (see Chapter 2).

Given these factors which constrain their decisions, national governments wish to maximize utility, and, if other factors are held constant, national governments maximize the degree of environmental quality (in their own country). In practice, this amounts to balancing competing goals, namely environmental protection and non-environmental goals.

In my view, governments pursue environmental quality goals for two reasons. First, environmental quality is *scarce*. This is the consequence of polluting activities by domestic polluters and the (often) involuntary "import" of foreign pollution (see Mäler's typology of pollution patterns presented above).[11] Second, (most) domestic constituencies can force a government to pursue the goal of environmental protection (subject to a budget constraint, such as tax revenue), because voters can effectively replace governments (in the heterogeneous set of Western democracies) or de-legitimize any government (regardless of the type of government).

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11 If environmental quality were not scarce (i.e., abundant and free of charge), economists and politicians alike would not be very interested in national or international environmental politics.

The first aspect, namely the domestic versus international sources of pollution emissions, defines the type of inquiry.[12] It is always assumed that pollution reduces the level of environmental quality (and thereby lowers the level of utility). In this study of international environmental regulation, I will place emphasis on cases where transboundary (or global) environmental effects are of substantial magnitude.

Regarding the second aspect, i.e., governmental responsiveness to environmental problems, it is plausible to assume that pollution imports generate a societal demand for policies to protect the quality of the environment (societal pressure).[13] In turn, this makes the second assumption of a societal demand for *international* environmental protection plausible.[14]

In combination, both international infringements on environmental quality and societal demands for regulation constrain governmental decision-makers. In essence, I suggest that governments do not have "autonomy" in their policies, or, at least, not a substantial amount: Environmental protection is demand-driven.[15]

The line of argument presented here suggests a model of country-level preferences for international environmental regulation. Furthermore, it seems plausible to assume that a high willingness of a country to accede to international environmental regulation is a necessary condition for the implementation of strict environmental policies (see Figure 1.1).

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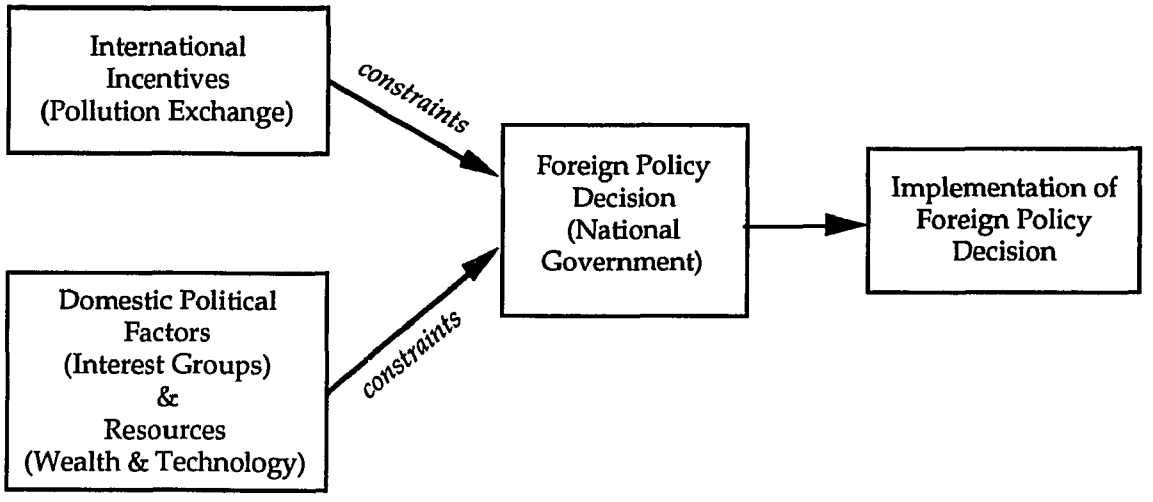
12 I use the term "pollution" as a shorthand for any type of environmental degradation.

13 Given current state practice, it is reasonable to assume that pollution "exporters" do not compensate pollution "importers" (victims).

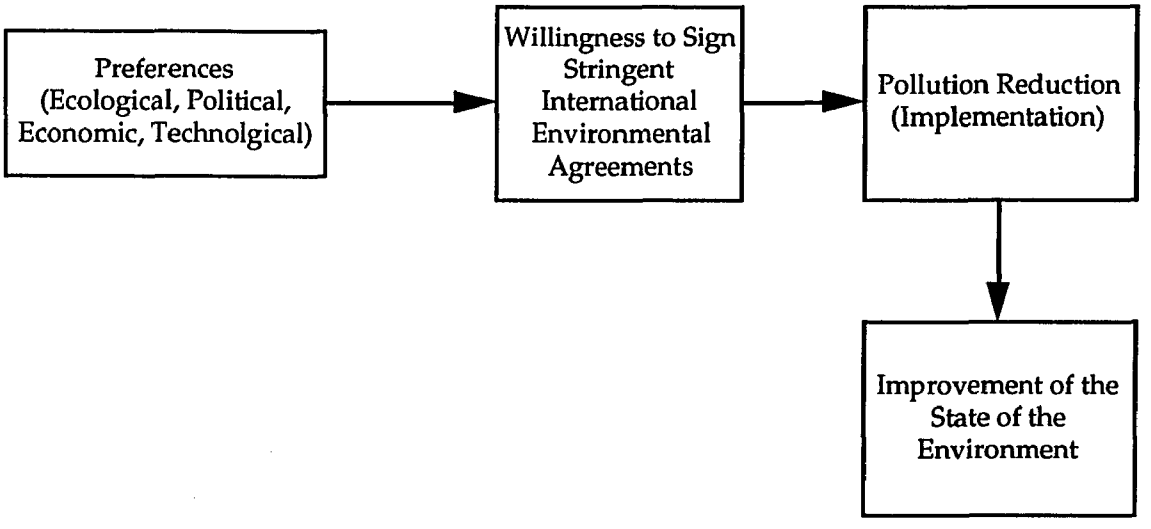
14 As outlined above, domestic environmental problems are not considered in this study. However, the political-economic modules of this study are straightforwardly applicable to a purely domestic environmental problem.

15 See Magee et al. for a similar argument on the domestic sources of US tariff policies (Magee et al. 1989). I am indebted to Gerald Schneider for referring me to this study.

Figure 1.1: A Conceptual Model of Support for International Environmental Regulation



The Cycle of International Environmental Regulation



The set of assumptions employed in the study and the components of the model displayed in Figure 1.1 have been, in part, derived from several strands of foreign policy analysis. First, the writing of Harold and Margaret Sprout suggests that environmental factors play an

important role for foreign policy decision-makers (Sprout/Sprout 1969).[16] Their combination of "environmental possibilism", "environmental probabilism", and "cognitive behaviorism" provides a set of constraints on foreign policy decision-makers. Second, in developing a conceptual model for the explanation of the outbreak of war, Starr has combined environmental probabilism and possibilism so as to create the dimension of "opportunities" or *constraints* which a decision-maker faces from various levels of analysis (Papadakis/Starr 1987; Starr 1978).[17] In addition, I have simplified foreign policy decision-making models proposed by Hermann (1990) as well as by Papadakis and Starr (1987) by assuming that the decision-making *process* itself is not essential as the support which the majority of domestic constituents lends to governmental positions (see above). However, the triad of (i) primary agents of change, (ii) position of the government, and (iii) policy consequences have been included in the study, although the analytical emphasis has been shifted away from the decision-making unit.

Overall, the simple model of constrained governmental decision-making on foreign policy corresponds to a simplified cycle of international environmental regulation: (i) articulation of policy preferences (the constraints), (ii) policy decision (or the willingness to sign strict environmental regulations), and (iii) implementation (Hanf 1991). This last phase should, at least in theory, lead to a measurable improvement in the quality of the environment. Ultimately, the improvements in environmental indicators (such as a reduction of the sulfur and nitrogen deposition per square kilometer) determine the degree of "success" of environmental policies. In an ideal research environment, students of foreign policy should study the consequences of foreign policy! An example from a related field may illustrate the point.

In the domain of international trade agreements, the Tokyo Round resulted in a reduction of tariffs and a code for non-tariff barriers. However, even more important than the agreement and the study of negotiations (Sebenius 1991) is their impact on world-wide trade patterns, sectoral restructuring in some countries, and international specialization in production. In political terms, sectoral industry peak associations will take the effects of international trade agreements on their industry into account when lobbying the national government. Focusing on *diplomatic* success, i.e., the conclusion of the agreement itself, unduly constrains the explanation of changes in industry performance and political lobbying. The same should hold for international security and international environmental agreements: The study of international agreements

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16 The Sprouts may not necessarily conceive of environment in the "ecosystem" sense as the term is used in this study.

17 The dimension of "willingness", introduced by Starr (1978) to reflect the choices involved in decision-making, has been excluded from the study, because I conceptualize government preferences as a result of domestic preferences. This may be a reasonable assumption for the analysis of international economic policy and environmental policy, but it me be less so for the analysis of international military security.

overshadows the explanation of the consequences of militarized dispute behavior or alternative states of environmental quality.

In summary, much of the study of international cooperation (Axelrod 1984; Keohane 1984; Oye 1986) has focused on an *intermediate* step, namely the arrangements that lead to anticipated consequences. However, socially beneficial results can be brought about by side-payments regardless of the distribution of the right to pollute (Coase 1960). Results-oriented foreign policy is not precluded in the sphere of international economic relations or international environmental relations.[18] If countries prefer strong pollution abatement, they may not wait for international agreements so as to avoid the distortion of trade patterns. Pressure exerted by domestic constituents may simplify international cooperation, although the motives of domestic constituencies vary across countries. In conclusion, desired social outcomes are not necessarily at the whim of a cooperation problem, although lack of cooperation may result in sub-optimal levels of the provision of desired (public) goods.

1.4. Case Selection and Overview of the Study

In order to test the implications of the model outlined above, ideally a series of cases should be selected so as to assess the extent to which societal and pollution-related factors account for governmental willingness to sign international environmental agreements. In turn, it should also be demonstrated that these agreements lead to *substantial* environmental improvements. Furthermore, the cases selected should guide future research on the ways of avoiding adverse effects created by the extended greenhouse warming effect, the major global environmental problem which politicians have to tackle. As Mäler has suggested, *regional, reciprocal* externalities with *many* victims and *many* polluters resemble the problems involved in the regulation of global environmental problems (Mäler 1990).

Given these criteria, the case of transboundary acidification in Europe was chosen for several reasons. First, twenty-four major emitting countries are involved in reciprocal, although asymmetrical pollution exchange. This leads to differential pollution-based interests across countries. Furthermore, an international regulatory system exists with five agreements as well as one voluntary informal (but well-known) agreement. Two of these six agreements were reached for reasons of their *substantive* rather than marginal beneficial effects on the state of the

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18 This does not mean that injured parties wish to be burdened with the victim-pays-principle. Insisting on the polluter-pays-principle (PPP) is essentially the hope to get 'something for free.' However, relying solely on the PPP may attest to a low time preference for environmental quality.

environment. This also implies (as the analyses in Chapters 5 through 7 will show in more detail) that compliant countries will normally have to dedicate substantial resources towards honoring their international commitments. Various sub-groups of countries have acceded to these two agreements, and countries can not easily cheat because of the adequate, scientific monitoring activities within the international pollution regime.

Second, the 24 European countries included in the analysis[19] vary considerably in the following dimensions of

- type of political system,
- attention placed on environmental quality,
- level of economic wealth, and
- technological capacity.

Third, although I will not be able to study the actual abatement of transboundary air pollution, I will still be able to capture the resolve of countries by studying the accession of countries to these international environmental agreements. The reason for this procedure lies in the fact that the deadlines for implementing these agreements have not yet been reached. However, there are compelling reasons to assume that countries will eventually comply with the provisions of the international environmental agreements.[20]

This study of the international regulation of transboundary air pollution in Europe is based on a general model of international environmental regulation for reciprocal, regional externalities. While it takes account of international pollution patterns, it also emphasizes the domestic sources of international environmental regulation by including important societal factors as well as economic wealth and the state of technology. In essence, a comparative static model is used for the explanation of environmental consequences of international regulation.

In Chapter 2, I will review the relevant literature on environmental regulation in more detail so as to derive the building blocks of the public choice models to be developed in Chapter 3. In Chapter 4, a summary of the diplomatic history of the international regime of transboundary air pollution is presented in order to provide the background for the empirical analyses to follow.

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19 The (former) SU and the (former) Yugoslavia were treated as (unified) countries which reflects their territorial and political status during the 1980s.

20 In addition, data sources on the actual impact of pollution do not yet allow an intertemporal comparison of the state of the environment. This is a major problem for establishing the link between the international policies undertaken and their consequences, since policies are likely to have impacts only several decades after their implementation. Therefore, simulation analysis is often indispensable for policy consulting.

The international pollution component and its effects on the willingness of a country to subscribe to international environmental regulation will be tested in Chapter 5. Furthermore, the societal influences as well as the effect of resources and technology on international regulation will be tested with mass public attitude and elite attitude data for a subset of the European countries (Chapter 6). In order to assess the generality of the results presented in Chapter 6, I will test the impact of some key variables, namely ecological vulnerability and resources, on international environmental regulation with the help of objective data rather than perceptions of decision-makers (Chapter 7). In the concluding chapter, the empirical tests are reviewed from a theoretical perspective, a few implications for practitioners in international public policy are discussed, and suggestions are made for future research on international environmental regulation (Chapter 8).

2. In Search of Appropriate Theory: Perspectives on International Environmental Regulation

International environmental problems, such as the enhanced "greenhouse effect" or transboundary air pollution, 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. However, substantive (rather than declaratory) international environmental agreements do rarely enjoy universal support. The purpose of this chapter is to review the literature on my major research question: Why are some countries supportive of international environmental regulations and why do other countries avoid these resource commitments?

First, I will review the "policy debate" on a specific international environmental agreement (Section 2.1.); second, I review a broader set of *general* theories which help explain differential support for international environmental regulation (Section 2.2.); finally, I conclude with a summary (Section 2.3.).

2.1. Why Regulate the International Environment? - The Policy Debate

The theoretical debate on international environmental regulation can be divided into two main branches of analysis: (i) a policy debate with in-depth studies of a particular policy problem and (ii) more general theories which seek to provide explanations across cases and, in part, beyond the realm of international environmental regulation. In this section, I will focus on the policy debate, whereas the more general theories are reviewed in Section 2.2. A brief review of the *policy literature* pertaining to the special environmental agreements considered in greater length in Chapters 4 though 7, namely the regulation of transboundary air pollution in Europe, may illustrate the limitations of this literature.[1]

In order to limit the adverse effects of transboundary acidification on forests, aquatic ecosystems, and human health, European (and North American) governments had created an international environmental regime by the late 1970s. While the 1979 Convention on Long-range Transboundary Air Pollution (LRTAP),[2] an umbrella convention for the regulation of various air

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1 Section 2.1. is partially based on (Sprinz/Vaahtoranta forthcoming, 4-6).

2 The LRTAP Convention (UNECE 1979) serves as an umbrella convention for the international regime on the regulation of transboundary acidification ("acid rain") in the member states of the United Nations Economic Commission for Europe (UNECE). The USA and Canada are members of the UNECE as are *all* European countries.

pollutants with transboundary impacts, has received considerable attention in the literature (Jackson 1990; Prittwitz 1984; Rosencranz 1988; Wetstone/Rosencranz 1983), relatively few publications have *predominantly* focused on the origins and consequences of the 1985 Helsinki (or Sulfur) Protocol. This is surprising, since the Helsinki Protocol is the first *substantive* agreement among a subset of signatories of the LRTAP Convention and mandates signatories to the Protocol to reduce sulfur emissions or their transboundary fluxes by at least 30% by 1993 (compared to 1980). Even more remarkable is the absence of a substantive literature on the regulation of nitrogen oxides (NO_X) within the LRTAP regime, namely the NO_X Protocol and the NO_X Declaration (see Chapter 4). Since NO_X emissions are associated with many industrial processes and contribute to the enhanced (human-made) greenhouse heating effect, the regulation of NO_X could contribute an understanding of the problems involved in arriving at international regulations of global climate change. Given the limitations of the literature, I have to restrict my review to the case of the Helsinki (or Sulfur) Protocol.

In general, three tiers of literature related to the Helsinki Protocol can be distinguished:

(i) historical and legal perspectives,
(ii) description of emission control policies of specific countries, and
(iii) policy assessment of support for the Helsinki Protocol.

First, historical and legal assessments of the Helsinki Protocol stress the origin of the LRTAP Convention in (i) the Conference on Security and Cooperation in Europe (CSCE) and the Brezhnev initiative to hold specialized, international conferences on energy, transport and environmental protection in the wake of détente as well as (ii) Scandinavian and Canadian preferences for an agreement to reduce transboundary air pollutants. While Chossudovsky (1989), and Jackson (1990) present historical accounts of the diplomatic process leading to the LRTAP Convention and the Helsinki Protocol, Lang stresses the substantive provisions of the Protocol as well as the division lines regarding accession to the agreement (Lang 1989, 29-31).

The second type of literature in the policy tradition focuses on the emission control policies for sulfur and nitrogen oxides. The two volumes edited by Rhode (1988), as well as the studies by Weidner (1986; 1987), Boehmer-Christiansen/Skea (1991), and Wetstone/Rosencranz (1983) summarize and assess the following factors for various countries:

- institutional setting of air pollution control (e.g., legal regulation and its history, monitoring, and enforcement),
- damage caused by air pollutants to humans, ecosystems, and materials,
- technological capacity to reduce the emission of air pollutants,
- national decision making on emission policies, and the

- impact of national environmental policies on foreign countries.

While these studies contribute *country-specific* information needed for comparative assessments of air pollution policies, they normally lack a parsimonious (and explicit) normative, theoretical, or empirical framework.[3]

A third type of literature sheds light more narrowly on the factors which explain why some countries support the Sulfur Protocol and why other countries abstained from it. In his article on "international policy responses" to transboundary air pollution in Europe, Sand stressed the impact which geographical location, the adverse effects of the deposition of air pollutants on lakes and forests, joint research, and related national and international regulations played during the 1980s (Sand 1987). However, Sand fell short of an explanatory theory for the variance found among countries in support of the Helsinki Protocol. Conversely, Rosencranz chose to explain why Poland, the U.K., and the USA declined to sign the Helsinki Protocol for economic, meteorological, scientific, or political reasons (Rosencranz 1988). Although Levy offers the most detailed factual account of the reasons why various prominent countries joined or did not join the Helsinki Protocol, he does not put forward a systematic explanation of state behavior towards international environmental regulation (Levy forthcoming).

The studies reviewed above contribute only *partial*, ad hoc explanations of support for the Sulfur Protocol, and, more generally, for the study of international environmental regulation. In my study, historical and legal considerations will be of little importance, since they do not provide theoretical guidance and do not necessarily the stress substantive (environmental) implications of international agreements. However, they offer important background knowledge in terms of diplomatic history (see Chapter 4). The emission policies of countries and the effect of the emissions on other countries will form the core of the pollution-based explanation of international environmental regulation (see Section 2.2.2.), whereas technological aspects of regulation will be reviewed in detail below (Section 2.2.3.4.). Furthermore, the determinants of support for international environmental regulation forms the core research question for this study. Rather than eclectically stressing various explanations, I will review and integrate various strands of theory and assess their merits in an empirical, cross-national analysis (see below). Since a systematic explanation of state support for international environmental regulation is lacking from these policy studies, I will review the broader theories of international politics and comparative politics.

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3 The study by Boehmer-Christiansen/Skea (1991) serves as a noted exception.

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

2.2.1. Overview

International environmental regulation can be understood as the consequence of international and domestic factors which operate on different levels of analysis.

In terms of the strategy of inquiry, I consistently locate theories of international relations and their empirical tests at the unit- or country-level. In particular, I will shed light on the question of whether pollution exchange shapes a country's preferences for international regulation. Thus, I will build on the vulnerability dimension of the "complex interdependence approach" (Keohane/Nye 1989) and the "foreign environmental policy" ("Umweltaußenpolitik") approach (Prittwitz 1984). As in the neorealist and neo-institutionalist traditions, both approaches emphasize the interests which countries hold.[4]

In addition to international factors, I will introduce the domestic factors of international environmental regulation. I will pay attention to (i) individual-level factors, such as environmental attitudes, and (ii) societal factors, like elite perspectives on environmental regulation, as well as (iii) the role which abatement costs and technology play.

2.2.2. International Factors: Interdependence, Foreign Environmental Policy Approach, and Ecological Vulnerability

In "Power and Interdependence", Keohane and Nye develop an opposite ideal type to the neo-realist paradigm, namely the concept of "complex interdependence" (Keohane/Nye 1989). For them, "interdependence refers to situations characterized by reciprocal effects among countries or among actors in different countries" (ibid., 8). Transboundary pollution is an example of such a situation with reciprocal effects. However, "[i]t is *asymmetries* in dependence [in the degree of pollution exchange, for example, D.Sp.] that are most likely to provide sources of influence for actors in their dealing with one another" (ibid., 10-11). Since they perceive "power" as "the ability of an actor to get others to do something they otherwise would not do" (ibid., 11), Keohane and Nye distinguish between sensitivity and vulnerability interdependence: They define

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[4] Rather than thinking of countries as aggregate actors, I will refine the analysis of Prittwitz and disaggregate the interests held by various actors within a country (see below and Chapter 3).

> sensitivity ... [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 [its] 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 cost 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*, I will gain first order predictions of state behavior towards international environmental regulation: The most vulnerable countries will pursue policies of stringent environmental regulation.

Building on "complex interdependence", Prittwitz developed his "foreign *environmental* policy approach". Defined as "all the activities of a nation state or another representative body directed towards one or more foreign actors which are designed to pursue environmental goals" (Prittwitz 1990b, 6), this approach assumes (i) existence of a common (ecological) 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 (see below); it 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 in reducing 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 interest 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).[5]

In his analysis,

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5 The nuclear power industry is an example of a substitution industry for fossil fuel power plants (the latter emitting acidifying pollutants). However, the nuclear power industry generates a different type of waste which has long-term environmental, as well as political consequences.

> [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, 121-127). 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 is helpful to understand how pollution interests are linked to a country's position with respect to international environmental regulation. As in structural theories which emphasize issue-specific power over outcomes, the foreign environmental policy approach offers a simplified set of expectations regarding a state's preferences for international environmental regulation. While it fails to provide a method for aggregation of so-called "national" interests,[6] this approach points to the domestic sources of international regulation in general and to the interests of "third parties" in particular. I will pursue this latter aspect further below (see Section 2.2.3.).

Several independent syntheses of the complex interdependence approach and the foreign environmental policy approach have been developed during recent years. First, Sætevik has developed a scheme which relates state preferences for the regulation of an (international) common property resource to policy outcomes (Sætevik 1988); second, in a similar effort, Sprinz and Vaahtoranta have derived an interest-based explanation for a country's position during negotiations on international environmental regulations (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 parsimonious ways to predict a country's behavior in 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 each country's ecological vulnerability as well as its asymmetry in pollution exchange (or the pollution trade *balance*). In turn, these preferences of states, in conjunction with a (i) state's ability to promote its own preferences as well as (ii) institutional constraints, are assumed to explain policy outcomes,

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6 The aggregation of interests is postulated by Prittwitz, but he fails to provide an aggregation mechanism or a systematic test of the propositions.

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 concludes that her model yields good "postdictive" (as opposed to predictive) 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 research effort to integrate the propositions of the interdependence approach and the foreign environmental policy approach was undertaken by Sprinz and Vaahtoranta in comparing determinants of state behavior towards regulation of international air pollution (Sprinz/Vaahtoranta forthcoming). They suggest a classificatory scheme

> by *comparing* countries across the dimensions of (i) damage caused by pollution, i.e., the [ecological] vulnerability dimension, and (ii) abatement costs, i.e., the economic constraints imposed on states. ... By 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.; emphasis in the original) (see Figure 2.1).

Figure 2.1: Classification of National Support for International Environmental Regulation

		Ecological Vulnerability	
		Low	High
Abatement Costs	Low	Bystanders	Pushers
	High	Draggers	Intermediates

source: Sprinz/Vaahtoranta (forthcoming)

They hypothesized that "pushers" are more willing to engage in international environmental regulation than "intermediates" or "bystanders"; in turn, members of the latter two groups are more likely to be in favor of international regulation than "draggers" are. Comparing the regulation of the stratospheric ozone layer (the Montreal Protocol) with transboundary

acidification in Europe (e.g., the Helsinki or Sulfur Protocol), they found substantial support for their classification scheme in both cases. In particular, this holds for the postdiction of positions taken by countries during international negotiations, and their study suggested that a combination of low abatement costs and high ecological vulnerability ("pushers") increases a country's propensity to sign international environmental agreements.[7] However, they agreed 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 the international pollution structure approach suggest a set of hypotheses about the *international* sources of environmental regulation. Furthermore, I will pay particular attention to the domestic sources of international environmental regulation in the next section.

2.2.3. Domestic Sources 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 on environmental protection, domestic sources are likely to account for a substantial proportion of the variance in willingness of a country to agree to costly international regulation. Particularly, domestic factors may, in the extreme, account for a variety of state behavior not easily predicted by a 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. They may sign such a treaty because of the nominal costs involved. In conclusion, I expect that 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 focus on the role which economic and technological factors play in environmental regulation.

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[7] 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).

2.2.3.1. The Impact of Postmaterialism

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; 1990a; 1991). However, since this theory has largely been studied with 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 rise of environmental attitudes among the mass public in industrialized countries; this, in turn, had lead mass publics to demand policies in line with their preferences for environmental quality (see below). Postmaterialists are more likely than materialists to (i) be supporters and members of the environmental movement and (ii) engage in protest behavior. Second, the rise of postmaterialism had lead to the creation of green or ecological parties which stress environmental regulation. These factors may play an important role in determining national positions in international environmental negotiations.

In particular, environmental concern is represented by the aesthetic dimension of postmaterialism, although it failed to polarize on the postmaterialist/materialist dimension 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, this association is rather weak (Inglehart 1990a, 383).

Furthermore, it has been established that 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 - had lead to support for green or ecological parties which were founded, in reaction, during the 1980s (Müller-Rommel 1989). While Inglehart found that postmaterialists are consistently more supportive of these New Politics parties than materialists were, most postmaterialists still support traditional left parties. As a consequence of this rising postmaterialism, *traditional* left parties, which used to respond to materialist (redistributive) demands, had been challenged by green parties.

For this analysis, I expect postmaterialism to be positively associated with the (i) growth of the environmental movement and (ii) emergence of green or ecological parties. In turn, I expect countries with high shares of postmaterialists, on the level of mass publics and elites, to be willing to spend scarce resources on international environmental regulation.

2.2.3.2. Exposure to Pollutants, Environmental Concern, and Environmental Action

Several models have been developed to explain a *person's* willingness to spend resources on environmental goals. Particular attention has been placed on the following factors

- exposure to pollutants or the role of self-interest,
- environmental concern or the sociotrophic dimension (see below), and
- environmental action.

Early research showed that if an individual is personally exposed to environmental degradation, then s/he is likely to show general concern for the environment in the national and international context. However, the reverse does not necessarily hold (Hagstotz/Kösters 1986, 349). In addition, Weigel and Weigel found that environmental concern is related to various forms of environmental action, such as signing of petitions, litter pick-up, and recycling (Weigel/Weigel 1978, 11). Other research points to the relevance which socioeconomic status plays with respect to membership in environmental groups (Buttel/Flinn 1978; Tucker 1978).

The second generation of research on the determinants of environmental action simultaneously estimated these components of environmental concern. Four studies may help to clarify the debate on the determinants of environmental action. First, Rohrschneider (1988) and Sprinz (1990a) had estimated close to identical models which explained environmental action as resulting from (i) exposure to environmental hazards (the self-interest dimension), (ii) postmaterialism, (iii) high socioeconomic status, and (iv) concern for the quality of the environment on the national and international level (the sociotrophic dimension). While all four components contribute substantially to an explanation of environmental action, it has to be noted that self-interest has only an indirect effect on environmental action via the environmental concern dimension. Substantial differences exist across countries regarding the relative contribution of these factors (Sprinz 1990a).

In a related study, Rohrschneider found that favorable evaluations of environmental groups as well as group membership were best explained by a sociotrophic model as well as postmaterialism, while the self-interest component seemed to play a very minor role (Rohrschneider 1990, 17). These findings are corroborated by an analysis undertaken by Holzhauer (1991).

However, the last two studies may have estimated misspecified models, since Rohrschneider also concludes that

> [t]he most systematic predictor of the national perception of pollution problems (the sociotrophic dimension, D. Sp.) is the experience with pollution problems in the personal environment of individuals. If respondents perceive such problems,

> they become sensitized to national pollution issues, which, in turn, influence popular support for environmental organizations (Rohrschneider 1990, 23).

Therefore, a hierarchical model which allows for the indirect effect of self-interest on environmental action by way of the sociotrophic component may be a more appropriate model (Sprinz 1990a).

In conclusion, I find that environmental attitudes are often associated with postmaterialism. In combination, both factors have contributed to the rise of the new social movements and their parliamentary representation by green parties. While exposure to environmental hazards is not directly associated with environmental action, it should indirectly be related via its effects on the sociotrophic dimension. For the research on international environmental regulation, I conclude that

- postmaterialism,
- environmental concern of the general public (the sociotrophic dimension),
- support for the ecology movement, and
- voting for green or ecological parties.

are positively related to a national government's willingness to subscribe to international environmental regulations.

2.2.3.3. Elites and the Environment

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.

In the previous section, I found postmaterialism to be a major indicator of the political cleavages which guide mass public attitudes on the environment. 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 1990a, 141-142). Furthermore, a broader study by Milbrath systematically shed light on elite (and mass public) attitudes on the environment in three advanced, industrial societies (Milbrath 1984).

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

- perceived condition of the environment is a large (vs. small) problem,
- basic change in society (vs. better technology) is needed to solve environmental problems, and
- there are (vs. are no) limits to growth.

Milbrath found 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) gravitated 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 urgency to environmental problems than public officials, business leaders, and labor leaders (ibid., 84). Furthermore, mass publics and environmentalist leaders perceived government actions in dealing with environmental problems to be inadequate (ibid., 86). Consequently, environmentalist leaders and mass publics were sooner 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 are (ibid., 91). However, substantial majorities of all elite groups and the mass public agreed that *considerable* change is necessary to solve environmental problems (ibid., 125).

In conclusion, the sparse research on elite environmental attitudes shows that, for the most part, environmentalist leaders are close to or lead the mass public on environmental questions, whereas public officials, business leaders, and labor leaders are closer to the rearguard on environmental attitudes. Since elite studies on environmental issues are largely missing in the literature, I will draw on the theories reviewed in this chapter for my own elite survey.

2.2.3.4. Economic and Technological Capacity

In reviewing the literature on pollution-based explanations of international regulation, I have already pointed to economic and technological sources of national and international regulation. Even *without* facing severe environmental destruction, actors with sufficient resources at hand will be able to undertake environmental policies. This is supposed to hold at the individual level, especially for postmaterialists, as well as countries at large (Prittwitz 1990a, 112, 236). In addition, the presence of abatement technology (i.e., end-of-pipe and process control technologies) or integrated technologies (which avoid or reduce pollution by modifying production processes) may allow countries to adopt policies which lead to substantial improvements of their environmental quality (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 systematically tested this hypothesis. In their work on the ecological dimension on industrial change, Jänicke and Mönch stressed that a combination of *ecological problem pressure* and *the level of wealth* serve as the two most powerful postdictors of effective pollution abatement ("wirksame Umweltschutzanstrengungen") in industrialized countries (Jänicke/Mönch 1988, 2). Wealthy countries may be the most polluting countries, however, they possess better technological, material, and institutional capabilities to protect the environment (Jänicke 1990, 222).

Of specific relevance to this study, Jänicke and Mönch show for the sulfur dioxide (SO_2) emissions of *industrialized* countries[8] that relatively poor countries had increased their per-capita emissions between 1970 and 1985. During the same period, wealthy countries had reduced their per-capita emissions (Jänicke/Mönch 1988, 7). However, this did not hold across pollutants. For example, the emissions of nitrogen oxides (NO_X) increased for all countries during the period 1970-1985, although the *rate* of increase seemed to decline with rising levels of per-capita wealth (ibid., 8). The difference in the emission trends in this crossnational and crosstemporal analysis can be easily explained by changes in the industry structure due to the recession of the 1970s and early 1980s as well as by successful implementation of end-of-pipe technologies for SO_2; for NO_X, I expect increases as the consequences of increased levels of individual mobility, particularly among late developers.

In my view, particular attention must be placed on the dimensions of economic wealth and technological access. In accounting for the ability of a country to implement substantive environmental policies, both dimensions are necessary, but not sufficient, factors. While Prittwitz locates these factors at the core of his "capacity hypothesis" (Prittwitz 1990a), Vaahtoranta demonstrates that technological innovations, in conjunction with new evidence of adverse ecological effects of CFCs on the stratospheric ozone layer, made the radical restrictions on the emissions of chlorofluorocarbons (CFCs) possible (Vaahtoranta 1990). Furthermore, the study by Sprinz and Vaahtoranta shows that low *relative* abatement costs are strongly and positively associated with signing the Sulfur Protocol among the member countries of the United Nations Economic Commission for Europe (UNECE) (Sprinz/Vaahtoranta forthcoming).

In conclusion, I find that overall wealth of resources, both materially as well as technologically, should be associated with ambitious environmental policies.

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8 The study by Jänicke and Mönch largely focused on member countries of the Organization for Economic Coordination and Development (OECD) as well as members of the former Council for Mutual Economic Assistance (CMEA) (Jänicke/Mönch 1988).

2.3. Conclusions

In the beginning of this Section, I posed the question: Why are countries willing to allocate scarce resources to international environmental protection? The policy-oriented literature provided a series of ad hoc explanations (Section 2.1.). On various levels of analysis, a broad range of general 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 (Section 2.2.).

Among the international factors, theories of complex interdependence and the foreign policy approach offered pollution-based explanations of anticipated state behavior. In addition, other theories offer a first approximation of state behavior on the basis of ecological vulnerability and abatement costs and thereby provide a domestic-international link for the explanation of national support for international regulation.

Among the domestic factors, the theory of postmaterialism offers an explanation of value change in industrialized countries. Given the shift from the Old Politics of (re-) distribution to the New Politics of self-fulfillment (which are based on material security), postmaterialism has been related to the rise of environmental attitudes as well as support for the ecology movement. I expect this to hold for mass public attitudes and for elites. However, while attitudes might be supportive of environmental policies, economic resources and technological capacity are what makes them practically feasible. Therefore, I expect wealthy countries with indigenous abatement technologies to undertake more ambitious emission reduction programs than less wealthy countries would.

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 chapter, I will integrate the theories reviewed here (Chapter 3), and this will be followed by an in-depth introduction to the specific regulations on transboundary air pollution (Chapter 4).

3. Public Choice Models of International Environmental Regulation

The results to date are strong enough to sustain the plausibility of the hypotheses that (a) candidates spend money to win votes, and (b) contributors give money to obtain more preferred political outcomes.

Dennis C. Mueller

A striking implication of the assumption that parties maximize votes is that they exert no independent influence over policy. To do so would lower their probability of election. Thus the powerless politician effect: endogenous policies are outside of policymaker control.

Stephen P. Magee, William Brock, and Leslie Young

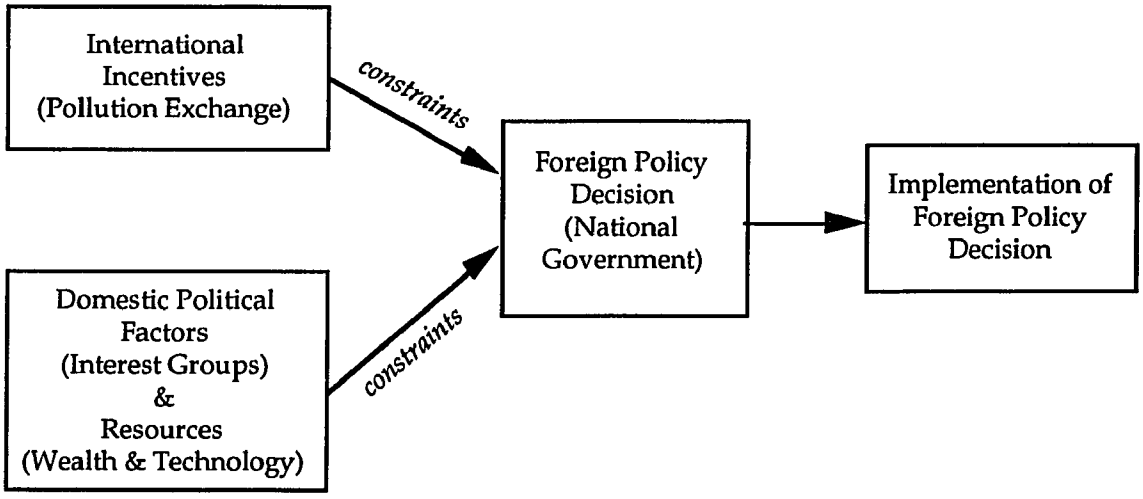
In the opening chapter, I outlined the major purpose of this study: I wish to explain why countries sign or reject international environmental agreements. The "causes" which are supposed to generate this behavior were reviewed in the previous chapter. Therefore, the purpose of this chapter is to provide a mechanism which relates the "causes" to the effects. Public choice and environmental economics offer helpful tools which allow me to integrate the factors involved in explaining a country's willingness to participate in international environmental regulation.

In the following, I will provide a simplified synthesis of the basic flow of argument which will guide the remainder of the study (Section 3.1.). Afterwards I will demonstrate that international environmental protection represents an international public goods problem, i.e., the rationale underlying the sub-optimal provision of environmental quality will be outlined (Section 3.2.). In Section 3.3., I will (i) use a modified analysis of environmental externality to show how macro factors, such as environmental damages, economic and technological wealth, account for a country's "optimal international environmental agreement" (Section 3.3.1.), and show how (ii) domestic constituents can be incorporated in an endogenous policy model for the explanation of a country's preferred degree of international environmental regulation (Section 3.3.2.). In the concluding section, I will summarize the findings from these social choice models (Section 3.4.).

3.1. A Brief Synthesis of the Literature on International Environmental Regulation

The literature reviewed in Chapter 2 provided an overview of the roles which international pollution transport and political-economic factors play in determining a country's preferences for international environmental regulation. In particular, I focused on the hypothesized impact of (i) the international pollution exchange pattern and (ii) ecological vulnerability on a country's willingness to sign international environmental agreements. Furthermore, various interest groups as well as economic and technological factors were emphasized. In the following, I will present a brief descriptive rationale of the expected preferences of a country depending on its pollution configuration as well the domestic factors involved (see Figure 3.1; derived from Figure 1.1).

Figure 3.1: A Conceptual Model of Support for International Environmental Regulation



The sources of environmental degradation may be of domestic and/or international origin. Therefore, a simple matrix may help to define the scope of international environmental regulation as opposed to the study of domestic regulation. By assuming a simple "problem pressure model" (which is a derivative of the stimuli-response mechanism), I suggest the direction of the behavioral response (ibid.) (see Figure 3.2).

Figure 3.2: Origin and Destination of Pollutants

		Dominant Origin of Pollution	
		Country A	Country B
Dominant Recipient of Pollution	Country A	1. *domestic* env. problem in Country A	2. *international* env. problem ("A internalizes" [victim], A puts pressure on B)
	Country B	3. *international* env. problem ("A externalizes" [aggressor], B puts pressure on A)	4. *external* (foreign) env. problem for A

For clarity of presentation, let me assume that the world consists of two countries, namely Country A and Country B.[1] From the perspective of Country A, purely *domestic* environmental regulation is called for if A essentially pollutes itself (Quadrant 1). However, if A receives most of its pollution from abroad, this country "internalizes" an international environmental problem, i.e., A involuntarily absorbs part of the environmental problem created by Country B (Quadrant 2). It is likely that Country A would like to put pressure on Country B to reduce these detrimental, international effects. However, if Case 2 is reversed, then B is likely to put pressure on A, because Country A "externalizes" part of its emissions at the expense of Country B (Quadrant 3). In the fourth case, B pollutes itself. From the perspective of Country A, this environmental problem is of a purely external (foreign) nature and does (normally) not attract A's attention (Quadrant 4). Since this is a study of *international* environmental regulation, I will focus on the international dimension of environmental problems as represented in Quadrants 2 and 3, and leave Quadrants 1 and 4 to specialists of (comparative) domestic environmental policy analysis. However, this simple crosstabulation also suggests which country will prefer substantial reductions in foreign-based pollution. To this end, international environmental agreements are a prominent way to coordinate *national* pollution abatement programs. The alternative remedy to pollution abatement, namely international compensation schemes (Coase 1960), have received little attention to this date. In summary, global and transboundary environmental problems of sufficient magnitude will divide countries into victims

1 Country B can also be interpreted as the rest of the world from the perspective of Country A.

and aggressors. In the case of reciprocal pollution patterns (see Chapter 1), countries may simultaneously be victims and aggressors.

The review of the domestic sources of international environmental regulation emphasized the role of (i) wealth and technology and (ii) non-industrial interests, such as a concerned mass public, environmental pressure groups, and green or ecological parties, as well as (iii) industrial interests (Chapter 2). In the latter case, a distinction was made between abatement technology providers, a pro-environmental actor, and major polluters, which rarely are the strongest supporters of environmental regulation. As was the case for a substantial part of the European automotive industry in the mid-1980s, major polluting industries can be vigorous opponents of state-of-the-art environmental regulation. How will these domestic interests translate into governmental positions on international environmental regulation? I will present two models which (i) relate wealth and technology (Section 3.3.1.) and (ii) the various interest groups (Section 3.3.2.) to international environmental regulation.

Before I introduce the public choice models of the various international and domestic sources of international environmental regulation, I suggest a theoretical rational for the study of international environmental agreements: The protection of the international environment may be conceptualized as an "*international* public good".[2]

3.2. The Protection of the International Environmental as an International Public Good

As I have suggested in Chapter 1, international pollution exchange is an international externality if countries (as unitary actors) are chosen as the unit of analysis. In general, an externality is defined as

> the consumption or production activity of one individual or firm has an *unintended* impact on the utility or production function of another individual or firm (Mueller 1989, 25, emphasis in the original).

Exporters of pollution are allowed a "free ride" to the extent that they are not forced to bear the costs of abatement for the damages they create abroad. However, it is not always possible for the victim of pollution to offset imported pollution by reductions of its own

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[2] Kindleberger used the term "international public good" in his presidential address to the American Economic Association in 1985 (Kindleberger 1986). However, a formal derivation of the properties is missing from his analysis. The standard solution suggested for the provision of international public goods, namely international hegemony (Keohane 1984), seems not to be applicable to international environmental problems.

emissions.[3] This is particularly true if major exporters of pollution "donate" pollutants to minor polluting countries. Since pollution emissions are, in the short run, strictly covarying with the level of output of major industrial sectors, smaller recipient countries may simply not be able to compensate major exporters for abating their emissions because of the asymmetry in the size of the economies. Applied to the case of transboundary air pollution, it seems rather difficult for Norway or Sweden to compensate the utility sector of the U.K. for abating sulfur emissions. Although the Coase theorem (Coase 1960), in one of its variants, states that

> the initial allocation of legal entitlements does not matter from an efficiency perspective so long as they can be freely exchanged (Cooter 1989, 64),

it is not necessarily applicable to countries: Firms can cease to exist, but countries (normally) do not![4] As a consequence of internationally not enforceable pollution (property) rights - such as the "polluter pays principle" - the victims are likely to bear the ecological burden, or they compensate the pollution exporter. Consequently, ensuring a high quality of the international environment is equivalent to the public good problem: Too little international environmental protection is likely to prevail.

This result may be shown by treating countries as utility maximizers. In particular, governments are agents of their societies for the provision of environmental and non-environmental goods. Because environmental quality is partially dependent on the pollution policies of foreign countries, the quality of the *international* environment can be described as an *international* public good, i.e., it is characterized by jointness (or non-rivalness) of supply and the impossibility to exclude a country from the consumption of the good (Mueller 1989, 11; Russett/Sullivan 1971, 846).[5,6] To illustrate the meaning of international environmental problems as an international public good, one might think of the examples of the preservation of biodiversity or the deforestation of tropical rainforests: Once the rate of decline of biodiversity is

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3 This phenomenon could also be interpreted as "vulnerability" to the emission policies of other countries (see Chapter 2).

4 The extension of the jurisdiction of the laws of the Federal Republic of Germany to the territory of the former German Democratic Republic is a rather unusual (voluntary) event.

5 For the original work on (pure domestic) public goods, see the theoretical framework developed by Samuelson (1954; 1955). Instead of the term "non-rivalness of *supply*", I would prefer the label "non-rivalness in *consumption*", since every production of a good or service with scarce inputs has opportunity costs.

6 The reader might ask why I did not choose the "tragedy of the commons" as a point of departure for the public goods problem (Hardin 1968). The "tragedy of the commons" is the result of the overutilization of a public good because of the lack of property rights. Since I wish to explain international efforts to save the international environment rather than to explain its destruction, I chose the traditional public goods approach as originally outlined by Samuelson (1954; 1955).

reduced, every person can (theoretically) enjoy the remaining variety of flora and fauna. Conversely, if the rate of disappearing tropical rainforests is offset by new forest growth, every member of the "global village" will be able to enjoy the prospects of the (partially) avoided extended greenhouse heating effect.

For the purpose of this study, I only focus on *international* public goods and *international* private goods. While the former has been described above, *international private goods* refer to commodities or services where there is (i) rivalness in consumption between nationals and non-nationals and (ii) non-nationals can be effectively excluded from consumption. Examples of international private goods include education, public infrastructure, physical and social security, voting rights, etc.[7,8] To simplify the presentation to follow, I assume that the protection of the international environment is the *only* (pure) public good which a government (or a society) attends to, and all other goods are treated as *one* non-environmental, (pure) private good.

Let U_i represent the utility function of country i, and let E and NE_i represent the amount of environmental goods and non-environmental goods.[9] Each country i is supposed to maximize its level of utility (3.1).[10]

$$U_i = U_i(E, NE_i) \rightarrow \max! \quad (i = 1, \ldots, n) \tag{3.1}$$

While each country independently determines its output of private goods NE_i, the contributions of each country i for the public good E are added across all n countries, i.e., the public good E is for all to enjoy (such as the protection of a rare animal; see (3.2)).

$$E = E_1 + E_2 + \ldots + E_n, \quad (i = 1, \ldots, n) \tag{3.2}$$

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7 I use the terms "public" and "private" goods as "ideal types" (Max Weber) for reasons of analytical clarity (Samuelson 1954). Buchanan has developed a theory of "club goods" which allows for various degrees of privateness and publicness of goods where exclusion can be achieved at reasonable costs (Buchanan 1965).

8 It is helpful to distinguish between (i) private vs. public goods (see above) and (ii) private vs. public *provision* of goods. Education is both a private good (marginal rate of productivity) as well as a public good (civic culture). It can be supplied by privately and publicly owned schools.

9 Social welfare functions, such as the utility function for a country used in this example, have received considerable attention in economics after World War II. In particular, the Bergson-Samuelson social welfare function assumes cardinality and interpersonal comparability, whereas Arrow shows the impossibility of the aggregation of individual ordinal utility under a certain set of assumptions (Mueller 1989, 373-407). For the purpose of this study, I assume that countries are unitary actors and resemble individuals in standard (individual) welfare economics. Furthermore, I assume that social welfare functions exist and are well behaving, i.e., they are monotonically declining (decreasing rate of the marginal rate of substitution among goods) and convex to the origin.

10 The presentation to follow is derived from Mueller (1989, 17-19). The original derivation of the results can be found in Samuelson (1954; 1955).

Given the absence of knowledge of the provision of the public good by other countries, i has to decide to allocate its resources Y (budget constraint in a single period model) between environmental and non-environmental goods; p_e and p_{ne} represent the prices of environmental and non-environmental goods; E and NE continue to represent the quantities of the environmental and non-environmental goods respectively. The optimization of (3.1) is therefore subject to the budget constraint of (3.3) which can be inserted as a Lagrangian multiplier λ in (3.4).

$$Y_i = p_e E_i + p_{ne} NE_i, \quad \text{or} \quad Y_i - p_e E_i - p_{ne} NE_i = 0, \tag{3.3}$$

$$U_i = U_i(E, NE_i) + \lambda_i(Y_i - p_e E_i - p_{ne} NE_i) \rightarrow \max! \tag{3.4}$$

Taking the partial derivatives of U_i with respect to E and NE_i yields the Cournot/Nash equilibrium for country i (3.5): The marginal rate of substitution between these goods is identical to the relationship among the prices for both commodities.

$$\frac{\partial U_i / \partial E}{\partial U_i / \partial NE_i} = \frac{p_e}{p_{ne}} \tag{3.5}$$

However, this result is *not* Pareto optimal, because too small a contribution will be made to the provision of the public good (E). To demonstrate this, I assume the existence of an (international) social welfare function W which aggregates individual countries utility functions U_i, with δ_i reflecting each country's weight in the (international) welfare function W (3.6). If E and NE_i can be chosen so as to maximize W, a Pareto-optimal allocation is found.

$$W = \delta_1 U_1 + \delta_2 U_2 + \ldots + \delta_n U_n, \quad \text{for all } \delta_i > 0, \quad (i = 1, \ldots, n) \tag{3.6}$$

As is the case for a single country (see above), W is subject to an international budget constraint

$$\sum_{i=1}^{n} Y_i = p_e E + p_{ne} \sum_{i=1}^{n} NE_i. \tag{3.7}$$

The maximization problem can be expressed as a constrained maximization procedure with the Lagrangian multiplier. After taking the partial derivatives with respect to E and NE_i and rearranging terms, one arrives at the Pareto optimality condition in the presence of a public good (3.8):

$$\sum_{i=1}^{n} \frac{\partial U_i / \partial E}{\partial U_i / \partial NE_i} = \frac{p_e}{p_{ne}}. \tag{3.8}$$

The comparison of (3.8) with (3.5) shows that

$$\frac{\partial U_i / \partial E}{\partial U_i / \partial NE_i} = \frac{p_e}{p_{ne}} - \sum_{j \neq i} \frac{\partial U_j / \partial E}{\partial U_j / \partial NE_j}. \qquad (3.9)$$

If both goods E and NE are normal goods in each person's utility functions (i.e., the expressions in the numerator and in the denominator of (3.10) are *each* larger than zero), then it follows that

$$\sum_{j \neq i} \frac{\partial U_j / \partial E}{\partial U_j / \partial NE_j} > 0. \qquad (3.10)$$

However, this amounts to the marginal rate of substitution between environmental and non-environmental goods for country i in (3.9) to be less than the marginal rate of substitution for i in (3.5): In the Pareto-optimal solution, the relative price of the (international) environmental public good is cheaper than in the Cournot/Nash equilibrium. As a consequence of not achieving a Pareto-optimal solution, countries will provide too little international environmental quality because it is an international public good.[11] As a consequence, international environmental agreements can improve the level of the provision of the public good beyond the level of unit-level maximization (3.5); thereby, international agreements may bring the community of countries *closer* to the Pareto frontier (3.8).[12]

From the previous discussion it can be concluded that countries provide international environmental goods at least at the level of the Cournot/Nash solution for their *own* benefit. However, international agreements can provide even higher levels of international environmental protection. While the previous analysis has indicated abstractly that there will be some provision of the public good in the case of perfect continuous supply (such as air pollution abatement), it should be specified which factors actually account for efforts to improve environmental quality. I will turn to this question below by presenting two simple endogenous policy models.

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11 For non-privileged groups, Olson comes to the same result (Olson 1971).

12 Analytically, this argument is equivalent to the rationale for free international trade: Given factor endowments and production patterns, countries cannot be worse off by trading commodities internationally as compared with a closed economy.

3.3. Endogenous Environmental Policy Models

In this section, I will present two models which provide indications about the *stringency* of the international environmental agreements demanded by a country. In the first model, I will treat the degradation of the environment as an externality problem and investigate how macro factors, such as environmental damages, wealth, and technology will affect the level of abatement (Section 3.3.1.). In addition, I will present an endogenous policy model based on voter preferences, lobbying activities of interest groups, and political parties which seek electoral support (Section 3.3.2.).

3.3.1. An Externality Model of Preferences for International Environmental Regulation

Contemporary environmental economics concentrates on optimal taxing schemes for environmental regulation (Baumol/Oates 1988; Pearce/Turner 1990), the *absence* of adverse effects of regulation on international trade patterns (Murrell/Ryterman 1991; Tobey 1990), and institutional aspects (Wicke 1989). However, to the best of my knowledge, there hardly exists any study on a rather pressing topic: Which factors explain the variation of preferences for international environmental regulation found *across* countries? Building on the political economy literature reviewed in Chapter 2, I suggest that environmental damages, economic wealth, and access to indigenous abatement technology are positively associated with a country's preference for strict international environmental regulation. The remainder of this section will demonstrate how these predictions follow from a standard set of assumptions.

As I have mentioned further above, international pollution can be conceptualized as an international externality. In general, two approaches can be taken towards the analysis of (international) environmental externalities. First, environmental degradation can be treated as a negative externality which needs to be *avoided* (precautionary principle). Second, abatement policies to correct for actual degradation of the environment can be conceptualized as an activity to reduce an *existing* externality. However, both approaches yield the same level of so-called "optimal pollution" (Pearce/Turner 1990, 70-83) which is the intersection of the marginal costs for abatement and the marginal benefits stemming from continuing (uncompensated) pollution (see below). In the analysis to follow, I will take the existence of environmental degradation (or externality) as given.[13] Since the problem of the provision of (international) public goods is the

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13 For a global environmental problem, such as global warming, the first approach should be taken in accordance with the precautionary principle. However, given perfect knowledge of all parameters considered, the results are identical.

same as the determination of the optimal level of an (international) externality,[14] one should expect less than Pareto-optimal levels of abatement. This is supposed to hold, because the recipients of cleaner air normally do not compensate countries which undertake remedial action. But the Cournot/Nash level of abatement needs explanation. For this purpose, I use the basic logic of the determinants of the optimal level of pollution and apply it to the explanation of the optimal level of *environmental regulation* preferred by a country.

Let me assume for the remainder of this section that countries only focus on environmental problems, and the level of non-environmental goods is held constant (except if mentioned explicitly) (see 3.11).

$$U_i = U_i(E_i, \overline{NE_i}) \rightarrow \max! \quad (i = 1, \ldots, n) \tag{3.11}$$

As mentioned above, I also assume that international environmental damages have already occurred, i.e., resources would have to be allocated to *regain* environmental quality. The first derivative of the total costs of abatement programs are the marginal (social) cost of cleanup (MC_i), and it is reasonable to assume that the marginal costs of improving the state of the environment are monotonously increasing with the level of environmental quality regained. Conversely, the (social) marginal benefits of improving environmental quality (MB_i) are assumed to be monotonously decreasing with higher levels of environmental quality (see Figure 3.3). Alternatively, the social cost curve can be interpreted as a supply curve for international environmental regulation, and the marginal benefit curve represents a demand curve for international environmental regulation for country i. Given this interpretation, the intersection of the marginal cost curve and the marginal benefit curve yields the level of optimal international treaty preferred by a country, E_i^*, at the level of $MB_i^* = MC_i^*$ (see Figure 3.3). In case this country could persuade or compensate other countries to accept this level of regulation, the quality of the environment would improve by $\overline{0E_i^*}$, whereas $\overline{E_i^* \text{ Max}}$ would be the amount of *remaining* damages to the environment. Unlike radical ecologists, this simple model suggests that it would normally not be beneficial for any country to pursue maximum environmental quality.

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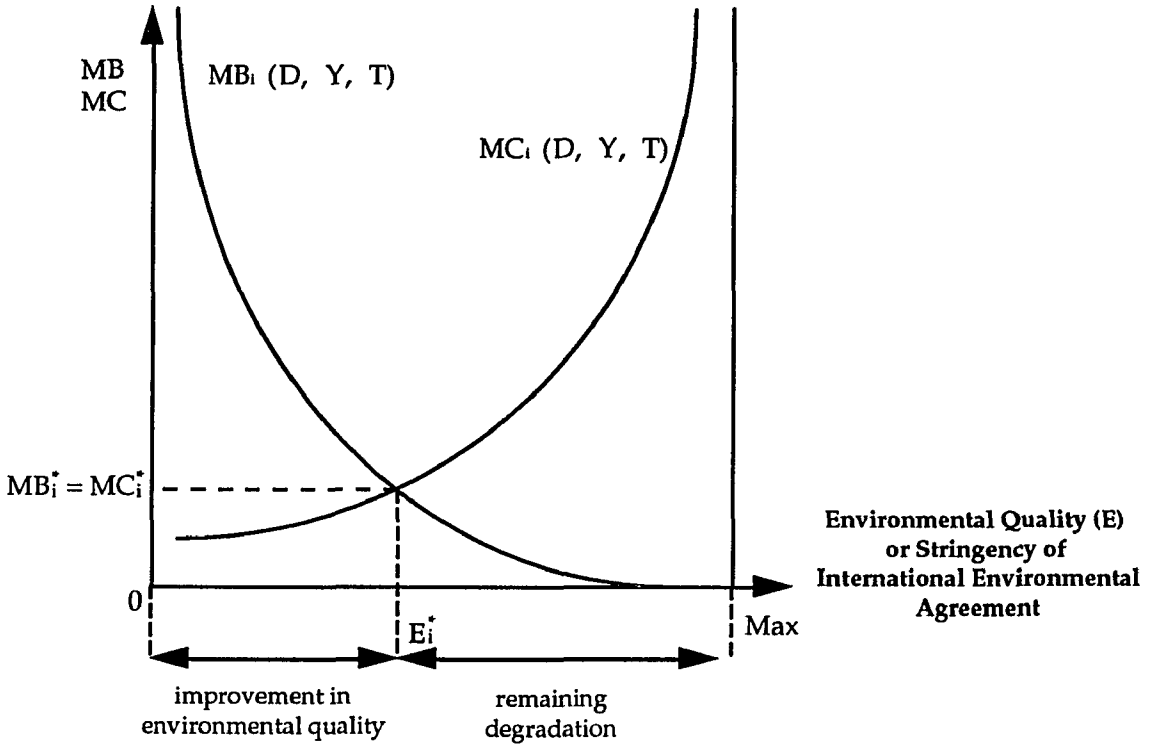
14 In a comparison of the externality and the public goods problem, Mueller demonstrates algebraically that the discrepancy between optimal solutions from the perspective of one country (Cournot/Nash equilibrium) as opposed to the Pareto-optimal conditions for all countries is the same in both cases (Mueller 1989, 25-27). The study of externalities resembles the study of public goods.

Figure 3.3: Optimal International Environmental Agreements



In order to make this analytical tool more useful for the generation of hypotheses regarding international environmental regulation, I explicitly make the specific marginal cost and marginal benefit curves dependent on the level of internationally caused damages (D), the level of economic wealth of a country (Y), and the state of technological knowledge (T).

For reasons of presentation, I assume now that MB_i and MC_i are straight lines.[15] These functions can then be written as,

$$MB_i = \alpha_1 - \beta_1 E_i, \quad \text{and} \tag{3.12}$$

$$MC_i = \alpha_2 + \beta_2 E_i. \tag{3.13}$$

Setting $MB_i = MC_i$ and rearranging terms yields the partial equilibrium solution

$$E_i^* = \frac{(\alpha_1 - \alpha_2)}{(\beta_1 + \beta_2)}, \tag{3.14}$$

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15 The subscripts attached to α or β always refer to the marginal benefit curve ("1") or refer to the marginal cost curve ("2"). Furthermore, i and j refer to countries.

with the commensurate level of

$$MB_i^* = MC_i^* = \frac{(\alpha_2\beta_1 + \alpha_1\beta_2)}{(\beta_1 + \beta_2)}. \tag{3.15}$$

For practical reasons, I furthermore assume that

$$0 \leq E_i^* \leq Max\ , \quad MB_i^* \geq 0\ , \quad MC_i^* \geq 0\ . \tag{3.16}$$

The set of equations (3.12) through (3.16) will be helpful in deriving hypotheses about the level of environmental regulation preferred by a country if the level of internationally caused damages (D), the level of wealth (Y), or the state of technology (T) changes. In addition, differences in benefit assessment, or alternatively, cross-national variation in the assessment of identical states of environmental quality can be related to preferred international environmental agreements. The analyses to follow will be comparative static comparisons of the partial equilibria generated by varying the level of *one* of these factors (D, Y, or T). The equilibrium solution E_i^* from equations (3.12) through (3.15) will serve as the reference case.

First, I focus on variations of the level of internationally caused damages. Since I hold the maximum physical units of damage constant (Max in Figure 3.3), the MB_i curve has to shift upwards since each unit of environmental quality regained becomes more valuable than before (shift from MB_{i0} to MB_{i1}, see Figure 3.4).[16] Consequently, the optimal level of international environmental regulation preferred by country i increases from E_i^* to E_{iD+}^*. Algebraically, this amounts to substituting α_1 (in 3.14) by $(\alpha_1 + \Delta\alpha_1)$, which yields the new level of preferred international environmental regulation of

$$E_{iD+}^* = \frac{((\alpha_1 + \Delta\alpha_1) - \alpha_2)}{(\beta_1 + \beta_2)}, \quad \Delta\alpha_1 > 0. \tag{3.17}$$

Since $\Delta\alpha_1 > 0$ corresponds to an increase in damages, we see by comparison of (3.14) with (3.17) that $E_{iD+}^* > E_i^*$. Other factors held constant, I expect that a country's preference for stricter international environmental standards will positively covary with the level of internationally caused damages.

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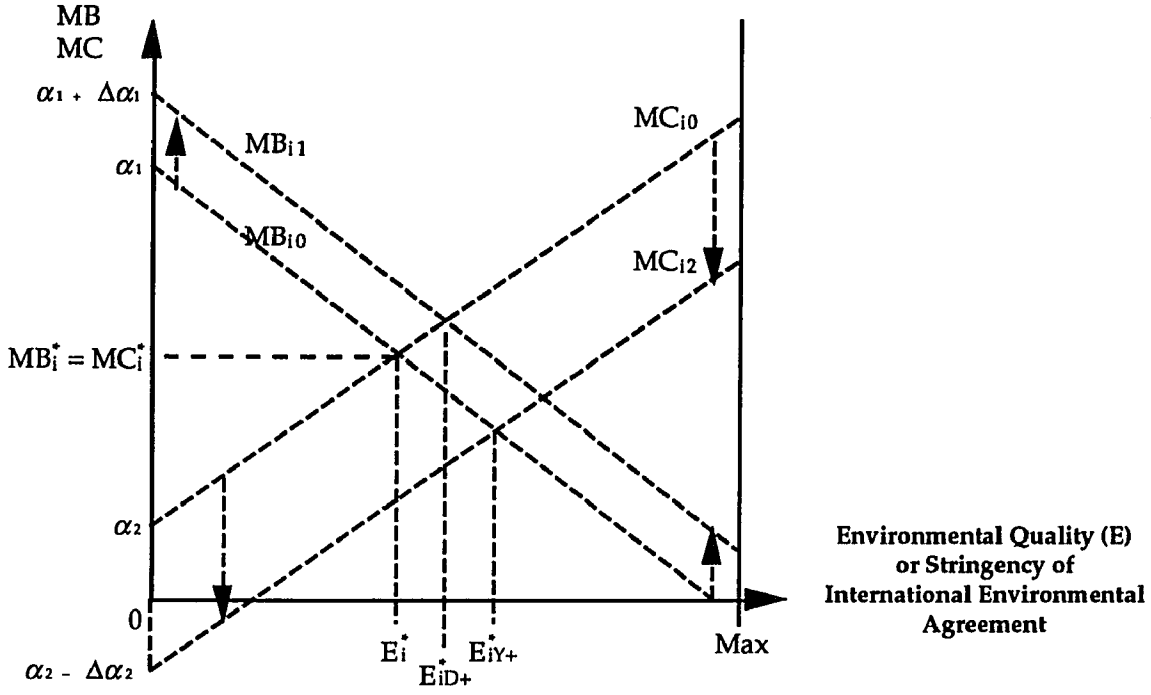
16 In other words, the degree of destruction of each physical unit of environment has become more severe. Alternatively, marginal benefit curves would have to be defined for each level of ecosystem destroyed.

Figure 3.4: The Comparative Static Analysis of Optimal International Environmental Agreements



Second, a similar analysis can be undertaken for the impact of varying levels of economic wealth (Y) on a country's demand for international environmental regulation. As in the previous case, MB_{i0}, MC_{i0}, and E_i^* serve as the reference case. Increases in the level of wealth can be conceptualized as a lump-sum grant received from a foreign country per unit of environmental quality regained.[17] Consequently, the marginal (relative) costs of achieving higher environmental quality should *decrease*. In Figure 3.4, this is reflected by a *downward* shift of MC_{i0} to MC_{i2} in the amount of $\Delta\alpha_2$. The new intersection point of MB_{i0} with MC_{i2} suggests a level of preferred international environmental regulation of E_{iY+}^* (see Figure 3.4). Algebraically, this move can be represented by a substitution of α_2 with $(\alpha_2 - \Delta\alpha_2)$ in (3.14). The new equilibrium solution will be

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17 Differences in wealth could alternatively be conceptualized as an increase in GDP (as a results of sustained, traditional economic growth). This would lead to a relative lower share of GDP to be devoted the environmental program. Unlike a lump-sum grant for a specific environmental program, a general increase in wealth should be represented by a lower slope for the marginal cost curve. The algebraic treatment of this form of an increase in economic wealth follows the presentation of a comparative static analysis of countries with different technologies (see below).

$$E^{*}_{iY+} = \frac{(\alpha_1 - (\alpha_2 - \Delta\alpha_2))}{(\beta_1 + \beta_2)}, \quad \Delta\alpha_2 > 0. \tag{3.18}$$

Since I assume $\Delta\alpha_2 > 0$, the comparison of (3.14) with (3.18) shows that $E^{*}_{iY+} > E^{*}_{i}$. This observation can be generalized to suggest that wealthier countries will prefer higher levels of international environmental regulation if all other factors are held constant.

Third, differences in the state of abatement technology can be related to preferences for international environmental regulation. Most easily, this is understood by a modification of the slope of the marginal cost curve MC_i (3.13), i.e., every unit of environmental quality can be regained at a fraction of the costs the old technology. For clarity of presentation, I assume that country i has a technology (T_{i2}) at its command which results in the specification of equation (3.20) (which is identical to (3.13) for $T_{i2} = 1$), whereas a technologically more advanced country j is capable of improving environmental quality at a fraction of the costs of country i ($T_{j2} < T_{i2}$). Technological improvements results in a lower slope coefficient for all values of the improvement of the quality of the environment (3.21):

$$MC_i = \alpha_2 - (T_{i2}\beta_2)E, \quad \text{with } T_{i2} = 1, \quad \text{and} \tag{3.20}$$

$$MC_j = \alpha_2 - (T_{j2}\beta_2)E, \quad \text{with } T_{j2} < T_{i2}. \tag{3.21}$$

Assuming that i and j share the same marginal benefit curve $(MB_i = MB_j)$ and only vary with the degree of technology, country i will prefer E^{*}_{i} (3.14), and country j will prefer E^{*}_{iT+} (3.22).

$$E^{*}_{iT+} = \frac{(\alpha_1 - \alpha_2)}{(\beta_1 + T_{j2}\beta_2)} \tag{3.22}$$

Since I assumed that country j has access to a superior technology as compared to i (i.e., $T_{j2} < 1$), I conclude that $E^{*}_{iT+} > E^{*}_{i}$. In general, this suggests that countries with superior abatement technology will seek more stringent international environmental agreements than technologically disadvantaged countries.

Fourth, differences in environmental preferences can also be incorporated in the model. Let me assume that all countries share the same level of damages, wealth, and technology. Still, some countries may hold different preferences for international environmental regulation because of differences in the marginal rate of substitution between (international) environmental public goods and (international) non-environmental private goods. For example, these difference may stem from differences in the historical patterns of political demands for international environmental regulation or a strong preference for traditional economic "development". Applied to the scheme above, I assume that country j shows a *higher* valuation (V) of

environmental quality as compared to country i. To illustrate this algebraically, the original equation for the marginal benefits for i (3.12) can be rewritten as (3.23), and since j has a larger appreciation for nature, the slope for the marginal benefits of i $(MB_i)$is flatter than for the marginal benefits curve of country j (MB_j) (compare (3.23) with (3.24)):

$$MB_i = \alpha_1 - (V_{i1}\beta_1)E_i, \quad \text{with } V_{i1} = 1, \quad \text{and} \tag{3.23}$$

$$MB_j = \alpha_1 - (V_{j1}\beta_1)E_i, \quad \text{with } V_{j1} < V_{i1}. \tag{3.24}$$

Since both i and j share the same marginal cost curve $(MC_i = MC_j)$, country i will still prefer E_i^*, whereas country j will prefer

$$E_{iV+}^* = \frac{(\alpha_1 - \alpha_2)}{(V_{j1}\beta_1 + \beta_2)}. \tag{3.25}$$

Since $V_{j1} < 1$, it follows that $E_{iV+}^* > E_i^*$. In general, I expect countries with a higher valuation of environmental quality to prefer more stringent international environmental agreements than countries with less appreciation for international environmental protection.

In this section, I have shown that the standard model for optimal pollution policies can be adopted to the study of a country's demand for international environmental agreements. In particular, I have shown how increasing environmental damages, wealth, technology, and the appreciation for environmental quality translate into preferences for various levels of international environmental agreements. In principle, this scheme could also be extended to analyze the impact of domestic *political* actors (see the analysis of the valuation of environmental quality above). However, for the incorporation of political factors, an endogenous policy model will be employed which better mimics the domestic political *process*.

3.3.2. An Endogenous Policy Model of International Environmental Regulation

As the literature review in Chapter 2 suggested, societal demands within a country induce the national government to pursue international environmental policies. While macro factors, such as damages, have to be present, it is the policy preferences of domestic political-economic actors which ultimately account for governmental positions on environmental regulation. On the one hand, the environmental concern of the mass public, the interests of the environmental movement, and the impact of green or ecological parties were singled out in Chapter 2 as prominent non-economic political actors. All of these actors are supposed to respond to environmental degradation with a pro-regulatory position. On the other hand, the

interests of industry groups are likely to be split: Major polluters prefer not to be burdened with the (short-term) costs of additional regulation,[18] whereas the providers of abatement technology equipment and services prefer strict regulation so as to improve their profits. However, until the late 1980s, it should be expected that the interests of major polluters will often outweigh the interests of the nascent industry of abatement technology providers.

Given these (implied) interests, these five groups should fall into two groups: pro-environmental and anti-environmental interest groups. Major polluting industries are supposed to fall into the latter category, and the other groups are to be found in the former category. The purpose of the remainder of the section is to model the political process which translates the preferences of voters and interest groups into government policies. For this purpose, I reformulate an endogenous policy model which was originally developed by Magee, Brock, and Young (1989).

In their analysis of public policies on tariffs, Magee et al. characterize the political process in analogy to economic competition. Tariffs are redistributive policies in favor of the relatively scarce production factor, namely labor (in the advanced industrialized countries). Whereas for neo-classical economists *economic efficiency* would be secured by free trade (which is equivalent to a tariff level of zero), *political efficiency* is achieved when (at a particular level of tariffs) pro-tariff and anti-tariff interests within society are balanced (ibid.). Parties fulfill the function of offering alternative tariffs on their party platform so as to maximize votes, whereas lobbies make contributions to those parties which maximize the lobbies' future income. For example, pro-tariff lobbies, such as labor unions, support the pro-tariff party (e.g., the Democratic Party in the USA). Since rationally ignorant Downesian voters are uninformed (Downs 1957), these contributions of lobbying organizations are used by the parties so as to influence voters. However, as Magee et al. observe, not every level of tariff is acceptable to voters: Ever higher tariffs will not be supported because of the (i) "distortion effect" (increasing prices of imported commodities and products of the domestic import substitution sector; I will use the term "negative reallocation effect", see below) and (ii) "contribution effect" (decreasing marginal returns from spending lobby contributions on voter campaigns). In essence, Magee et al. have developed an endogenous policy model which is similar to the one presented in Section 3.2.1. As applied to the calculus of parties, the marginal benefit curve (in my model) represents the contribution effect, whereas the marginal cost curve (in my model) represents the distortion effect. The intersection of the marginal cost and the marginal benefit curve marks the tariff preferred by the pro-tariff party, and a similar calculus explains the position of the pro-export party regarding an export subsidy

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18 I assume that major polluters are producing at their profit maximum before the regulatory intervention. Any deviation from this equilibrium should be resisted in the absence of full compensation of profits lost.

(i.e., a negative tariff rate). In this model, politicians are *powerless*, since any deviation from the optimal tariff reduces their likelihood of electoral success. Lobby groups also behave according to a utility-maximizing calculus, since it is assumed that the level of contributions is determined by the intersection of the marginal benefits (future income if the recipient party wins the election) and the marginal cost curves for their contributions to supportive parties (ibid., 36-39). As a consequence of maximizing political rather than economic efficiency, the study by Magee, Brock, and Young takes issue with the classical liberal-economic beliefs that the pursuit of individual preferences is conducive to society at large. Instead, they suggest that their theory

> advances the notion that the unbridled pursuit of private individual gain does not maximize society's wealth because of the negative externality of redistributive activity (Magee et al. 1989, 2).[19]

In the following, I will reformulate the basic model for explaining the effect of interest groups on the position which a country takes on international environmental agreements.[20] Three types of actors are involved: parties, lobbies, and voters. Each type of actor is presumed to maximize its utility. In particular, there are two parties: The pro-environmental party (PEP) determines the level of international environmental regulation to maximize voter support.[21] In relation to the pro-environmental lobbies (PEL) and voters, the PEP behaves as a Stackelberg leader, i.e., it chooses the level of pro-environmental regulation that will maximize its electoral success while taking into account the reaction curve of the PEL to the level of environmental regulation. This calculus also assures that the PEL achieves its maximum level of income, since the PEL is ultimately interested in the electoral success of the PEP.[22] Since voters are rationally ignorant, contributions yield increasing voter support by way of campaign expenses, however, as the level of environmental protection increases, voters become more and more reluctant to support further environmental regulation due to rising opportunity costs (ibid., 55-58).[23] A

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19 A study by Olson on "the rise and decline of nations" is another fascinating analysis of the impact of interest groups on macroeconomic performance (Olson 1982).

20 The model presented below is derived from Magee et al. (1989, ch. 3 and pp. 267-270).

21 Barring Lenin's prohibition of fractionalization of the Communist party, one-party systems can be conceived of a consisting of a pro-environmental fraction and an anti-environmental fraction. Thus, the logic developed for an idealized two-party system can be applied to any form of political system (by fragmenting one-party systems and consolidating multiparty systems with more than two parties).

22 In line with the contribution specialization theorem, I assume that each lobby only contributes to its most preferred party, i.e., the pro-environmental lobby contributes only to the pro-environmental party, and a similar behavior holds for the anti-environmental party and the anti-environmental lobby. For a proof of this theorem, see Magee et al. (1989, 269-270).

23 I use the term "negative reallocation effect", since environmental regulations are not necessarily distortions. Ever higher environmental regulations will lead to growing opportunity costs in terms of non-environmental goods.

similar calculus applies to the Anti-Environmental Party (AEP) and the Anti-Environmental Lobby (AEL).

Whereas the notion of direct financial contributions seems to be very appropriate in the context of tariff policies and in view of the influence of US political action committees, "contributions" may take various forms. Unlike Magee et al., I suggest to think of lobbies as legitimizers of policies, either in one-party systems or in consociational or neo-corporatist countries (see Chapter 6). By providing endorsements (and funds), they give cues to voters which, in turn, may guide voting decisions. For example, environmental interest groups may endorse strict air pollution regulations supported by the PEP. Members and sympathizers of environmental interest groups could take these endorsements as cues for their voting decision. Securing public endorsements by certain lobbies can therefore be beneficial to parties. In conclusion, the notion of contributions should be more flexibly applied so as to accommodate the variety of political systems found across countries.

The propositions outlined above can be written more formally as a simplified Arrow-Debreu model of regulation with two parties and two lobbies. Parties are assumed to maximize electoral results and lobbies maximize future incomes. Information costs, such as the costs of organization, are ignored. The strategy for the Pro-Environmental Lobby (PEL) is described by

$$\max_{C_{PEP},\, C_{AEP}} R_{PEL} = p\ r_{PEP} + (1-p)\ r_{AEP} - C_{PEP} - C_{AEP}\,, \tag{3.26}$$

and the strategy for the Pro-Environmental Party (PEP) can be represented by

$$\max_{HES} p = p\ (\underset{(+)}{C_{PEL}},\ \underset{(-)}{C_{AEL}},\ \underset{(+)}{LES},\ \underset{(-)}{HES}), \tag{3.27}$$

where

R = expected total income of a lobbying group,
p = probability of election of the Pro-Environmental Party (PEP),
(1-p) = probability of election of the Anti-Environmental Party (AEP),
r = income of a lobbying group,
C = contributions by each lobby,
PEL = Pro-Environmental Lobby,
PEP = Pro-Environmental Party,
AEL = Anti-Environmental Lobby
AEP = Anti-Environmental Party,
HES = high environmental standards of the PEP, and
LES = low environmental standards of the AEP.

First, the calculus for the PEL (3.26) shows that its future income is determined by the probability of election of the Pro-Environmental Party (PEP) multiplied by future income derived from this party, the equivalent product for the AEP, and the direct costs of contributions to the various parties. Second, PEP maximizes its probability of election by setting the optimal (high) environmental standard. In particular, the probability of election is positively associated with (i) high contributions received from PEL and (ii) low environmental standards (LES) of AEP, whereas contributions to AEP and higher environmental standards reduce the likelihood of electoral success of PEP (3.27).

Taking PEL as an example, the logic underlying positive contributions of a lobby for its favored party is captured by the first derivative of (3.26):

$$dR_{PEL}/dC_{PEP} = \underset{(+)}{dp/dC_{PEP}} \quad \underset{(+)}{(r_{PEP} - r_{AEP})} \quad - 1 = 0 \qquad (3.28)$$

[marginal political revenue] [marginal cost]

Since $(r_{PEP} - r_{AEP}) > 0$ (i.e., PEL profits more from the policies of PEP than from the policies of AEP) and because of the additional assumptions introduced above, PEL will make positive contributions to PEP.

Furthermore, in order to see the impact of environmental standards on the electability of the PEP, the first derivative of (3.27) with respect to HES shows

$$dp/dHES = \underset{(+)}{dp/dC_{PEP}} \quad \underset{(+)}{(dC_{PEP}/dHES)} \quad + \quad \underset{(-)}{dp/dHES} = 0 \; . \qquad (3.29)$$

[positive contribution effect] [negative reallocation effect]

Since rising high environmental standards (HES) adversely affects the electability of the PEP due to the opportunity costs of non-environmental policies, the reallocation effect is negative. This has to be seen in combination with the positive effect of contributions on the electability of a party, $dp/dC_{PEP} > 0$. Furthermore, PEL contributes to PEP because of this party's high environmental standards. As a consequence of these effects, the (high) environmental standard must be larger than zero.

The equations for the Anti-Environmental Lobby (AEL) and the Anti-Environmental Party (AEP) can be derived in a similar way.

The implications of this model for the study of international environmental regulation are as follows. Among the five groups of interest outlined in the literature review of Chapter 2, the voters are most clearly represented by the population at large. The voters will be the least informed group due to their heterogeneity, and they will take their cues from the behavior of interest groups and the policies sponsored by the two parties. In view of the problem pressure,

namely environmental damages, they should be preferring some environmental regulation, however, the extent of this devotion is also dependent on the contributions made by the interest groups towards the parties. In particular, the environmental movement will endorse the PEP and legitimize their actions in return for specific, pro-environmental policies. Green or ecological parties can also be subsumed under the group of PEL, since they are always minor parties which will try to influence major parties (and, in some instances, join coalition governments). In addition, abatement technology producers should prefer strict environmental regulation so as to assure their future profits and the growth of their industry sector.

Major polluting industries, an anti-environmental lobby (AEL) will have diametrically opposite interests as long as they are not fully compensated: They will support the Anti-Environmental Party (AEP) in an effort to promote low environmental standards. Given the fact that major polluters are normally very well entrenched in the political system of industrialized countries (utility sector, transport sector including the car manufacturing industry, heavy industries), and substantial unemployment effects are often feared to result from stringent environmental regulation (Crandall 1983), it seems reasonable to assume that the influence of the anti-environmental policies will be far from negligible.

3.4. Conclusions

The study of international environmental regulation is a relatively new field of political inquiry, however, it can build on the theoretical developments in other disciplines. In this chapter, I have applied three concepts of public economics or social choice.

First, I have characterized the problem of achieving international environmental protection as an *international* public goods problem. As the theoretical analysis showed, it is very likely that international environmental protection will not be supplied at a Pareto-optimal level as long as countries pursue a narrow utility-maximizing calculus. International environmental agreements potentially improve the suboptimnal provision of international environmental protection.

Second, the impact of major macro factors, such as the impact of environmental damages, wealth, and technology, on a country's preferences for international environmental agreements were incorporated in an externality model. The results derived do not only offer guidance for the directional hypotheses, but the model also helps to integrate various strands of theorizing.

Third, an endogenous policy model was employed so as to explicitly relate various interest groups to lobbying efforts as well as to party programs. In particular, this model showed that utility-maximizing, pro-environmental parties will opt for stringent international

environmental treaties, whereas the opposite will be true for the anti-environmental parties. While it is beneficial for lobbies to support like-minded parties, the model does not explain which party will win. However, the model clearly describes how particularistic interests translate into policies to be chosen by parties and governments.

The models presented above are applicable to a broad range of international environmental problems. Potential topics include global climate change, the maintenance of biodiversity, the protection of coastal estuaries, transboundary air pollution, international river pollution, and many others. None of the policy models assures that Pareto-efficient solutions will be found, however, given a few minor assumptions, these models predict that governments will undertake *some* efforts to protect the international environment. International environmental agreements are just one way to accomplish this end, and uncoordinated actions (atomistic economic markets are one example) could account for similar results. This observation shall not obviate the fact that international environmental agreements may be politically efficient: Political actors have to respond to international environmental problems in most (but not all) instances because of domestic political-economic pressures. While the models presented above provide a simplified rationale for the directions of the hypotheses implied by Chapter 2, the actual outcome of this conflict of interest has to be assessed empirically (see Chapters 5 through 7). Before I turn to these empirical analyses, a brief historical-diplomatic overview will be provided in Chapter 4 to assist the interpretation of the empirical findings.

4. An Overview of the International Regulations of Acid Rain in Europe

You cannot pollute the river and expect to eat fish.

Ruth Carina Feldsberg

International environmental regulation often responds to environmental damages - instead of preventing it. While the precautionary principle is becoming more prominent with the cases of the regulation of the depletion of the stratospheric ozone layer and the extended greenhouse heating effect, much of the contemporary regulation of the international environment still follows a stimuli-response mechanism. This also holds for the regulation of acid rain in Europe. The purpose of this chapter is to briefly describe the environmental implications of acid rain as well as the regulatory efforts to reduce acid depositions in Europe.

In the first section, I will review the rationale for studying transboundary air pollution in Europe (Section 4.1.). This is followed by a description of the environmental problem at hand (Section 4.2.). Since international negotiations were undertaken to limit the transboundary air pollution problem, I will summarize the diplomatic efforts for its regulation in (Section 4.3.). The concluding section will provide a brief preview of the themes addressed in the empirical analyses (Section 4.4.).

4.1. Transboundary Acidification and the Study of International Environmental Regulation

Rhetorically, one may ask: Why study the comparatively well-established case of transboundary acidification when the regulation of the extended greenhouse heating effect seems to be more pressing? I think there are five reasons for studying transboundary air pollution, and this will also yield helpful insights for the regulation of the most important global environmental problem.

First, transboundary air pollution is an *international public goods problem* (see Chapter 3), and since imported pollutants outweigh the domestic contributions in many countries, *international* policies have to be devised to limit environmental degradation. The same holds for global warming, because the mixing of the air masses assures that the (national) emissions of so-

called greenhouse heating cases (foremost CO_2, but also methane, various CFCs, nitrous oxides, and other gases) will have world-wide effects. Because the regulation of acid rain and global warming are international public goods problems, countries are likely to endure less than Pareto-optimal levels of environmental quality (see Chapter 3).

Second, a subset of the agreements concluded within the (European) regime on transboundary acidification is likely to have *substantial* effects on improving the quality of the environment. It also holds for the case of global warming that stringent abatement plans have to be implemented by the major present and future polluters. International environmental regulation will be costly, if the quality of the environment is to be maintained (extended greenhouse effect) or if countries wish to improve it (acid rain).

Third, transboundary acidification in Europe is a regional, reciprocal environmental problem, and more than 20 countries are simultaneously (involuntary) exporters and importers of air pollutants. A similar number of countries is at the core of the regulation of global warming, and, as I suggested in Chapter 1, regional, reciprocal environmental problems (with many victims and many polluters) analytically pose the same regulatory challenge as global environmental problems.

Fourth, I have chosen a diverse set of countries with respect to type of political system, economic wealth, and access to modern abatement technology. If the theories reviewed in Chapter 2 and integrated in Chapter 3 perform reasonably well for this diverse set of European countries, they might provide guidance for the worldwide regulation of greenhouse heating gases.

Fifth, transboundary air pollution is associated with major industrial interests, such as the automotive industry, transport in general, utilities and the energy sector in particular, and other industrial processes. The same holds for the case of global warming. In fact, nearly every citizen, directly or indirectly, contributes to both problems: Car owners and users of *public* transport are all direct or indirect polluters - although to varying degrees. Therefore, the regulations to be sought are likely to affect nearly of all parts of society in both cases.

In conclusion, to study the multilateral case of transboundary air pollution is likely to provide guidance for the study of other major environmental problems.[1] Before turning to the diplomatic history of efforts undertaken to limit transboundary air pollution in Europe, I summarize the environmental aspect of this environmental problem.

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1 For a similar conclusion, see the excellent study by Boehmer-Christiansen and Skea (1991, 3-4).

4.2. Causes and Effects of Transboundary Air Pollution

The phenomenon of "acid rain" is *not* new. Roughly one hundred years ago, Angus Smith, a British scientist, first used this term when establishing the link between emitters of sulfuric acids, and their damage to plants and materials (Cowling 1982). In those times, acid rain was discussed in terms of *local* air pollution. The high smokestack policy after World War II turned acid rain from a local environmental problem into an international environmental problem. However, it was only in the mid-1960s that Svante Odén, a Swedish soil scientist, linked sulfur emissions *in the U.K.* to adverse ecological effects *in Sweden*. The conclusions from his research on "an insidious 'chemical war' among the nations of Europe" (Cowling 1982, 114A) were published in scientific journals and in a Stockholm newspaper. They were summarized by Cowling as follows:

> - [A]cid precipitation was a large-scale regional phenomenon in much of Europe with well-defined source and sink regions,
> - both precipitation and surface waters were becoming more acidic,
> - long-distance (100-2000 km) transport of sulfur- and nitrogen-containing air pollutants was taking place among the various nations of Europe,
> - there were marked seasonal trends in deposition of major ions and acidity, [and]
> - long-term trends in acidity could be detected in many countries of Europe.
>
> Odén also hypothesized that the probable ecological consequences of acid precipitation would be changes in surface water chemistry, decline of fish populations, leaching of toxic metals from soils into surface waters, decreased forest growth, increased plant diseases, and accelerated damage to materials. These conclusions and hypotheses led to a veritable storm of scientific and public concern about acid precipitation (ibid., 114A-115A).

This "veritable storm" mobilized domestic constituencies, and led to attempts by Scandinavian governments to reduce transboundary acidification. Undoubtedly, Odén's hypotheses have set the agenda for the political evaluation of science and the conclusion of international agreements. Before I turn to these international environmental agreements, I wish to clarify what acid rain actually is.

Until now, I have treated acid rain and transboundary air pollution as the same phenomenon. In fact, the former is part of the latter in natural science terms. Acidifying pollutants, such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), and hydrocarbons (HC), result from emissions created by burning fossil fuels, or they stem from industrial processes (e.g., smelters) - in addition to *natural* emissions (such as volcanic activities). Whereas worldwide natural and anthropogenic emissions contribute similar shares of sulfur, ca. 90% of the emissions of sulfur are of anthropogenic origin in Europe (National Swedish Environmental Protection Board 1987, 17). If these emissions are directly deposited to the earth without being converted

chemically, they are considered to be *"dry" depositions.* However, in the atmosphere, part of the sulfur and nitrogen oxides are converted to sulfuric and nitric acids; the resultant *"wet" depositions* in the form of rain or snow include sulfate, nitrate, and hydrogen ions (the latter are an indicator of the degree of acidity, hence the pH-scale for determining acidity). It is the notion of wet depositions which originally lead to the popular term "acid rain". However, one should keep in mind that both wet and dry depositions have adverse impacts on ecosystems.[2]

In addition to nitrogen oxides, *ammonia* is emitted by way of animal manure and the application of liquid fertilizers to farmland. While ammonia is a base (rather than an acid), microorganisms subsequently convert ammonia in the soil. Furthermore, nitrogen oxides help to convert hydrocarbons to form (tropospheric) ozone (O_3) in the presence of sunlight. Whereas nitrogen oxides and ammonia contribute to an overfertilization of soils and plants, and adverse effects on forest soils and surface waters are expected, ozone formation is thought to lead to direct plant damage (e.g., on forests and commercial crops) as well as adverse effects on human health (Los Angeles smog or photochemical smog).[3]

The actual damage to the environment is conditional: The so-called *buffering capacity* of lakes, e.g, by hydrocarbonates, allows for a neutralization of the water. For forests, soils, and lakes, it holds that calcareous bedrock is capable of offsetting the impact of acidifying pollutants. Unfortunately, the bedrock of much of Scandinavia and parts of Scotland and Wales is incapable of neutralizing much of the incoming acids. As a consequence, hydrogen ions are released, and *lakes* become more acidic which results in the depletion of fish species.

In *soils*, incoming hydrogen ions mobilize metallic ions (such as magnesium, calcium, and aluminum), which are otherwise attached to the surface of the soil particles. In turn, these metals hold a prominent place in hypotheses which stress the impact of metals on *forest decline and forest dieback* ("le Waldsterben", in *French*!) as well as the acidification of lakes (Boehmer-Christiansen/Skea 1991, 38-39).

Numerous studies exist on the specific impacts of acidifying pollutants (Chadwick/Hutton 1991; Cowling 1982). In general, adverse impacts on forest, soils, crops, freshwater ecosystems, and human health, as well as the corrosion of monuments are attributed to these pollutants. Among these effects, the impact of acidifying pollutants on *aquatic ecosystems* seems to best understood due to Scandinavian (and Canadian) research over the past 20 years: Acidic depositions kill fish species and lead to biologically "dead" lakes. For the case of *forest damage,* the aluminum leaching hypothesis (Ulrich) has been superseded by the "multiple stress"

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2 Much of the presentation of the natural science aspects of acidification follows National Swedish Environmental Protection Board (1987).

3 Photochemical processes are considered a transboundary air pollution problem, and they do *not* belong to the classical domain of acidification problems.

hypothesis (Schütt) as the dominant explanation of foliage and needle loss which can be observed in Northern and Central Europe. Over time, it has become less common to solely stress the impact of air pollutants on forests, and "a consensus is emerging that air pollution may be one factor among many contributing to a complex set of damage syndromes" (Boehmer-Christiansen/Skea 1991, 40). However, in political terms, the early hypothesis (which related acidification to forest dieback by way of aluminum leaching) lead the federal government of the Federal Republic of Germany (FRG) to turn from a resister to international air pollution regulation into an ardent supporter of Scandinavian attempts to limit the effects or air pollutants to the European environment.

In the empirical part of this study (Chapters 5 through 7), I will focus on the traditional domain of transboundary air pollution (TAP), namely sulfur and nitrogen oxides (excl. ammonia). The reason for this delimitation is that (i) the formation of sulfur and nitrogen acids are best understood in the natural sciences, (ii) emission data have become reliable, (iii) crossnational emission-receptor data are available, and (iv) a reasonably broad set of experts was able to respond to relevant questions (see Chapter 6).[4] Furthermore, within the United Nations Economic Commission for Europe (UNECE), some European countries have agreed to reduce or stabilize their emissions of these two pollutants (see Section 4.3.). While governments have also recently agreed to regulate the emissions of volatile organic compounds (or hydrocarbons), comparable data are presently *not available* for an analysis of the determinants of support for international regulation.

4.3. The International Environmental Agreements on Transboundary Air Pollution

In their efforts to limit the damages associated with transboundary air pollutants, European (and North American) governments have created an international regime. The formal international agreements include the

(i) 1979 Geneva "Convention on Long-Range Transboundary Air Pollution" (LRTAP) (UNECE 1979) (also called the *Geneva or LRTAP Convention*),

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4 The experts interviews were undertaken by this author between November 1990 and October 1991 in nine European countries parallel to negotiations on the protocol on volatile organic compounds (VOCs). Respondents clearly felt most comfortable to respond to questions on sulfur and nitrogen oxides.

(ii) 1984 "Protocol to the Convention on Long-Range Transboundary Air Pollution on 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) (also called the *EMEP Protocol*),

(iii) 1985 Helsinki "Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulfur Emissions or Their Transboundary Fluxes by at Least 30 Percent" (UNECE 1985b) (also called the *Helsinki or Sulfur Protocol*),

(iv) 1988 Sofia "Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution Concerning the Control of Emission of Nitrogene Oxides or Their Transboundary Fluxes" (UNECE 1988) (also called the *Sofia or Nitrogen Protocol*), and

(v) 1991 Geneva "Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution Concerning the Control of Emission of Volatile Organic Compounds or Their Transboundary Fluxes" (UNECE 1991) (also called the *VOC Protocol*).

In addition to these formal international environmental agreements facilitated by the UNECE, some governments also signed the "Declaration on the 30 Per Cent Reduction of Nitrogen Oxide Emissions" in 1988 so as to strengthen the Sofia or Nitrogen Protocol (Signatory States to the "Declaration on the 30 Per Cent Reduction of Nitrogen Oxide Emissions" 1988) (also called the *Nitrogen Declaration*). The purpose of this section is to provide a brief background to these international environmental agreements and the political processes which lead to their conclusion. The presentation is, in part derived from public sources and more than 140 interviews undertaken by the author of this study.[5]

4.3.1. The Origins of the Regulation of Transboundary Air Pollution in Europe

The hypothesis of an "insidious 'chemical war' among the nations of Europe" advanced by Odén in the mid-1960s can be taken as a prominent point of departure for the international regulation of acidifying pollutants. Sweden, in particular, had been experiencing loss of fish species in its southern lakes, and given monitoring data from the European Air Chemistry Network dating back to the 1940s, increased levels of acidification were suspected to be the major cause. Odén's set of propositions, which included the proposition of long-range transmission of

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5 References to written sources follow standard academic procedures. Interview partners are not identified for reasons of confidentiality. However, I have followed the norm that information presented here has to be supported by two independent sources.

air pollutants (see above), had shaped the research agenda for many years. As it turned out, Norway's meteorological position is even worse than that of Sweden, since Norway imports up to 90% of acidifying depositions. Given the increasing public attention paid to "acid rain" and traditional Scandinavian appreciation of the environment, the Swedish government hosted the 1972 Stockholm United Nations Conference on the Human Environment. Sweden's scientific contribution was entitled "Air Pollution Across Boundaries" (Bolin 1972), and it constitutes the point of departure for sustained Scandinavian attempts to seek a remedy to their international vulnerability to the imports of acidifying pollutants.

In 1972, Norway, another "victim" of sulfur "donations", started a massive interdisciplinary research program on "Acid Precipitation - Effects on Forests and Fish", while the Norwegian and Swedish governments (which are not members of the European Community), asked the Organization for Economic Cooperation and Development (OECD) to conduct a study on the long-range transmission of air pollutants in Europe. The results of the OECD program showed that (i) air pollutants may travel long distances and (ii) transboundary depositions are of substantial magnitude (OECD 1979). However, since the East Central European countries, a set of major air pollution emitters, are not OECD members, a different forum had to be found for an all-European regulation of transboundary air pollution.

In order to deflect from the human rights record of the (former) Soviet Union after the conclusion of the Final Act of the Conference for Security and Cooperation in Europe (CSCE), then Secretary General Brezhnev suggested in 1975 "that ... the holding of all-European congresses or inter-State conferences on questions of co-operation in the fields of the protection of the environment, the development of transport and general energy problems would lead to positive results" (for détente) (Chossudovsky 1989, 23). Of these three agenda items, the environment

> was by far the most innocuous. But Swedish and Norwegian officials saw in Brezhnev's ... speech an opportunity for international discussion, negotiation, and perhaps even progress toward resolution of [the transboundary air pollution] problem (Wetstone/Rosencranz 1983, 140).

Consequently, Scandinavian diplomacy transferred the issue to the UNECE at Geneva, and serious negotiations began by 1977. Given their position as victims of transboundary air pollution, the Scandinavian countries preferred to freeze or even reduce the emissions of sulfur oxides, which was considered to be the most important pollutant in the late 1970s. However, German and British resistance to any sincere pollution regulations lead to a rather weak framework convention on transboundary air pollution. Only substantial pressure at the highest level assured that the Federal Republic of Germany would even sign this international agreement in 1979 (ibid., 143). In sharp contrast to their technology-forcing policy since the 1982, it was the

Federal Republic which insisted in 1979 that the best available technology standard (BAT) was supposed to also be "economically feasible" (ibid.), a position normally reserved for the British delegation and their domestic policy-makers. Furthermore, the U.K. debated the validity of the implications of Odén's research, namely that it were British emissions from coal-fired power plants which caused adverse effects to Scandinavian lakes. The FRG and the U.K. succeeded, against the opposition of Denmark and the Netherlands, to make their position the official position of the European Community (EC) at large.[6]

As a result of these debates, the 1979 Geneva "Convention on Long-Range Transboundary Air Pollution" is best characterized by its declaratory character: good intentions, no promises to abate emissions within a *pre-determined* time frame, and universal support. It was left to the substantive agreements to follow to improve the state of the European environment. However, the Geneva Convention is the first all-European environmental agreement, and it was signed parallel to a "Declaration on Low- and Non-Waste Technology and Re-utilization and Recycling of Wastes" (Chossudovsky 1989, 108); the latter agreement was of particular interest to the Central and East European countries. In addition, the Geneva Convention also assured the continuation and enlargement of the OECD-founded Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) as well as the initiation of collaborative research programs on (i) cause-effect relationships and (ii) the cost-effectiveness of international abatement policies.

It clearly takes more than a framework convention to improve the state of the environment. What matters in the long run is the actual reduction of the effects of pollution - not "diplomatic successes" in the form of declarations of good intentions. This point was not lost on the Swedish government which turned the tenth anniversary meeting of the 1972 Stockholm Conference on the Human Environment into the highly specialized 1982 "Stockholm Conference of the Acidification of the Environment". While the expert meeting indicated that sulfur and nitrogen emissions have to be substantially reduced so as to improve the quality of endangered ecosystems, the political highlight of the conference may be seen in the complete policy reversal of the FRG. As a consequence of (i) preliminary results of the first systematic forest survey which showed that roughly half of German trees were damaged and (ii) the fast rise of the green party (which was perceived to pose a threat to the major established German parties), the German head of delegation announced a demanding and technology-forcing domestic abatement program (Swedish Ministry of Agriculture 1982).[7] Many diplomatic observers see the reversal of the position of the FRG as a major turning point for the international regime on transboundary air

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6 In addition to its member states, the EC is a signatory of the 1979 LRTAP Convention.

7 In domestic German law, the BAT standard ("Stand der Technik") was introduced -- with comparatively little (sic!) attention being placed on cost-effectiveness.

pollution despite the insistence of the British delegate "that the costs [of abatement] are difficult to justify, since we cannot be sure that they will be effective in curing the environmental problem" (ibid., 70). An additional effect of the 1982 conference had been that countries were speeding up the ratification of the 1979 Geneva Convention, which only entered into force in early 1983.

4.3.2. From Declaratory to Substantive Agreements on Transboundary Air Pollution

The diplomatic activities following the 1982 Stockholm Conference can be best described as an act of coalition building. The 1983 meeting of the Executive Body, the formal rule-making body of the 1979 Geneva Convention, witnessed an alliance of the Nordic countries with Austria, Switzerland,[8] and the FRG in support of a 30% reduction of sulfur dioxide emissions until the mid-1990s as compared to 1980 emissions. From the perspective of decision-makers as well as from an environmental perspective, the 30% figure was *arbitrarily* chosen: The reductions were supposed to be both (i) substantial and (ii) low enough in order to maximize support across countries.

Two special efforts were undertaken to enlarge this group which came to be known as the "30% Club". First, the Canadian government (a North American "victim" country) wanted to put pressure on its reluctant, southern neighbor to adopt more stringent regulations on sulfur emissions; thus, it convened the "International Conference of Ministers on Acid Rain" at Ottawa in early 1984 (Environment Canada 1984). Participant countries had to promise a 30% reduction of sulfur emissions. The group of like-minded countries now included Austria, Canada, Denmark, Finland, France, the FRG, the Netherlands, Norway, Sweden, Switzerland. In short, the prominent OECD "victim" countries succeeded in coordinating their policies. Second, a Canadian-FRG alliance led to the 1984 Munich "Multilateral Conference on the Causes and Prevention of Damage to Forests and Waters by Air Pollution in Europe". Furthermore, the (former) SU continued to take a special interest in advancing the LRTAP regime it initiated. In particular, the SU wished to maintain cordial relations with the NATO countries in the midst of the missile deployment crisis of the 1980s (Boehmer-Christiansen/Skea 1991, 28). While many East European countries, with the exception of Poland, indicated their support for a 30% reduction goal, the British government remained unmoved on the aggregate level. This is the more remarkable, since some Conservative Parliamentarians, a special committee of Parliament, the Department of Environment, and parts of the scientific community wanted to commit the

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8 Austria and Switzerland resemble the meteorological position of the Scandinavian countries, because they are minor emitters of acidifying pollutants, and much of their depositions originate from abroad.

U.K. to go further than a reduction of sulfur emissions by 30% until the *end* of the century. Prime Minister Thatcher herself decided to pursue a very cautious abatement policy (Boehmer-Christiansen/Skea 1991, ch. 11).

One year after securing the financial support for the European Monitoring and Evaluation Programme (EMEP) by way of the 1984 "Protocol to the Convention on Long-range Transboundary Air Pollution on 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), the first *substantive* international environmental agreement on sulfur emission reductions had been concluded. The "Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulfur Emissions or Their Transboundary Fluxes by at Least 30 Percent" (the Helsinki or Sulfur Protocol) was approved by 16 countries.[9] The Protocol basically stipulates that signatories have to reduce their national sulfur emissions or their transboundary fluxes by 30% by 1993, using 1980 emission 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.

Among the European countries, the U.K. and Poland did not sign the Protocol, whereas the (former) German Democratic Republic (GDR) surprised some of its East Central European neighbors by signing the Protocol; implementing legislation was never passed by the GDR. While the British position is best explained by a combination of (i) reliance on high levels of scientific certainty, (ii) cost-effectiveness as well as (iii) a rejection of the base year,[10] the Polish case can best be captured in terms of honesty and economic poverty (see Chapter 3). Polish decision-makers knew that the implementation of the Sulfur Protocol would be too costly for one of Europe's poorest countries; furthermore, it did not wish to commit itself to an international policy that it cannot implement. In contrast, the former Czech and Slovak Socialist Republic ratified the Helsinki Protocol and, initially, did *not* pass domestic abatement laws which would assure treaty compliance.[11] Furthermore, Hungary was already abating sulfur emissions during

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9 The provision regarding transboundary fluxes is only of importance to geographically large countries, such as the (former) SU, whereas for geographically small countries, the reduction of transboundary fluxes is roughly proportional to its emission reductions.

10 The U.K. had considerably reduced its sulfur emissions during the 1970s. Since the emissions for 1980 serve as the base year, no credit would be given for past accomplishments.

11 The environmental ambitions of the Central and East European countries have clearly changed by the 1990s. Poland, the (current) CSFR, and Hungary now have the political will to implement domestic air pollution abatement law roughly in line with contemporary German standards. However, these East Central European countries still face a sharp resource restriction, and their current abatement successes are the product of a sharp economic recession.

the 1980s, and it is likely to be the only East Central European country to intentionally honor its international obligations.

Overall, if signatories to the Helsinki Protocol will only implement their international obligations and if resisters of regulations will freeze their emissions at 1980 levels, sulfur emissions should be 18% lower in 1993 as compared to 1980 (my own computation from (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution/Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) 1991, 11). In reality, some countries have adopted much *more stringent* abatement goals, while the late developers in the European Community will *increase* their emissions. In conclusion, the Sulfur Protocol is the first substantial agreement within the LRTAP regime to reduce the effects which acidifying pollutants have on the European environment.

As the scientific research shifted from sulfur oxides to nitrogen oxides, diplomatic efforts began to consider a similar international agreement on nitrogen oxides. A declaration by the Austrian, (West) German, and Swiss Ministers of the Environment at a conference at Saas Fee in early 1986 called for a 30% reduction of nitrogen oxides as well as hydrocarbons (Lang 1989, 31). Given the review of the scientific debate presented further above, it has to be noted that the role of ammonia emissions was not yet well understood, and Dutch interests in including ammonia in a Nitrogen Protocol was not sufficient to keep this pollutant on the agenda.[12] Overall, the regulation of NO_X was of major importance to protect the forests in Central and Northern Europe. Therefore, the Dutch, (West) German, and Swedish governments as well as Austria and Switzerland became major supporters of strict regulations on NO_X emissions.

British decision-makers perceived a higher ecological vulnerability to nitrogen oxides as compared to sulfur oxides, and abatement costs for nitrogen oxides were considered to be substantially lower than for sulfur oxides. Since diplomats wished to avoid a replication of the antagonism associated with the Sulfur Protocol, a "freeze" protocol was envisioned for the international regulation of nitrogen emissions. The lowest common denominator prevailed, in part, because the growing transport sector is the largest emitter of NO_X. Given the importance of many two-stroke engines for the East European passenger car fleet (visit Budapest!), it could not be expected that East European countries could commit themselves to more than a standstill agreement. The request of East European governments, a provision for technology transfer was included in the Nitrogen Protocol (Sand 1990; UNECE 1988, Article 3).

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12 Dutch interests in the control of ammonia stems from its intensive form of agriculture, including cattle raising.

Thanks to the freeze provision, the "Protocol to the 1979 Convention on Long-range Transboundary Air Pollution Concerning the Control of Emission of Nitrogene Oxides or Their Transboundary Fluxes" (or Sofia or NOx Protocol) (UNECE 1988) enjoys close to universal support. It was signed on 01 November 1988 at Sofia by most of its supporters, and went into force on 14 February 1992. In detail, it stipulates that national annual emissions or transboundary fluxes in the year 1994 shall not exceed the emissions or transboundary fluxes of the year 1987. In case an alternative base year is chosen, the average annual emissions or transboundary fluxes between 1987 and 1994 shall not exceed their corresponding 1987 levels (ibid., Article 2).

The signatories also agreed to use BAT and to start negotiations on a pollution *reduction* protocol within six months after the Nitrogen Protocol will come into force.[13] Furthermore, abatement policies shall become *effects-oriented*, i.e., the goal of abatement policies shall be to achieve emissions of nitrogen emission in accordance with critical loads which reflect

> a quantitative estimate of the exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge (ibid., Article 1).

Future international environmental agreements on transboundary air pollution will not only rely on the application of technology, but they will become more effects-oriented, which reflects the British style of environmental regulation (Boehmer-Christiansen/Skea 1991).

However, a subgroup of countries, unsatisfied with the Nitrogen Protocol, *also* signed a "Declaration on the 30 Per Cent Reduction of Nitrogen Oxide Emissions" (or Nitrogen or NOx Declaration). This agreement asks its members to reduce emissions of annual nitrogen oxides "in the order of 30%" by 1998 (in comparison to any base year chosen between 1980 and 1986). The NO_X Declaration may also be seen as a success of the "Stockholm Group" on automotive emission standards, which is an alliance of the members of the European Free Trade Association (EFTA), the Netherlands, and the FRG. Since 1985, its goal has been to introduce the stringent US car emission standards in Europe. In particular, the introduction of catalytic converters for new cars (ten years after their introduction in the US market) was seen as a partial solution to the NO_X problem.

While this agreement had been concluded outside the framework of the UNECE and the LRTAP Convention, it is left to environmental NGOs to assure that governments are reminded of this obligation. In conclusion, the member countries of the UNECE do not show uniform support

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13 The members of the LRTAP Convention were reminded of this provision at the 1992 meeting of the Executive Body. My personal observation from this meeting is that the UNECE member countries did not wish to address this point according to the time-table which the signatories supported in 1988.

for international nitrogen abatement policies. It is the ambitious, Western and Northern European countries which pursue more stringent international environmental policies on NO_x emissions.[14] Since only the Nitrogen Declaration stipulates emission reductions, I consider this to be the second international environmental agreement which is supposed to improve the state of the environment.[15]

More recently, the LRTAP regime has devoted its attention to the regulation of volatile organic compounds. In particular the ozone creating potential of photooxidants is perceived to have adverse effects on forests, agricultural crops, and human health (Los Angeles smog). More than 80 substances need to be regulated, and the natural science is less well understood as compared to sulfur and nitrogen oxides.[16] In contrast to the cases of the regulation of sulfur an nitrogen oxides, *quantification* of transboundary exchanges for all countries will only be available in the *future*. However, initiating scientific research programs *after* the conclusion of international abatement programs would not be entirely new: The Netherlands - a victim of acid rain with strong pro-environmental attitudes held by its citizens - did so after the conclusion of the Sulfur Protocol. Gaps in research and transboundary source-receptor maps did not preclude the conclusion of the 1991 Geneva "Protocol to the 1979 Convention on Long-range Transboundary Air Pollution Concerning the Control of Emission of Volatile Organic Compounds or Their Transboundary Fluxes" (or VOC Protocol). It basically offers countries a three tier approach, including

- a 30% reduction of VOCs until 1999, taking any year between 1984 and 1990 as the base year, or
- the same provisions as in (i) but applied only to areas where emissions have *international* effects, and the total national emissions of VOC in 1999 do not exceed the 1988 level, or

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14 Incidentally, the U.K. was not invited to sign the NOx Declaration. Some government officials of countries which support the NOx Declaration *implied* that the U.K. might have signed the NOx Declaration if it had been invited to do so.

15 This does not imply that a freeze of nitrogen emissions does not entail costs. However, from an environmental standpoint, improvements of the state of the environment are only possible with actual pollution *reductions* (other factors held constant). Given the varying reference years, it is not possible to predict the European-wide reduction in nitrogen emissions from the provisions of the Nitrogen Declaration.

16 Volatile organic compounds (VOCs) are not acidifying pollutants. However, in the presence of sunlight, they have adverse effects on those ecosystems which are also at risk due to sulfur and nitrogen depositions. Since VOCs also travel long distances, the more inclusive term "Long-Range Transboundary Air Pollution" (LRTAP) is appropriate. Because the empirical tests will exclusively focus on the regulation of sulfur and nitrogen emissions for reasons outlined above, I will continue to use the terms "acidification" and "transboundary air pollution" interchangeably.

- a freeze provision for minor emitters, i.e., the emissions in 1999 shall not exceed the emissions of 1988 (UNECE 1991, Article 2).

These "equitable rather than equal" obligations (Sand 1990, 9) allowed nearly all countries to sign the VOC Protocol. However, since sufficient reliable data are not yet available, I will limit myself to a study of the Sulfur Protocol and the Nitrogen Declaration. In both domains, upgraded and effects-oriented new agreements are planned for the mid-1990s (Ågren 1992).

Up to now, the impact of the European Community (EC) on its member countries has been omitted. Since the EC is a signatory to the 1979 LRTAP Convention, and because its environmental mandate has been covering environmental policies since the 1970s, I will provide a brief overview of the regulatory efforts as they pertain to the regulation of sulfur and nitrogen oxides in Europe.

4.3.3. The Regulations of Some Air Pollutants by the European Community

During the 1970s, the European Community (EC) became an increasingly important actor by way of promulgating environmental laws which bind its member states. Until 1986, the EC had to take recourse to Articles 100 and 235 of the Treaty of Rome to justify its common environmental policy; unanimity had to prevail for any environmental policy to become Community law. This changed with the Single European Act which explicitly mentions environmental protection as a goal of the Community and allows for decisions with a qualified majority (Article 100A). Whereas the diplomatic coalitions within the UNECE have been described above, part of the political-economic controversy also took place within the EC. The purpose of this section is to highlight some of these conflicts which are linked to country positions at the UNECE.[17]

Two major sets of regulations had been undertaken by the EC. First, the regulation of stationary sources of air pollutants was achieved by the Large Combustion Plant Directive (LCP) in 1988. Furthermore, varying attempts to regulate passenger car emissions in the EC lead to a succession of agreements within the EC which reflect the different political-economic constraints that various EC member countries face. I will turn to each of these themes below.

First, the Large Combustion Plant Directive can be seen as an attempt by the German government to "export" its own domestic regulations of stationary sources to the member

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17 For a detailed overview of the EC's air pollution policy, see Johnson and Corcelle (1989, ch. 4). In addition, the German-British controversy within the EC on the regulation of air pollution is described in some detail by Boehmer-Christiansen and Skea (1991, ch. 12).

countries of the EC (Boehmer-Christiansen/Skea 1991, 234). In response to the discovery of forest dieback, the national government of the FRG embarked on an ambitious reduction of sulfur and nitrogen emissions from large combustion plants in 1983. Stringent emission standards were invoked for new plants and old plants had to be retrofitted in a relatively short amount of time (or they had to shut down). This approach can be seen as technology-forcing, since flue gas desulphurization, an end-of-pipe abatement strategy, had been introduced vigorously. Similar regulations were also taken in Sweden and account for German and Swedish technology firms to be major exporters of abatement technology on a European scale.

Roughly parallel to the domestic regulations, the German government pushed the EC members to adopt similar laws by way of an EC Directive. However, given the varying energy policies of various countries and the reluctance of late developers within the EC to commit themselves to strict regulations (at the potential expense of "economic development"), uniform emission standards became illusory. Instead, the EC Directive on LCP, a compromise solution, offers country-specific emission reductions "à la carte". In particular, the U.K. succeeded in not joining the group of environmentally ambitious countries, namely the Netherlands, the FRG, Belgium, Denmark, and France. Ireland, Portugal, and Greece were allowed to *increase* their emissions (Boehmer-Christiansen/Skea 1991, 241). For the British government, the reference year of 1980 turned out to be a particularly unrewarding choice, since it had reduced emission to a considerable extent in the 1970s. Cost considerations and country-specific energy supply policies also played an important role. For example, Germany, Spain, and the U.K. wished to protect their coal mining sectors by way of assuring the continued existence of coal-fired power plants.[18] In conclusion, variations in ambitions, cost effectiveness, energy policies, and level of economic development lead to a finely tailored Directive of the European Community on Large Combustion Plants. Environmental federalism has been long practiced before the 1992 Danish referendum on the Maastricht agreement.

Second, given its importance for the abatement of nitrogen oxides, the regulation of car emission standards became a contentious issue within the EC since the mid-1980s (Johnson/Corcelle 1989, 124-136). German considerations for their forests led to discussions over the imposition of strict unilateral car emission standards in line with the Stockholm Group (Boehmer-Christiansen 1990). However, in this case, the common market provisions of the Treaty of Rome did not fail to prevail, and (formally) *common* standards were adopted. Different clusters of countries held various regulatory preferences. Most easily, the adoption of US car emission standards for *large* cars was agreed upon in 1985 by mandating the use of lead-free gasoline in

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18 Fuel switching might be economically more efficient, but this option violates the political efficiency standard (see Chapter 3). Environmental end-of-pipe technologies have the potential to *preserve established* political interests!

conjunction with a three-way catalytic converter (to control carbon monoxide, NOx, and hydrocarbons). For smaller cars, different preferences were held across Europe. Producers of small cars in Italy, France, and the U.K. did not wish modern emission control technologies to interfere with car sales, since catalytic converters would add substantially to the price of new, small cars. At this point in time, it was also believed that a "lean burn" engine could be developed which would accomplish equivalent exhaust reductions at a much smaller expense (ibid.). Furthermore, German technology producers had very substantial market power in Europe, because they produced key technologies associated with the three-way, controlled catalytic converter. As was the case for the European-US conflict over the regulation of CFCs, technologically more advanced countries are eager to sell their products abroad or to receive royalties for the transfer of technology. Countries with producers of small cars successfully fought a stringent directive for small cars,[19] and the German and Dutch government seized the opportunity to promote the purchase of cleaner cars by way of (illegal) subsidies. Different marginal rates of substitution between environmental and non-environmental goods for a tradable commodity were allowed to coexist in a common market.

While it was not the purpose of these brief comments to present pertinent EC air pollution regulations in detail, it is clear that similar motives are underlying support for the regulations of the UNECE and regulations within the EC. Determined countries, supported by pro-environmental attitudes (esp. in Denmark, the Netherlands, Sweden, and the FRG), normally prefer strict environmental regulations. Other wealthy countries may follow. However, poorer or extremely cost-conscious countries will try to avoid strict regulations. Uniform international environmental regulations shall not be expected as long as the underlying factors vary considerably across countries.

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19 The European Parliament was considering to finalize a comprehensive regulation of car emission standards for all car sizes by late 1991.

4.4. Conclusions

The regulation of the international environment is partially dependent on the vigor with which countries pursue international agreements. Victims of pollution imports are destined to fill this role, and the Scandinavian countries fulfilled expectations in the case of European transboundary acidification. However, it takes some convincing of other countries so as to arrive at international environmental regulations which will have substantive impacts. This chapter has provided a brief overview of how coalitions were built, and which major reasons were underlying the positions of some prominent countries.

Governments in Europe have used different fora to pursue their policies. Fundamentally, long held interests were not changed, even in the German case. Had the (wealthy) FRG known of its forest death as early as the Swedes knew about the decline of their lakes, the German position would have been much more in line with that of the Scandinavian governments. In both cases, problem pressure translated into technology-forcing abatement policies. First, they were undertaken at the national level; later, these governments tried to persuade less ambitious countries to pursue more stringent pollution abatement policies. The review of the regulations concluded within the UNECE and the EC show that international commitments can be totally or partially avoided (UNECE), or a country may receive special waivers (or "derogations" - in the parlance of the EC). Support for international environmental agreements is largely dependent on pollution-based factors, wealth, technology, and domestic politics.

In the chapters to follow, I will relate the hypotheses derived in Chapters 2 and 3 to a country's support for the international environmental regulations concluded within the UNECE. In Chapter 5, I will present the impact of *pollution configurations* on a country's support for international environmental regulations within the UNECE. The *domestic interface* of the (i) perceived damages, regulatory costs, and technology with (ii) interest group influence over a country's positions will be highlighted in Chapter 6. Furthermore, in Chapter 7, I will focus on the impact which (i) objective environmental damages and (ii) abatement costs had on the support of international environmental regulations in 24 European countries.

5. Pollution - The International Source of Environmental Regulation

Factors influencing the regulatory steps taken by countries can be broadly classified as being of (i) international or (ii) domestic origin. In the specific context of the international regulation of transboundary pollution, the major international factors to be considered in this chapter are transboundary pollution exchanges (or fluxes) as well as ecological vulnerability to these pollutants. The role of domestic factors will be the focus of Chapter 6.

In this chapter, I will (i) briefly review the theories pertaining to pollution as a source of international regulation (Section 5.1.), (ii) describe the data used for the analyses (Section 5.2.), (iii) test the theories outlined previously (Section 5.3.), and (iv) conclude with a summary of the findings (Section 5.4.).

5.1. Theories of Pollution Exchange and International Environmental Regulation

In Chapter 2 three major sets of theories have been outlined which link the international exchange of pollution to a country's willingness to sign international environmental agreements. These comprise the (i) complex interdependence approach, (ii) the foreign environmental policy approach, and (iii) more recent extensions of these two approaches.

In the complex interdependence approach suggested by Keohane and Nye, asymmetries in vulnerability[1] provide a source of power (Keohane/Nye 1989). Since sulfur and nitrogen emissions may travel up to several thousand kilometers before returning to the earth's surface as dry or wet deposition (see Chapter 4), it can be easily shown that emissions in one country affect the environmental quality of other countries. In fact, theses emitter-receptor relationships are modeled by the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) under the auspices of the Executive Board for the Convention on Long-range Transboundary Air Pollution (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution/Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) 1991). Since countries differ sharply on the order of magnitude with which they emit acidifying pollutants (compare the U.K. with Norway) and given prevailing (average yearly) wind patterns, some countries are able to affect other countries in an *asymmetrical* way. As a consequence, emissions of sulfur and nitrogen oxides create an asymmetrical pattern among

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[1] To avoid confusion, "vulnerability" refers to asymmetries of pollution exchange, whereas "ecological vulnerability" refers to threats to an ecosystem's performance as described further below.

recipients of acidifying pollutants. From this *victim perspective* of transboundary pollution, I expect countries which are exposed to high shares of imported pollutants to be willing to sign environmental treaties more often than countries with a low percentage of imported depositions.[2]

In the foreign environmental policy approach, Prittwitz extends this victim perspective to a comprehensive interest-based approach of a country's position on international environmental regulation. In addition to the victim perspective, it also includes *polluter interests* (the socio-economic advantages of continuing to pollute) as well as third party interests (producers of abatement technology; see Chapter 6) (Prittwitz 1984; 1990a). Countries with dominating victim interests, like many Nordic countries, will favor strict environmental regulation as opposed to countries which have dominating polluter interests. The U.K. and Spain are examples of the latter category, since they are both major exporters of acidifying pollutants while enjoying relative minor imports of air pollutants. Two hypotheses can be derived from the foreign environmental policy approach. First, as in the case of the complex interdependence approach, I expect a country's preference for international environmental agreements to covary positively with the share of imported pollutants. Second, major exporters of emissions of pollution are expected to sign international environmental treaties *less* often than minor exporters. This is supposed to hold, because the scale of exported pollutants also reflects avoided abatement costs.

Neo-liberal institutionalists may hold a different position on this last proposition. For them, the reputation of a government in the implementation of international agreements is an asset (Keohane 1984). In international environmental politics, most framework conventions, such as the 1979 LRTAP Convention (see Chapter 4), are supported by most countries - although the specific rules on pollution abatement are phrased rather vaguely. Since the transboundary effects of air pollution emissions are the major aspect to be regulated in international agreements, reductions in pollution emissions are likely to enhance the reputation of a country within an international regime. This does not mean that pollution abatement has to be necessarily in the economic interest of governments, but the pressure of victim countries can become rather uncomfortable for major exporters of pollution. For example, British-Scandinavian relations, which are normally very cordial, became strained because of the impact of British emissions on Scandinavian ecosystems; as a consequence, the U.K. became anxious to offer at least some pollution abatement. The announcement to "implement" the Sulfur Protocol by the end of the century (rather than in 1993) has to be seen in this light. Therefore, it seems plausible for major

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[2] Choosing absolute pollution imports (such as kt of sulfur per year) is not helpful in operationalizing the victim (or deposition) perspective, since the absolute amount of imports only matters in view of some normalization procedure, such as the size of the depositing country or the relationship between domestic and international sources of deposition.

exporters to favor some pollution abatement because of adverse effects across issue areas. Neo-liberal institutionalists would also stress that having signed the framework convention will also be helpful in signing more ambitious agreements on international pollution abatement.

In conclusion, the foreign environmental policy approach extends the analysis of the complex interdependence approach by complementing the victim with a polluter perspective. However, opposing hypotheses can be made with respect to the polluter perspective.

Several extensions of the complex interdependence approach and the foreign environmental policy approach were undertaken by Sætevik (1988) as well as by Sprinz and Vaahtoranta (Sprinz/Vaahtoranta forthcoming). In both studies, *ecological vulnerability*,[3] understood as the exceedance of an ecosystem's capacity to cope with pollution without changing its general performance, plays an important role in explaining support for international environmental agreements on the protection of the North Sea (Sætevik) or international air pollution problems (Sprinz and Vaahtoranta). As a consequence, explanations of international environmental regulation should combine pollution transfer with ecosystem performance. For example, very resilient ecosystems may well be able to endure high import shares of pollutants, whereas extremely vulnerable ecosystems may already be altered by low pollution imports or low domestic depositions.

Several findings of theses studies may guide expectations regarding the influence of (i) pollution and (ii) state of ecosystems on environmental regulation. First, Sætevik finds for the regulation of pollution released into the North Sea that "the dimension 'exchange ratio' [of pollution exports to pollution imports] has a greater unilateral explanatory power than 'degree of affectedness' [or ecological vulnerability] ... on state preferences" (Sætevik 1988, 97). Second, Sprinz and Vaahtoranta find in a comparative case study of (i) the regulation of the stratospheric ozone layer and (ii) the regulation of sulfur emissions in Europe that countries facing a combination of low abatement costs and high ecological vulnerability are much more supportive of environmental agreements as compared to countries with the reverse characteristics (Sprinz/Vaahtoranta forthcoming). By including ecological vulnerability, these extensions of the complex interdependence and foreign environmental policy approach may yield improved explanations. In order to separate them from models presented previously, I will use the qualifier *"extended"* to indicate the incorporation of ecological vulnerability.

First, I suggest for the *extended victim perspective* to combine imported pollutants with ecological or environmental vulnerability of the recipient country. Compared with the traditional victim perspective, this should yield much better predictions for those countries which do not

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3 Sætevik uses the term "affectedness by environmental problems" (Sætevik 1988, 24).

sign international environmental agreement because of their low ecological vulnerability. Thus, the ecological vulnerability acts as a reinforcer for pollution import.

Second, this logic can be applied to the export of pollution. In the *extended polluter perspective*, a country's exports matter most if they are deposited on very vulnerable, foreign ecosystems. This also provides me with a justification of the critique of the polluter perspective mentioned further above: If major pollution exports affect countries with highly vulnerable ecosystems, the exporter is likely to find itself to be the object of diplomatic pressure. Anticipating (or having experienced) this diplomatic configuration, dominant emitters may wish to agree to some sort of internationally accepted regulation so as to alleviate the strain on diplomatic regulation. For example, it may help to sign treaties which point to the need for further studies on the effect of the pollutant under consideration on ecosystems. The 1979 LRTAP Convention (see Chapter 4) and the US-Canadian dispute on transboundary acidification during the mid-1980s provide some evidence to this effect.

Third, the combination of the extended victim and the extended polluter perspective results in the *extended compound interest perspective*. This will allow a simultaneous test of the impact of the interest configuration of a country on its likelihood to sign international environmental agreements. In essence, this would provide an empirical test of Prittwitz' suggestion of compound interest configurations (with the impact of third party interests deferred until Chapter 6). For example, countries with high extended victim interests and high extended polluter interests should be strong supporters of international environmental regulation, because they (i) simultaneously reduce diplomatic pressure resulting from their exported emissions, and (ii) they can hope for other countries - which also sign the treaty - to reduce the imported threat to its ecosystems.

Fourth, international regulations sometimes build on past experience with pollution abatement. Pollution abatement undertaken previously may allow a country to sign an environmental treaty with comparatively little *extra* effort provided that this is permissible under the terms of the agreement. In itself, this *past pollution policy perspective* may take three different versions. First, past success in reducing the pollutants to be regulated internationally permits countries to comply with the treaty at little cost, or, in the extreme, at no costs at all. For example, countries which have embarked on a policy of nuclear electricity production will most likely reduce fossil fuel-powered energy production and thereby reduce sulfur and nitrogen emissions. In the specific case of transboundary acidification, France and Finland may provide excellent cases where one would expect past policies (and lack of additional costs) to account for support for international environmental agreements. Second, signing a prior treaty in the same regulatory domain may lead to autocorrelation: Having taken the first step, like signing the Sulfur Protocol, may be conducive to signing successor treaties, such as the Nitrogen Declaration,

especially if countries have not yet had much experience with domestic abatement of this new pollutant. Alternatively, new technologies, such as the three-way catalytic converter, may allow countries to sign international environmental agreements. This proposition is inherent in institutionalist theories of world politics, however, it is rarely stated very explicitly. Third, for a treaty under consideration (e.g., the Nitrogen Declaration), successful reductions of emissions of a pollution regulated *earlier* (e.g. sulfur) may explain support for international environmental agreements. Combining these three perspectives of the past pollution policy *each* with the extended compound interest perspective should yield strong postdictions of a state's support for international environmental regulation. The combination of pollution interests with actual policies can be interpreted as a set of constraints on the opening positions which governments can take in international environmental negotiations.

5.2. Data Sources and Manipulation

In the analysis of pollution-based explanations of a country's support for international environmental regulation, two different types of data will be used: data on (i) support for international agreements and (ii) pollution data.

As outlined in Chapters 2 and 3, *treaty support* is the dependent, categorical variable in these analyses. For the analyses to follow (Section 5.3.), two agreements were selected: (i) The "Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulfur Emissions or Their Transboundary Fluxes by at Least 30 Per Cent", which was signed in 1985 at Helsinki (UNECE 1985b, also called the *Sulfur or Helsinki Protocol*); and (ii) the "Declaration on the 30 Per Cent Reduction of Nitrogen Oxide Emissions", which was concluded parallel to the Nitrogen Protocol in 1988 at Sofia (Signatory States to the "Declaration on the 30 Per Cent Reduction of Nitrogen Oxide Emissions" 1988, also called the *Nitrogen Declaration*).

The substantive reasons for selecting these two cases is guided by three considerations: First, international environmental agreements should be associated with beneficial results to ecosystems. This eliminates the LRTAP Convention and the EMEP Protocol (see Chapter 4) as potential choices since they are documents defining (i) the domain of long-range transboundary air pollution (LRTAP) and (ii) the research and monitoring activities related to it. In effect, they create the international regime of LRTAP but do not prescribe *specific* abatement policies. The NOx Protocol itself would be a potential candidate since it limits future emissions by its standstill provisions and the duty to negotiate a NOx *reduction* protocol. However, beneficial environmental effects will not be achieved until a major *reduction* of NOx emissions has been concluded and implemented. The NOx Declaration concluded by a subset of signatories to the

NOx Protocol exactly fills this gap by providing a pollution (or emission) reduction agreement. While it is *not* an international treaty, governments feel bound by this agreement as well as the publicity created by NGOs. In addition, the recently agreed upon VOC Protocol (see Chapter 4) could have been chosen, however, this leads me to a second consideration.

Second, availability of high quality data, especially their international exchange, cannot be provided for volatile organic compounds (VOCs); improved monitoring and emission inventories will permit me to undertake parallel analyses in the future.[4]

Third, while some students of cooperation theory investigate the factors which enhance the probability of arriving at (binding) agreements (Keohane et al. forthcoming), it is quite difficult to test for the impact of independent factors in case of lack of variation on the dependent variable. In effect, had all countries supported all agreements, different research techniques would have to be employed to trace the impact of pollution-based variables on treaty support. In fact, the LRTAP Convention, the EMEP Protocol, and the NOx Protocol[5] all share the property of universal or close to universal support, whereas in the cases of the Sulfur Protocol and the NOx Declaration, the international community displays uneven support. However, this is an important property for testing alternative explanations.

In conclusion, the Sulfur Protocol and the NOx Declaration have been chosen for analysis, since they combine the characteristics of substantive ecological impact, availability of data, and variation on the dependent variable.

The actual data sources used in the study comprise documents on the ratification status of the Sulfur (or Helsinki) Protocol, which was taken from sources published by the United Nations Economic Commission for Europe (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution 1991, 16), and for the NOx Declaration(which is *not* a formal international agreement), the publication of the *signatories* in "Acid News", a specialist NGO magazine was chosen (Ågren 1989). It has to be noted that for the case of the Sulfur Protocol, the (former) GDR is the only country to have signed the Protocol without ratifying it (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution 1991, 16). For the case of the NOx Declaration, ratification is not necessary, because it is not an

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4 In addition, the VOC Protocol offers countries to sign the agreement with differential obligations which would have to be quantified with respect to their ecological impact and relative costs. In part, this will prove to be more complicated to asses than simple "across-the-board" pollution reduction protocols.

5 Furthermore, some important variables, such as the (relative) costs of regulation, are *not* available for the NOx Protocol; however, data can be found for the NOx Declaration (see Chapter 6).

international treaty. In both cases, however, implementation can be controlled by EMEP monitoring activities.[6]

Furthermore, this analysis is limited to a subset of 24 countries (listed in Appendix 1) for two reasons.[7] First, pollution *exchange* data are only available for 28 countries (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution/Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) 1991). Of these, three countries show only *very* minor contributions to the transboundary air pollution problem (Albania, Iceland, and Luxembourg), and prior research points to severe rounding problems in indicator construction for extremely small emitters (Sprinz 1990b).[8] Second, only a *small* part of Turkey is covered by the monitoring network EMEP, and, therefore, it has been excluded from the study.[9] In conclusion, data and analyses will be conducted for a set of 24 European countries.

Pollution data on sulfur and nitrogen oxides have been taken from two principal sources. First, pollution data were derived from the Regional Acidification and INformation Simulation Model (RAINS) (Alcamo et al. 1990) which has been developed by the International Institute for Applied Systems Analysis (IIASA).[10] While using EMEP's emitter-receptor matrices of pollution transport, the emission database is largely independent of governmental sources and avoids EMEP's procedure of reliance on officially reported emissions (which may not always be available or plausible). Furthermore, the RAINS model also incorporates a cost module which incorporates internationally comparable cost data for the abatement of acidifying pollutants. Because the RAINS model has been used for consulting the Executive Board Air of the LRTAP

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6 Final judgment of the implementation of these international environmental agreements has to await the years 1993 for the Sulfur Protocol and 1998 for the NOx Declaration.

7 Compared with the list of signatories of the LRTAP Convention, the Holy See, Liechtenstein, and San Marino have been removed from the analysis due to lack of emitter-receptor matrices. Furthermore, these countries are *very* minor emitters of air pollutants.

8 All measures of central tendency for crossnational comparisons would be severely affected without substantive justification for their inclusion.

9 In the case of the (former) Soviet Union, only the European part is covered by EMEP and included in the international agreements. However, despite gaps in monitoring, the Soviet Union has been retained for reasons of ecological and diplomatic importance (see Chapter 4). Furthermore, the former SU is considered to be one country, although the Byelorussian SSR (now Belarus) and the Ukrainian SSR (now Ukraine) are signatories to various treaties. Since EMEP treats the SU as one air-space, I will follow this convention of treating it as one country.

10 Release 5.1 of the RAINS model was used (January 1991). I am grateful to Roderik Shaw and Markus Amann for providing me with access to RAINS.

Convention and for training sessions with national decision-makers, I judge RAINS to be a reliable source of pollution data.[11]

Second, because RAINS data are available only for 1980 and 1985, emission data have been derived from EMEP sources, which have partially been submitted to the United Nations Economic Commission for Europe by national governments (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution/Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) 1991, 11-12). They will only be used for tracing emission *reductions* to assess past policies.[12]

In conclusion, the most reliable data sources have been chosen for the political variables and for the pollution data.

5.3. Empirical Analysis of Pollution-Based Explanations of International Environmental Regulation

The theories proposed in Section 5.1. will now be tested with the data described in Section 5.2. In particular, the victim perspective, the polluter perspective, and more elaborate combinations of these models will be put to the empirical test after a brief introduction to the statistical method used, namely logistic regression.

5.3.1. A Brief Introduction to Logistic Regression

Given the categorical nature of the dependent variable (dichotomy of "0" and "1", such as absence or presence of treaty accession) and this regression-oriented research design, *logistic regression* has been chosen for the analysis of the data (Hosmer/Lemeshow 1989). In brief, the logistic regression analysis uses a logistic curve for fitting the relationship between the independent variable (which may be on a categorical or continuous scale) and a dichotomous

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11 Perfect emission data have never existed, even not for traditional pollutants, such as sulfur and nitrogen oxides. However, the findings reported in this chapter are robust across RAINS and EMEP data sources.

12 Comparisons of RAINS and EMEP emission data for the years 1980 and 1985 show a very high correlation for the cases of sulfur (Pearson's r of .97 in both periods) and for nitrogen (Pearson's r of .85 in both cases). Major discrepancies involve the former SU across pollutants and time, Spanish sulfur emissions in 1985, as well as the nitrogen emissions of Bulgaria, the CSFR, Greece, Poland, and Romania at both time points.

dependent variable. The maximum likelihood estimation method is used to arrive at parameter estimates, since ordinary least squares or linear models estimates would be misleading (Hanushek/Jackson 1977; King 1989).

The particular logistic regression (link) function to be fitted is

$$P(Y=1 \mid x) = \pi(x) = \left(\frac{e^{\beta_0+\beta_1 x}}{1 + e^{\beta_0+\beta_1 x}}\right) = \left(\frac{1}{1 + e^{-(\beta_0+\beta_1 x)}}\right) \qquad (5.1)$$

with $\pi(x)$ denoting the conditional probability P of the event (Y=1) (e.g., accession to a treaty) for the given level of x (e.g., % of pollution imports). The parameters to be estimated are β_0 and β_1 for the constant term and the predictor variable respectively. The logit transformation, $g(x)$ - which is of particular importance for the interpretation of the estimated coefficients - is defined as

$$g(x) = \ln\left(\frac{\pi(x)}{1 - \pi(x)}\right) = \beta_0 + \beta_1 x, \qquad (5.2)$$

and it reports the *log odds ratio* of the parameter estimates for the constant term and the independent variable x (Hosmer/Lemeshow 1989). In fact, all logistic regression coefficients reported in this study are log odds ratios. By exponentiating the estimated parameter coefficients, $e^{\beta_1} = \psi(\hat{\beta}_1)$, we arrive at the odds ratio, ψ, of variable x. The odds ratio itself is the probability of an event happening (such as signatory status to a treaty) *in relation to* the absence of this event (such as non-signatory status) as a result of a unit variation of the independent variable. The odds ratio has proven to be of particular value in epidemiological research due to its intuitive meaning (ibid.) and will also be used in this research. The model presented above can be extended for multivariate analysis (ibid.).

A few words of caution have to be added. Since maximum likelihood estimation is normally used for large sample sizes, and I have only a maximum of 24 countries to be incorporated in this analysis, I expect that conventional benchmarks for assessing statistical significance of large samples may have to relaxed. For assessing statistical significance, I rely on (i) the likelihood ratio test (-2LL) for the complete model[13] and (ii) the significance of the t-statistic of the coefficient estimates.[14]

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13 This test involves a comparison of a model only containing a constant with a fully specified model (including the constant); this procedure assumes the same role as a F-test in linear regression analysis (i.e., it tests the hypothesis that *all* coefficients [excl. the constant] are zero).

14 There is considerable debate of the use of significance tests for parameter estimates *in logistic regression*. Hosmer and Lemeshow as well as Norusis, on the one hand, advise against the use of the Wald statistic referring to studies which report "aberrant" behavior (Hosmer/Lemeshow 1989, 17), nevertheless, they continue to use it in their textbook or manual (Hosmer/Lemeshow 1989; Norousis 1990, B-42). However, they agree on the usefulness of the

In the analyses reported below, pollution-based explanations of support for the Sulfur Protocol and the NOx Declaration will be tested. Since a standard assumption of causal analysis is that the causes have to predate the (suspected) effect (Asher 1983, 12), pollution data for 1980 have been chosen for the Sulfur Protocol (concluded in 1985), and 1985 data were used for the NOx Declaration (concluded in 1988).

5.3.2. The Victim Perspective

As described in the first section of this chapter, the complex interdependence approach and the foreign environmental policy approach share the victim perspective of international environmental regulation. From a victim or deposition perspective, countries are supposed to prefer little international infringements on the quality of their ecosystems.[15] In practical terms, this translates into having as small as possible an international contribution to the pollutant's affecting one's own country, i.e., a small international or foreign share of all *depositions* in one's country. A brief look at the data on the share of imported depositions (Appendix 1; PCIMDES0 denotes the percentage of imported depositions for sulfur in 1980; PCIMDEN5 denotes the percentage of imported depositions for nitrogen oxides) shows that (i) sulfur imports contribute

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likelihood ratio test for the fully specified model. King, on the other hand, defines the Wald statistic as

$$t = W = \frac{\hat{\beta}_1}{S.E.(\hat{\beta}_1)}$$

for comparison of the estimated $\hat{\beta}_1$ values with a null hypothesis of this coefficient being zero; he suggests that a t-distribution may be appropriate in small samples (King 1989, 104). In this study, I will employ both the likelihood ratio test as well as the procedure outlined by King.

In addition, I will report a measure of the *proportional reduction of error* (PRE) (lambda) (Bohrnstedt/Knoke 1988, 308). Lambda summarizes the improvement which the specified model offers beyond the knowledge of the mode of the (observed) dependent variable.

15 Ecosystems may perfectly be transformed or destroyed by pollutants of *domestic* origin. However, since my focus is on international and comparative regulation rather than domestic regulation of pollution, I emphasize *international* pollution exchange. If the substantive part of this study were on the avoidance of trade distortions for the production of commodities which generate acidifying pollutants, the essential research question would be: How can countries assure that none of the major trading competitors has a cost advantage (and an economic trade surplus)? However, this discussion of the effects of environmental regulation on international competitiveness misses a major point: Not internalizing ecological effects (or not adhering to environmental quality standards) leads to "ecologically distorted" economies with little quality of life. Therefore, I prefer to think of governments as a major (but not the only) trustee of their country's environment, and their international and domestic policies as means of securing high environmental quality (see Chapters 1 and 3).

60% of all depositions, on average, whereas it is 78% in the case of nitrogen oxides, and (ii) countries are asymmetrically affected by imports: The U.K. and Spain are hardly vulnerable to imported depositions in both pollution domains, whereas Austria, Norway, and Switzerland import at least 90% (sic!) of their depositions.[16] In order to achieve their environmental goals, the U.K. and Spain could equally rely on domestic policies whereas Austria, Norway, and Switzerland have no alternative than to seek commitments of foreign governments to reduce their acidifying depositions. Therefore, we should expect the former group of countries not to be signatories of the environmental agreements, whereas the latter group of countries should be strong supporters. In Table 5.1, this hypothesis is tested in the European context.

16 The case of the (former) SU is quite different from other European countries due to its geographic size. Most of the pollution transfer occurs within its (former) jurisdiction, and, therefore, the SU wished to have the qualifiers ("or their transboundary fluxes") included in the various Protocols (see Chapter 4).

Table 5.1: The Victim Perspective on the Regulation of Transboundary Acidification

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
% Imported Deposition	.0629**	.0298	2.11	.0356	.0302	1.18
Constant	-3.3051	1.8221	1.81	-2.9757	2.4462	1.22
-2xLog Likelihood (-2LL)	6.488			1.597		
significance (-2LL)	.0109			.2063		
Proportional reduction of error (N=23)	.22			n.a.		
Proportional reduction of error (all cases)	.11			.09		

Note: N = 23 for the analysis of the Sulfur Protocol and N = 24 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, the (former) SU was omitted.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

The proposition of the victim perspective holds remarkably well for the Sulfur Protocol, whereas it fails to be supported for the Nitrogen Declaration.[17] Expressed in odds ratios, every 10% point increase of imported depositions leads to an average 88% increase of signing the Sulfur Protocol (as opposed to not signing it; odds ratio of 1.88) and a 43% increase in the case of the Nitrogen Declaration. In a multinomial analysis of the regulation of NO_X showed similar results.[18] At least for the case of sulfur regulation, we can conclude that the victim perspective holds.

The extended victim perspective, as outlined in Section 5.1., combines imported depositions with a measure of the ecological vulnerability of a country. Because the rock types as

17 In many of the pollution-based explanations, the (former) SU poses severe outlier problems. Since EMEP monitoring of this country is not on par with monitoring of other countries and since the SU, unlike other countries, has substantial intra-country pollution exchange, I decided to remove the SU in those cases where its inclusion would mask clear effects across the remaining countries. This treatment of deviant cases can be seen as an extension of a procedure suggested by Ness for small sample designs (Ness 1985).

18 The multinomial analysis involves analyses of (i) those countries which did not sign *any* international environmental agreement on NO_X with signatories of the Nitrogen Declaration, *and* (ii) signatories of the Nitrogen Protocol with signatories of the Nitrogen Declaration.

well as flora and fauna varies across Europe, not all countries are equally vulnerable to acidifying pollutants. Therefore, the same amount of depositions may have different ecological effects. Countries with relatively 'robust' ecosystems will feel less inclined to sign international environmental agreements than countries which are ecologically extremely vulnerable. While this variation in vulnerability has been understood by policy-makers for a long time, its is only recently that a comparative database has been developed and officially accepted (Hettelingh et al. 1991). The notion of "critical loads" (see Chapter 4) embodies the reference base for the assessment of ecological vulnerability. Depositions in *excess of these critical loads* can then be understood as a measure of ecological degradation. The report by Hettelingh et al. provides data for each 150 x 150 km "grid" of the EMEP monitoring system (Hettelingh et al. 1991). Since (i) sulfur and nitrogen oxides both contribute to the acidification problem and (ii) the report asserts that "the sensitivity of an ecosystem is invariant to distinctions among acidifying compounds [,] only total acidification is relevant", I chose the "exceedance of the critical load of actual acidity (5th percentile)" as the basis for coding (Hettelingh et al. 1991, 19).[19]

A brief look at the variable "domestic exceedance of critical loads" (see Appendix 1; EXCLDO) and the exceedance maps in Hettelingh et al (ibid.) show a wide range of variation of ecological vulnerability across Europe: All of central Europe, including the Netherlands, Belgium, the FRG, the (former) GDR, Switzerland, Austria, Poland, and Czechoslovakia are extremely ecologically vulnerable. This also holds for the southern parts of the Nordic countries. However, the Mediterranean countries, including Portugal, Spain, (southern) Italy, and Greece show a very low degree of ecological vulnerability to the present load of pollution depositions. I expect this marked difference in exceedance of critical loads to translate into differential support for the two agreements. Ecologically vulnerable countries should sign these agreements with a higher likelihood than less ecologically vulnerable countries. In the bivariate analysis of the impact of the exceedance of critical loads on international regulation, conventional standards for significance levels are barely missed (analysis not shown here). This may be due to the fact that

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19 Using the 1st percentile would generate comparatively little variation across Europe. An additional impetus for choosing the 5th over the 1st percentile is that it is unlikely that policy-makers would be willing to protect nearly every ecosystem. The original data, which are geographically referenced, were transformed into country averages from grouped data (6 categories). The arithmetic average reported in Appendix 1 transforms the variable into a continuos variable. Unfortunately, some countries do not allow the release of the ungrouped data to the public, and the procedure chosen remains the best available. As a consequence, the variable created to represent the exceedance of critical loads might therefore perform less convincingly than the underlying continuos (but publicly unknown) distribution of exceedances of critical loads. The 150 x 150 km resolution was debated by the U.K. at the 1991 meeting of the Executive Board Air as misleading the assessment of their country (personal observation and personal interview); the officially submitted detailed map of the U.K. was used for revising the assessment of the U.K. (Hettelingh et al. 1991, A1-76).

the raw data were grouped and the country averages may therefore be distorted. However, using the multiplicative (or interaction) coding of percentage of imported deposition *with* exceedance of critical loads, we arrive at the extended victim perspective (see Table 5.2).

Table 5.2: The *Extended* Victim Perspective on the Regulation of Transboundary Acidification

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
% Imported Deposition x Exceedance of (domestic) critical loads	.0111**	.0049	2.25	.0051*	.0031	1.66
Constant	-2.3441	1.2713	1.84	-1.9412	1.1714	1.66
-2xLog Likelihood (-2LL)	8.310			3.132		
significance (-2LL)	.0039			.0768		
Proportional reduction of error (N=23)	.22			n.a.		
Proportional reduction of error (all cases)	.11			.09		

Note: N = 23 for the analysis of the Sulfur Protocol and N = 24 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, the (former) SU was omitted.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

As has been shown in the previous analysis of the victim perspective, the theoretical predictions are well supported for the Sulfur Protocol. The analysis of the Nitrogen Declaration is approaching statistical significance at the .05 level,[20] but the results lead to the same conclusion as in the case of the Sulfur Protocol. To illustrate the substantive meaning of the interactive coefficient in the case of the Sulfur Protocol, I compute the odds ratio for a 10% increase in imported depositions and an increase of two units of critical loads (e.g., from a medium ecologically vulnerable country to an extremely vulnerably country). In this case, the odds ratio

20 The multinomial analysis leads to the same results.

turns out to be 1.25, i.e., assuming a country could (theoretically) increase its score on these variables by the specified amounts, it would be 25% more likely to sign the Sulfur Protocol as opposed to not signing it.[21,22] The equivalent result for the Nitrogen Declaration is 11%. A brief look at the predicted probabilities in conjunction with diplomatic behavior is equally instructive: On the one hand, Austria, Denmark, the FRG, the Netherlands, Norway, and Sweden all have at least a 75% predicted value for signing the Sulfur Protocol, and in the diplomatic process, they were *all* very supportive after the reversal of position of the FRG in 1982 (see Chapter 4). On the other hand, Greece, Spain, and the U.K. each have less than a .20 predicted probability of signing the Sulfur Protocol, and during the diplomatic bargaining, they have either been active opponents of the Sulfur Protocol, or they have *not actively* participated in the international negotiations at all. To a very substantial degree, estimated probabilities and diplomatic behavior show important parallels.

Comparing the results of the two analyses for the case of the Sulfur Protocol, sharp differences in the magnitude of the effect of a 10% increase of imported depositions become obvious (compare Table 5.1 with Table 5.2). For theoretical reasons, I prefer the extended victim perspective, because ecological vulnerability would have an important effect on decision-makers; in fact, this is the reason why raw data are not made available to the public.[23] Regardless of the specification of the victim perspective, there is substantial evidence that countries experiencing substantial infringements on their ecosystems from abroad are likely to be signatories of the Sulfur Protocol, and, to a lesser degree, the Nitrogen Declaration.

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21 Some false predictions occur because of the use of a rigid threshold of a probability P of .50 for classifying countries into likely supporters and non-supporters of international environmental agreements. More robust procedures, to be invented, would either let the user determine the threshold, or, alternatively, they would withhold judgment within a narrow band around a probability P of .50. An example for the latter suggestion, "robust" logistic regression, would delete countries from the [.45, .55] prediction band for judging the appropriateness of classification. However, due to the small sample size (N_{max}=24), this procedure is not feasible in this study.

22 Two countries have not been well predicted in the analysis of the extended victim perspective (Sulfur Protocol), namely Italy and Poland. Italy, with its southern half being not vulnerable to acidification at all and, in general, a low percentage of imported depositions, has very little ecological incentive to sign the Sulfur Protocol, however, Italy signed the Sulfur Protocol. The reason for this might be the relatively low costs involved for a prosperous countries or pressure from other EC countries. While the role of costs (which is important to the understanding of the Polish case) will be dealt with in Chapters 6 and 7, I have no evidence of EC pressure on Italy to sign the Sulfur Protocol.

23 One might suspect that East Central European governments might not wish these data to be published. However, *by the early 1990s*, the reverse is true: One long established Western democracy (with a long-term policy of secrecy on air pollution data) still objects to the publication of raw data (personal communication).

5.3.3. The Polluter Perspective

The polluter perspective, which has originally been introduced by the foreign environmental policy approach, may enhance our understanding of the interests of a country in avoiding to sign international environmental agreements: The creation of externalities (exported emissions) amounts to a subsidy to polluting activities -- the internalization of which countries wish to avoid. As in the case of the victim perspective, I focus on the international part of pollution transfers, i.e., pollution exports. However, two rival hypotheses have been presented above. On the one hand, high shares of pollution exports[24] may pose an incentive *not* to sign an international treaty (so as to avoid the costs of regulation), and, on the other hand, high pollution exports create an incentive to sign international treaties so as to further a government's reputation. Before testing the polluter perspective, a brief look at the raw data (Appendix 1; PCEXEMS0 represents the percentage of exported emissions for sulfur in 1980, and PCEXEMN5 represents those for nitrogen emissions in 1985) shows that, on average, roughly 53% of a country's sulfur emissions and 72% of nitrogen emissions are exported to another country in the EMEP monitoring area. Combined with the data on the imports of acidifying pollutants it can be easily seen that nitrogen is much more "internationally traded" than sulfur. For the polluter perspective it holds that Belgium and Denmark export more than 75% of their emissions of sulfur. Furthermore, Austria, Belgium, the CSFR, Denmark, the (former) GDR, Hungary, Ireland, the Netherlands, and Switzerland export more than 80% of their emissions. Clearly, in order to protect their own ecosystems, these countries can not rely on domestic emission reductions to protect their own ecosystems. Consequently, joining an international treaty may be advantageous, especially, if the country faces substantial pollution imports. A first, simple model provides partial insights on the impact of pollution exports (see Table 5.3).

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24 The share of pollution export (as well as imports) is largely a function of prevailing wind patterns, industry structure, and location of pollutant activities. Over the short run, they are constant rather than variable. As a consequence, pollution-based theories imply that national governments, aware of their pollution situation, either take advantage of their privileged position (original polluter hypothesis) or feel compelled to limit their victim position (victim perspective).

Table 5.3: The Polluter Perspective on the Regulation of Transboundary Acidification (I)

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
% Exported Emissions	.1099**	.0507	2.17	.0456*	.0334	1.37
Constant	-5.2198	2.5364	2.06	-3.5337	2.5407	1.39
-2xLog Likelihood (-2LL)	8.260			2.499		
significance (-2LL)	.0041			.1139		
Proportional reduction of error (N=23)	.44			n.a.		
Proportional reduction of error (all cases)	.33			.09		

Note: N = 23 for the analysis of the Sulfur Protocol and N = 24 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are *two*-tailed tests. For the analysis of the Sulfur Protocol, the (former) SU was omitted.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

In both cases under investigation, the coefficient is positive: High pollution exports increase the likelihood of support for international environmental agreements. This also holds in a multinomial analysis of the international regulation of nitrogen policies. For the case of the Sulfur Protocol, the coefficient translates into an odds ratio of 3.00 for every 10% increase in sulfur exports, while the odds ratio for a 10% increase of nitrogen exports is 1.57. However, this model may be misspecified for theoretical reasons.

First, while small emitters, like Switzerland, have a high export share, they do not export substantively large amounts. Thus, while the export share is positively associated with signing an international agreement, the absolute size of the pollution exports may show the opposite sign. The analysis presented in Table 5.4 includes the impact of absolute pollution exports (besides the percentage of exported emissions) and partially supports this view; the analysis also reconciles the opposite views on the polluter perspective, namely the cost advantage of externalities versus the costs of reputation.

Table 5.4: The Polluter Perspective on the Regulation of Transboundary Acidification (II)

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
% Exported Emissions	.2194**	.1036	2.12	.0451*	.0330	1.37
Exported Emissions (absolute)	-.0055**	.0029	1.85	.0003	.0006	.45
Constant	-9.0464	4.4178	2.05	-3.6798	2.5365	1.45
-2xLog Likelihood (-2LL)	13.083			2.711		
significance (-2LL)	.0014			.2578		
Proportional reduction of error (N=23)	.56			n.a.		
Proportional reduction of error (all cases)	.44			.00		

Note: N = 23 for the analysis of the Sulfur Protocol and N = 24 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, the (former) SU was omitted.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

For the case of the Sulfur Protocol, substantial support points into the direction that absolutely large exporters are less inclined to sign international treaties when controlling for the percentage of exported emissions.[25] It needs mentioning that the coefficient for the absolute amounts of exported emissions is actually quite large since it applies to every kt of sulfur exported. For example, for every 100 kt of sulfur exported, the odds for signing the Sulfur Protocol is 1.73. As before, the Nitrogen Declaration poses a puzzle: While the signs of the coefficients partially point into the predicted direction, the indicator of the proportional reduction in error suggests that the theoretical model does not provide an improvement over the knowledge of the observed,

25 Alternative specifications for the model would pay particular attention to *extremely* large emitters by also including the squared, absolute pollution exports in the model. Estimation of such a model shows that the squared term turns out to be negative, while the term representing absolute exported emissions is positive. However, this would not change the substantive interpretation of the estimation results presented in Table 5.4: Major absolute exporters are less inclined to sign the Sulfur Protocol, whereas small exporters still favor the Sulfur Protocol. Given the similarity in substantive conclusions, I retain the simpler model.

marginal distribution of the dependent variable. A multinomial analysis of the nitrogen policies leads to the same result.[26]

Second, in analogy to the extended victim perspective, the ecosystems to receive pollution exports would be of additional concern to the emitting country. This implies, that pollution exports are of particular concern when they are deposited in countries with ecologically vulnerable ecosystems - or become more so with the "help" of pollution exports.

Since I have already mentioned that nitrogen pollutants are exported to a higher degree than sulfur, *two* new variables were created reflecting the exceedance of critical loads for the single highest recipient of sulfur and nitrogen oxide exports respectively (see Chapter 4 and Appendix 1; EXCLEXSU represents the exceedance of critical loads of the highest recipient of sulfur exports, and EXCLEXNO represents the same concept for nitrogen exports). The combination of percentage of pollution exports and the level of exceedance of critical loads may be termed the "extended polluter perspective". It is expected that countries scoring high on pollution exports as well as the ecological vulnerability of the "destination" country of their pollution will be more inclined to sign international environmental agreements than countries with the reverse characteristics.

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26 The same substantive results hold *across* pollutants if exported emissions are substituted by total emissions of the pollutants (in Table 5.4).

Table 5.5: The *Extended* Polluter Perspective on the Regulation of Transboundary Acidification

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
% Exported Emissions x Exceedance of critical loads of the major recipient of exports	.0180**	.0093	1.92	.0119**	.0066	1.79
Constant	-2.7232	1.5865	1.72	-3.3110	1.7862	1.85
-2xLog Likelihood (-2LL)	8.177			6.053		
significance (-2LL)	.0042			.0139		
Proportional reduction of error (N<24)	.38			.18		
Proportional reduction of error (all cases)	.22			.09		

Note: N = 22 for the analysis of the Sulfur Protocol and N = 23 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, the (former) SU and the (former) GDR were omitted; the (former) GDR was also omitted from the analysis of the Nitrogen Declaration.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

The analysis (Table 5.5) shows that there is considerable support for the extended polluter perspective for the Sulfur Protocol as well as the Nitrogen Declaration.[27] Similar results are found in a multinomial analysis of support for the international regulation of nitrogen. In addition, an alternative specification of this model with the absolute amount of exports replacing the percentage of exported emissions lacks statistical fit (analysis not shown here).

27 While the SU was removed for reasons mentioned above, the GDR was excluded from the analysis of the Nitrogen Declaration because its inclusion masked an otherwise apparent relationship to be found for the remaining 22 countries. A brief look at the raw data shows, why the GDR is an influential outlier: The (former) GDR is the worst per capita emitter of sulfur *and* nitrogen oxides. The fact of not ratifying the Sulfur Protocol and its lack of support for the Nitrogen Declaration put the GDR in sharp contrast with its (theoretically implied) ecological interests. In Chapter 6, I will try to contribute to a more elaborate explanation of why countries with environmental problems do not sign international environmental agreements.

In conclusion, both the victim and the polluter (or export) perspective receive support in nearly all cases. For substantive reason, I prefer the extended models over their more parsimonious predecessors, especially if one assumes that national governments shall protect the quality of their environment. Simple pollution transfer model cannot achieve this, however, models taking into consideration ecosystem vulnerability circumvent this problem. In the following section, both perspectives will be combined so as to provide a comprehensive test of the international (or pollution-based) sources of international environmental regulation.

5.3.4. The 'Extended Compound Interest Perspective' and the Influence of Past Policy

In his development of the foreign environmental policy approach, Prittwitz integrates the victim and polluter perspective so as to arrive at the aggregate position of a country (Prittwitz 1984; 1990a). As a consequence, country *i* is very likely to sign the agreement if it is strongly affected by pollution import (in the presence of vulnerable ecosystems) *and* if it pollutes other countries *j* (which have sensitive ecosystems). Conversely, this poses an interesting question: Did the U.K. *not* sign any of the two international environmental agreements for ecological reasons? By choosing the multiplicative link between the extended victim and polluter perspective, we can test the proposition of the extended compound interest perspective (see Table 5.6).

Table 5.6: The Extended Compound Interest Perspective on the Regulation of Transboundary Acidification

	Sulfur			Nitrogen		
Explanatory Variables	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
% Imported Deposition x Exceedance of (domestic) critical loads x % Exported Emissions x Exceedance of critical loads of the major recipient of exports	2.34 1)**	1.33 1)	1.76	2.00 1)**	1.03 1)	1.94
Constant	-.7339	.7136	1.03	-1.9783	1.0077	1.96
-2xLog Likelihood (-2LL)	6.097			7.152		
significance (-2LL)	.0135			.0075		
Proportional reduction of error (N=23)	n.a.			.27		
Proportional reduction of error (all cases)	.22			.18		

Note: N = 24 for the analysis of the Sulfur Protocol and N = 23 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. The (former) GDR was omitted from the analysis of the Nitrogen Declaration.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.
1) The coefficient estimate and the standard error have to be multiplied by 10^{-5}.

At first glance, while being in the predicted direction and statistically significant, the coefficient appears to be rather small, and odds ratios seem to imply no sharp deviation from unity. Taking a classificatory approach, the analysis shows that for the Sulfur Protocol, seven countries are misclassified, and nine countries are misclassified in the case of the Nitrogen Declaration.[28] For the Sulfur Protocol, these false predictions are largely concentrating on East Central European countries, whereas there is no clear pattern of misclassifications for the Nitrogen Declaration. Given prior knowledge of the observed behavior and the diplomatic history, the strength of this model seems to be that it predicts some high probability cases for signing the Sulfur Protocol rather well (namely Austria, Belgium, CSFR, the Netherlands, and

28 Of these, two cases are "narrow" misses within a 5% (point) band around a probability of 50% for each of the international agreements.

Switzerland) and a few prominent low probability cases (Greece, Portugal, Spain, and the U.K.). This also holds for the high probability cases of the Nitrogen Declaration (namely Belgium, the Netherlands, as well as Switzerland) and this agreement's low probability cases (Greece, Portugal, Spain, and SU). In conclusion, the results imply that the compound interest perspective may be of merit for further model building.

In review, the Sulfur Protocol seems to perform better in the empirical analysis than the Nitrogen Declaration. In part, first, this may be due to differences in the pollutants' degree of international "travel": The degree of international exchange of sulfur is lower than in the case of nitrogen oxides. This may also be a reason why nearly all countries signed the Nitrogen Protocol, which asks supporters to freeze their emissions. However, this would not explain why so few countries have signed the more demanding Nitrogen Declaration. Second, sulfur data might be based on better quality due to a longer period of monitoring. Higher random variation in the nitrogen data around their true values may then translate into much larger standard errors of the estimates, even if all coefficients are in the theoretically predicted direction. At the present stage, I cannot pass judgment on which of these two factors has played the decisive role. However, it might be the case that previously presented (pollution-based) models omit an important factor for the Nitrogen Declaration. Past pollution policy may be this omitted variable.

Taking the extended compound interest perspective as a point of departure, past pollution policy could affect a country's support in three ways (see Section 5.1.): (i) reduction of emissions of the *same* pollutant prior to concluding the specific treaty, (ii) signing a prior treaty in the *same* pollution domain (or within the same international regime), and (iii), as a combination of the prior two models, emission reductions of a *related* pollutant. In operational terms, I will look at the emission reductions during the period starting in 1980 until the conclusion of the specific international environmental agreement.[29] The test of *prior treaty-specific emission reductions* is presented in Table 5.7.

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29 EMEP data are used here for both pollutants (emission reductions only). Emission data for nitrogen are not of high quality from 1980 to 1985, since formal, European-wide monitoring only started by the mid-1980s. The time series for nitrogen must therefore rely on the earliest emission data published by EMEP or the Executive Board Air of the UNECE - which may vary widely (UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution 1991; UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution/Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) 1991). As a consequence, sulfur data should show better performance for reasons of data quality. Examination of the raw data also suggests that, on average, there has been a ca. 20% reduction of sulfur emissions during 1980-85, whereas Nitrogen emissions increased slightly during 1980-88.

Table 5.7: The Role of Past Policy (I): Prior Pollution Reductions

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
% Emission Reduction Since 1980	.0510**	.0235	2.17	.0261	.0224	1.16
Constant	-.4037	.6284	.64	.0677	.4273	.16
-2xLog Likelihood (-2LL)	6.155			1.585		
significance (-2LL)	.0131			.2080		
Proportional reduction of error (all cases)	.33			.09		

Note: N = 24 for the analysis of the Sulfur Protocol and N = 24 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

The analysis shows that in both cases the coefficient is in the predicted direction.[30] In the case of the Sulfur Protocol, the odds ratio attests to its substantive importance. For example, if countries have reduced their emission by 20% in the past, signing the Sulfur Protocol becomes ca. 2.7 times as likely than not signing it. Fifteen countries have reduced their sulfur emissions by 20% between 1980 and 1985, and most of these countries signed the agreement. Being on the road of compliance helps to sign international environmental agreements!

When combining the extended compound interest perspective with past pollution reductions, I expect that a combination of high vulnerability to pollution exchange to be associated with support for international environmental agreements; in addition, past pollution abatement is positively associated with support for international environmental agreements (Table 5.8).

30 The multinomial analysis of NO_X policies shows that the difference between supporters of the Nitrogen Declaration and the Nitrogen Protocol is better explained than the difference between supporters of the Nitrogen Declaration and those countries which did not sign any international agreement on NO_X. However, these results are not more statistically powerful than the results presented in Table 5.7.

Table 5.8: **The Role of Past Policy (II): Prior Pollution Reductions in the Presence of the Extended Compound Interest Perspective**

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Extended Compound Interest Perspective	4.25 [1)]**	2.38 [1)]	1.79	1.04 [1)]*	6.02 [1)]	1.67
% Emission Reduction Since 1980	.0695**	.0346	2.01	.0256	.0243	1.05
Constant	-2.8797	1.4652	1.97	-1.1763	.7804	1.51
-2xLog Likelihood (-2LL)	13.922			4.991		
significance (-2LL)	.0009			.0824		
Proportional reduction of error (N=23)	.56			n.a.		
Proportional reduction of error (all cases)	.44			.36		

Note: N = 23 for the analysis of the Sulfur Protocol and N = 24 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, the (former) SU was omitted.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.
1) The coefficient estimate and the standard error have to be multiplied by 10^{-5}.

The analysis presented in Table 5.8 shows that a summary measure of the pollution perspective of a country and past reduction policies have independent effects on a country's tendency to sign international environmental agreements. While the analysis of the Nitrogen Declaration shows the coefficients in the predicted direction (which also holds in a multinomial analysis), it may be that the less than desirable data quality leads to deflated coefficient estimates or that a different operationalization of the past policy indicator may be needed.[31] Given that there has not been much practical experience with nitrogen abatement policies during 1980-85 (as compared to sulfur emissions; see raw data in Appendix 1), it might be that past policy experience might stem (i) from signing the Sulfur Protocol - prior the Nitrogen Declaration (Model 1), or, more directly, (ii) from abating *sulfur* emissions during the period 1980-85 (Model 2). I will present these modified models for the Nitrogen Declaration below (Table 5.9).

31 In a five-way interaction of all variables included in Table 5.8, the predictions are well supported *statistically*, however, I decided to stay with the simpler model for reasons of interpretability.

Table 5.9: **The Role of Past Policy (III): The Nitrogen Declaration**

	Model 1			Model 2		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Extended Compound Interest Perspective x Ratification of the Sulfur Protocol	2.77 1)**	1.12 1)	2.47			
Extended Compound Interest Perspective				3.45 1)*	2.16 1)	1.60
% Emission Reduction of *Sulfur* (1980-85)				.1919**	.0905	2.12
Constant	-2.0963	.9049	2.32	-7.7461	3.6602	2.12
-2xLog Likelihood (-2LL)	13.410			22.408		
significance (-2LL)	.0003			.0000		
Proportional reduction of error (all cases)	.55			.73		

Note: N = 24 for Model 1 and Model 2. All significance tests for the coefficients are one-tailed tests based on their predicted sign.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.
1) The coefficient has to be multiplied by 10^{-5}.

Both models presented are simple extensions of the extended compound interest perspective. In Model 1, the ratification status of the Sulfur Protocol acts like a polarizing filter: If and only if a country has signed the Sulfur Protocol, the pollution interest may play any role in determining its status on the *Nitrogen* Declaration. In contrast, Model 2 relies on the additive, continuous component of past reduction policies with the abatement of *sulfur* for determining a country's accession to the Nitrogen Declaration.[32] Both models perform well and support the view that past policies are an important qualifier of a country's pollution-based interests. To explain support for the Nitrogen Declaration, the substantive interpretation of the coefficient for the past emission reductions for *sulfur* is helpful: An odds ratio of 6.81 for every 10% points of sulfur reduced in the past seems to reflect the notion that, in the absence of much experience with the abatement of a specific pollutant, governments may rely on prior experience gained with *other*

32 The estimation of Model 2 (Table 5.9) results in only three misclassifications with 2 of them being "narrow misses" (i.e., within a ± 5% point band around the probability of .50).

pollutants in the same broader policy domain. Past policy experience guides a country's willingness to commit itself to new international environmental regulations.[33]

5.4. Conclusions

In this chapter, various pollution-based explanations of international environmental regulation have been presented and tested against the evidence of the Sulfur Protocol and the Nitrogen Declaration. Derived from theories of complex interdependence and the foreign environmental policy approach, a victim (or import) perspective, a polluter (or export) perspective, and the compound interest perspective were tested. These analytical schemes were augmented by indicators of ecological vulnerability and the impact of past abatements policy on international environmental agreements. Overall, these pollution-based models lend credibility to the explanatory power of these theories and provide a first-order set of expectations for a country's willingness to subscribe to international environmental regulations.

As described above, not in all cases has the support for international environmental agreements been as strong as one might expect. In part, this might be due to the fact that factors other than pollution influence governmental decisions. To provide better explanations of support for international environmental agreements, I turn to the domestic factors which shape governmental preferences in international fora. This will be accomplished in Chapter 6.

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33 For the case of the Nitrogen Declaration, Christer Ågren suggested the specification of a prospective model. In particular, the EFTA countries and some EC countries were willing to introduce the three-way catalytic converter for passenger cars in the mid-1980s (see Chapter 4); as a consequence of a technological solution to an environmental problem, these countries could reasonably hope to implement the Nitrogen Declaration. Regrettably, the precise membership of this group could not yet be determined. In any case, introducing the catalytic converter would serve as a necessary condition for support of the Nitrogen Declaration.

6. Mass Public Attitudes, Resources, and Interests - The Domestic Sources of International Environmental Regulation

> *The most portentous development in the fields of comparative politics and international relations in recent years is the dawning recognition among practitioners in each field of the need to take into account entanglements between the two.*
>
> Robert D. Putnam

In Chapter 5, I have shown how various pollution perspectives explain the accession of governments to international environmental agreements. While these perspectives offered a first-order explanation of national support for international regulation, I did not yet include the domestic "transmission belt" (Lenin) which intervenes between the pollution perspective and support for international environmental regulation (see Chapters 2 and 3). In particular, several countries, such as Poland and the GDR, had unambiguous pollution-based incentives to accede to international environmental regulations. While they might enjoy a free-ride stemming from the emission reductions undertaken by other countries, domestic emission reductions would have lead to an even more pronounced improvement of the quality of their environments. Therefore, the purpose of this chapter is to explain how domestic factors account for an imperfect translation of pollution-based incentives into actual support for international environmental regulation.

I will briefly review the theories which specify the relationship among the domestic factors involved in the analysis in Section 6.1.. After outlining the data sources (Section 6.2.), I will proceed with the empirical analyses of the impact of domestic factors on international environmental regulation. In particular, the analyses will be undertaken with mass public data and elite data (Section 6.3.). In the concluding Section, I will integrate the findings from these analyses (Section 6.4.).

6.1. Theories of the Domestic Sources of International Environmental Regulation

Roughly twenty years after the publication of "Domestic Sources of Foreign Policy" (Rosenau 1967), international relations theory has renewed its interests in the non-systemic (or domestic) factors involved in the formulation of foreign policy. As Gourevitch pointed out in reference to neorealist reasoning, "[d]omestic structure for the 'I.R.' person is an independent or

intervening variable and sometimes an irrelevant one" (Gourevitch 1978, 881). In contrast to Waltz (1979) and despite different perspective on the discipline of international relations, both Putnam and Gourevitch would certainly agree that

> "[a]ny policy pursued by the state must be able to elicit the support of at least enough social elements to sustain the state leaders in power" (Gourevitch 1978, 903).

For Putnam, international negotiations are a simultaneous two-level game: On the one hand, a governmental representative negotiates with a set of foreign countries (Level I), and, on the other hand, s/he is in a bargaining situation with relevant domestic constituencies (Level II) (Putnam 1988). This framework of analysis lends itself to deductive and formal analysis, and its focus on the comparative *dynamics* of a bargaining situation could be easily applied to the analysis of international environmental regulation. However, the theories reviewed in Chapter 2 and integrated in Chapter 3 offer a *static* analysis of various *interest* groups and actors involved in the regulation of the international environment. Given my interest in *substantive* international environmental agreements rather than in negotiation analysis, a static theory may also provide better guidance than a theory of international bargaining which is, understandably, more interested in short-term outcomes.

Typological, conceptual, and empirical analyses characterize the new wave of studies on the domestic sources of international regulation. Karns and Mingst may serve as a representative of the first tradition, namely the typological approach (Karns/Mingst 1991). Their enumeration of contextual and policy process variables spans a wide domain of potential areas of research. Regrettably, the authors do not provide us with an integration of these domestic aspects of international politics.

Within the second category of conceptual perspectives on the domestic sources of international politics, Katzenstein takes a more focused approach by concentrating on state-society relations as a determinant of international (economic) policies (Katzenstein 1989; 1984a). As Gourevitch, he focuses on those interests groups which define public preferences (on foreign economic policy) (Katzenstein 1984b, 18). As a consequence, "foreign ... policy is seen primarily to reflect societal pressures" (ibid., 18). However, this (neo-) corporatist view, in its present stage of theorizing, does not lend itself to specific, a priori expectations, and, therefore, severely compromises external validity. For example, Katzenstein contends that

> [t]he definition of policy objectives is shaped by the ideological outlook and material interests of the ruling coalition. Such coalitions combine elements of the dominant social classes with political power-brokers finding their institutional expression in the party system and in a variety of institutions a step removed from electoral competition - government ministries, industrial associations, and

> large public or private corporations" (Katzenstein 1984c, 306-308, emphasis in the original).

It is not clear on theoretical grounds which particular institutions are relevant, and how they will influence foreign (economic) policy. While political history might suggest interesting hypotheses by way of induction, I prefer an explicit research design which a priori specifies relevant factors and their directional impact. In order to avoid the indeterminacy of Katzenstein's inductive approach, I will sharply limit myself to a group of actors and specify their expected support for international agreements (see Chapter 2 and 3).

Third, the research strategy preferred by this author is more closely represented by three separate studies. In an empirical-quantitative analysis of US domestic regulation of air pollution in the 1970, Crandall shows theoretically and empirically that members of the US Congress from the Frost Belt had promoted air pollution regulations which will slow down the migration of industry to the Sun Belt (Crandall 1983, 110-130). Closer to the realm of international politics, Morrow presents a set of hypotheses derived from a sequential bargaining model and tests these hypotheses regarding the impact of (i) macroeconomic factors as well (ii) congressional behavior on the concessions made by the USA and the (former) SU in international arms control negotiations (Morrow 1991). Furthermore, Magee et al. (1989) have developed a domestic political theory of support for international trade policies (see Chapter 3). In all three studies, domestic interests play an important role in explaining aggregate outcomes. Thus, given an appropriate theory of the domestic sources of international environmental regulation, *directional* hypotheses should be tested.

In conclusion, various strands of theorizing emphasize the importance of domestic factors for the explanation of foreign policy. Because I will not engage in negotiation analysis of the international environmental agreements under consideration, I build on more static theories of comparative theory. However, (neo)corporatist theories lack much specificity in outlining expected relationships between explanatory and outcome variables. As a consequence, I will (i) focus on a concise set of actors involved in the regulation of the international environment and (ii) specify their presumed direction of support for international environmental agreements. Furthermore, I will test these propositions in a cross-national analysis. These hypotheses will be largely taken from a wide range of comparative theories so as to contribute to the exchange of ideas alluded to by Putnam in the opening of this chapter.

As outlined in Chapter 2, postmaterialism may serve as a helpful point of departure for the analysis of mass public attitudes on the environment. However, it is not only postmaterialism which leads to (i) a rising awareness of environmental damage among the mass public as well as (ii) the growth of environmental movements, but, as , Inglehart points out

> [t]he rise of the ecology movement ... has taken place because the public has become more sensitive to the quality of the environment than it was a generation ago" (Inglehart 1990b, 44-45).

Therefore, a combination of perceived damage and postmaterialism should account for a mobilized public and the growth of the ecology movement. Furthermore, the 1980s also saw a rise of (European) green and ecology parties which is partially explained by the rise of postmaterialist values (Inglehart 1990a, 325), and these parties are "a political vehicle for those movement supporters whose grievances have been ignored by the larger established parties" (Müller-Rommel 1989, 17). Moreover,

> most of these parties follow an ideology that consists of strong concern for equal rights ..., *strong ecological* and anti-nuclear power thinking, solidarity with the Third World, demands for unilateral disarmament, and a general left-wing egalitarian disposition. Among others, most New Politics parties stand for ... *protection of the natural environment through the introduction of transnational pollution controls, and more generally an effective environmental policy* against an unquestioned commitment to economic growth" (Müller-Rommel 1990, 217, emphasis added).

While it should be expected that the strength of Green voting behavior will translate into a higher likelihood for the adoption of international environmental regulations, it will not be sufficient to explain green party support solely by way of environmental damage and support for the environmental movement. However, given the scope of this study, I will limit myself to this restrictive specification and, thereby, reduce explanatory power for green party support.

In conclusion, the following line of argument is suggested: Damage to the environment as well as the degree of postmaterialism among the mass public should be positively correlated with (i) a public that holds pro-regulatory attitudes, (ii) the strength of support for environmental movements, and (iii) support for green or ecology parties. These three factors also serve as (conceptual) aggregates on the country level. In turn, I also expect this mass political pressure component to be positively related to support for international environmental regulation (see Figure 6.1).[1]

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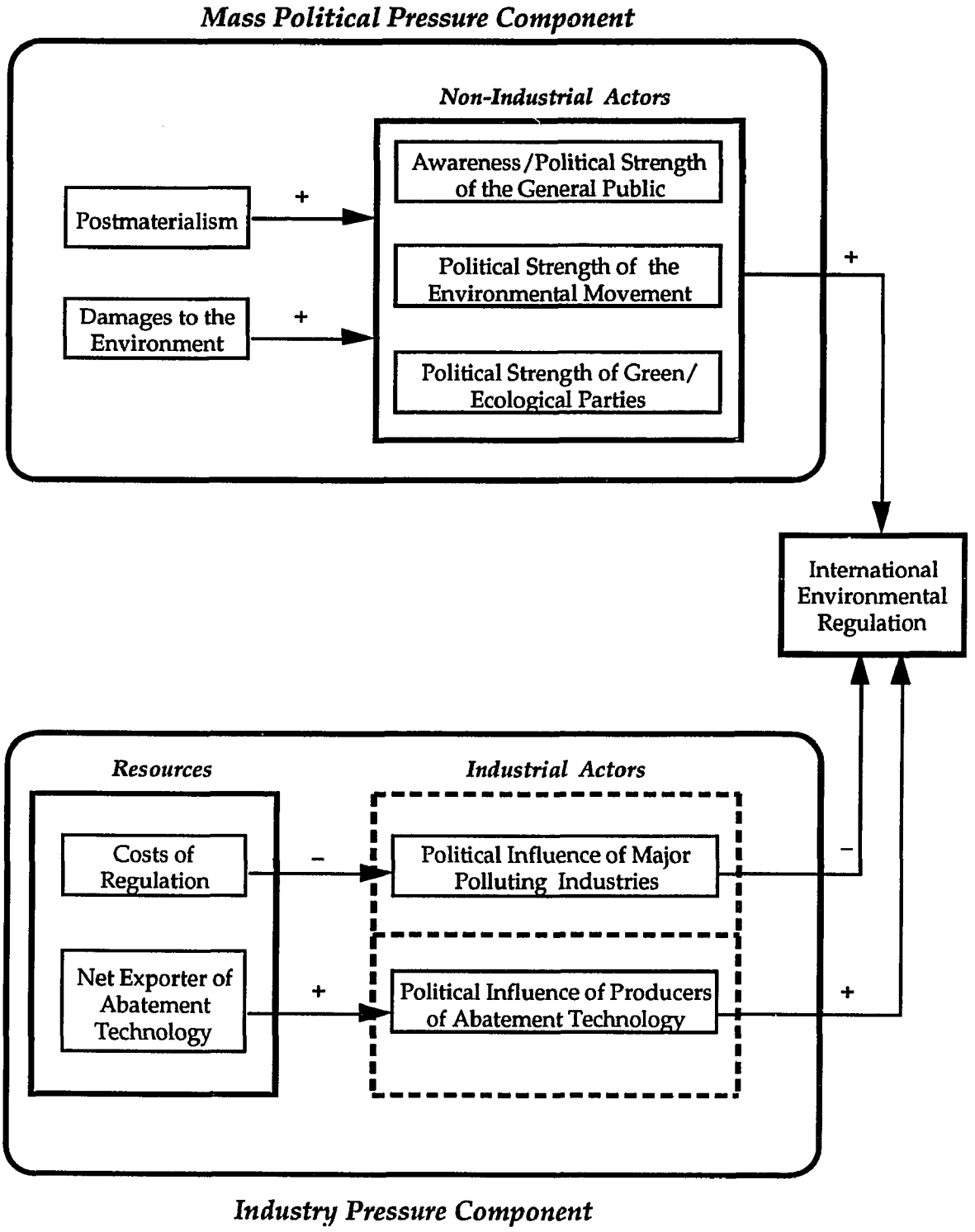
[1] Ideally, a slightly more elaborate explanation would allow these three factors to explain (i) the domestic regulations arrived at, and, consecutively, (ii) support for international environmental regulation. For two reasons, I do *not* follow this modeling strategy. First, from a substantive point of view, the factors outlined above shall be both associated with domestic *and* international regulation. Omitting the domestic regulations in place *before* the conclusion of international environmental treaties will only slightly misspecify the model and lead to somewhat biased estimates. However, taking past reduction policy as a proxy for national regulation (see Chapter 5), it was found that in the case of sulfur emission reductions active pollution abatement is positively associated with support for international environmental regulation. As a consequence, I do not expect the directional hypotheses to be overturned by the

inclusion of a variable representing domestic regulation. Furthermore, since acidification is an international phenomenon and, for most countries, cannot be ameliorated by domestic policy alone (see Chapter 5), it is inconceivable why domestic constituencies should be supportive of environmental regulation on the domestic level *alone*. Second, from a practical standpoint, incorporation of too many conceptually related predictor variables in a small N study (ranging between 9 and 11 for most parts of this chapter) increases the likelihood of multicollinearity among the predictors, and, consequently, inflated variance measures for the coefficient estimates. Furthermore, I have not found data of acceptable quality for the cross-national comparison of *domestic* abatement policies. (An overview of technical regulation with *different* technical standards is, however, available) Given (i) the findings presented in the previous chapter, (ii) my substantive interest in *international* environmental regulation, as well as (iii) the practical considerations outlined above, I will retain the more parsimonious model.

Figure 6.1: The Domestic Sources of International Environmental Regulation - An Overview



Economics is fundamentally concerned with scarcity, and the same holds for politics. Indeed, major (but not all) policies depend on (i) new resources being acquired or (ii) reallocation of resources from previous uses in favor of a new policy domain - such as environmental policies. Given my interest in those international environmental agreements which are supposed to have substantive environmental impacts, I expect that a country's resourcefulness, both economically and technologically, plays an important role. From an economist's point of view, resources should act like a budget constraint in view of the pro-environmental aspirations of a country. Conversely, if we assume that countries only accede to international agreements which they will honor, resources constitute the industry pressure component of international environmental regulation as opposed to the mass political pressure component outlined further above.

In the domain of environmental regulation, two important types of resources may merit particular consideration. First, countries can be conceptualized as a pool of economic wealth, traditionally represented by the Gross Domestic Product (GDP). Given this pool of resources, wealthy countries (with a high GDP per capita) will face less of a budget constraint than poorer countries for the accomplishment of a uniform abatement program - other factors held constant (Jänicke/Mönch 1988). One important factor to be held constant is the absence of substantial resource transfers among countries. However, wealthy countries have been reluctant to commit themselves to substantive international resource transfers: The discussion about the New International Economic Order (NIEO) in the 1970s, the Rio de Janeiro meeting of the UN Conference on Environment and Development (UNCED) in 1992, and the international bargaining on transboundary air pollution (LRTAP) during the 1990s[2] all point into this direction. Therefore, it seems appropriate to assume that countries are largely dependent on their own resource pool.

Second, wealthy countries may also be more likely to develop technologies needed to undertake abatement efforts, especially if they have ecological incentives as a result of substantive damages or an ecologically mobilized public (Jänicke 1990). In the field of environmental regulation, two particular forms of technology seem to be important.[3] First, so-called end-of-pipe (or add-on) technologies control the release of hazardous emissions while

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2 Personal observation at the top level meeting of the Executive Board Air in November 1990 and November 1991. Interviews with government delegates point to a tendency among Scandinavian governments, foremost Sweden, to undertake limited international resource transfers. However, major European countries, such as the FRG (before or after its enlargement of jurisdiction), are unwilling to transfer resources beyond demonstration projects or monitoring equipment. Although it would be actually more cost-efficient for a *pool* of Western European countries to "bribe" some Eastern European countries to undertake emission reductions for the benefit of *Western* (and Eastern) European countries, I could find no evidence of substantial international resource transfers.

3 I am indebted to Andrzej Jagussiewicz for a discussion on this issue.

keeping the industrial processes unaltered. Most common filter and scrubber technologies are representatives of add-on technologies for reducing the emissions of acidifying pollutants. Second, industrial processes can be modified so as to reduce the production of emissions of hazardous substances in the first place. These technologies are called integrated or process technologies (UNECE 1985a, 33-133). Countries which export these products and services undoubtedly have interests to further international environmental regulation *besides* potential victim interests (see Chapter 5).

The introduction of economic and technological factors permits a differentiated assessment of "industry". On the one hand, major polluting industries (smokestack industries such as utilities and smelters, and car manufacturers) are adversely affected by regulations, and, therefore, I expect major polluting industries to favor less stringent regulations (or, alternatively, substantial subsidies). On the other hand, technology producers should have the opposite interest: Environmental regulation creates demand for their products, and, consequently, technology producers should be supportive of environmental regulation (Praetorius 1989) (see Figure 6.1), and their political strength should be positively associated with their degree of net exports of abatement technology.

Overall, the specification of the mass political pressure component and the industry pressure component, as outlined above, provides a more detailed specification of Prittwitz' "capacity hypothesis" (Prittwitz 1990a, 107-108). Rather than referring simply to the importance of the "state of socioeconomic and political-institutional capacities" to deal with environmental hazards (ibid., 108), I suggest a particular set of factors which reflect victim, polluter, and third party (or technology) interests as well as their antecedents on the *domestic* level and international level (see Figure 6.1 and Chapter 5). The empirical analyses to follow in Section 6.3. will test if the mass political pressure component as well as the industry pressure component are helpful in explaining support for international environmental agreements.

In conclusion, I expect countries with strong political pressure components and a developed technology sector to favor international environmental regulation, whereas major polluting industries are likely to oppose stringent regulations. In particular, relatively poor countries, which are also likely to be technology importers, will be less likely to support international regulations - provided they intend to honor their international obligations. However, what should be expected if a country has a strong mass political pressure component, but its resource base is weak? If technology and wealth are interpreted as a budget constraint, it is unlikely that political mobilization will be able to overcome the lack of resources. Conversely, What should be expected of a country with resource abundance despite low political pressure? In effect, it should not be surprising if this country will sign and implement this treaty, since, at worst, the resource requirements are minimal, and, at best, governments will be able to improve

their environmental image. However, some governments may simply ignore such opportunities, since they may not be politically rewarded for their support of internationally coordinated environmental policies. Thus, both the mass political pressure component and the industry pressure components are necessary conditions for international environmental regulation, however, it is unlikely that political mobilization will be able to overcome the effect of *severe* resource restrictions.

The analyses to follow further below (Section 6.3.) concentrate on various aspects of the full model. First, most components of the political pressure component will be tested with aggregated data stemming from surveys of the public. Regrettably, for reasons of data availability, these analyses will be restricted to the members countries of the European Community (EC). Second, I will evaluate the comprehensive model with the help of a written questionnaire which I administered to experts in a group of nine European countries. All geographical regions, political systems, levels of wealth, and various levels of support for international environmental regulation are represented. Before turning to the various analyses of the model in Section 6.3., I will briefly introduce the data sources in the following section.

6.2. Data Sources and Manipulation

The data employed for these two analyses comprise

- Euro-Barometer data (of the Commission of the European Community) for the analysis of mass public attitudes and
- responses to a written questionnaire by elites (or experts) in the field of transboundary air pollution (collected by myself).

6.2.1. Mass Public Attitudes

Twice each year since the mid-1970s, the Commission of the European Community (CEC) sponsors the Euro-Barometer survey of the mass public attitudes among its member states. These surveys normally include a core of civic culture items and a much larger section of questions sponsored by a particular Directorate General of the CEC, the administrative arm of the Commission.[4] Of particular interest to this study are two specialized Eurobarometer studies

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4 I am indebted to Ronald Inglehart for this information.

which concentrate on environmental attitudes of EC citizens: Euro-Barometer 25 (Rabier et al. 1988), and Euro-Barometer 29 (Reif/Melich 1990).[5,6] Since fieldwork for Euro-Barometer 25 was undertaken in April 1986 - shortly after the conclusion of the Sulfur Protocol in November 1985, and since fieldwork for Euro-Barometer 29 was conducted roughly *parallel* to the signing of both the Nitrogen Protocol as well as the Nitrogen Declaration in November 1990, these data sources seem to be adequate for the purpose of this study. Although only data for the 12 member countries of the EC were available, this still represents an adequate distribution of the supporter and non-supporters of the various international environmental agreements, however, EC member countries either signed *both* environmental agreements *or none* of them (compare Table 6.1 with Table 6.2).[7]

Table 6.1: **Support for International Environmental Agreements: Distribution of All Countries (Reference Table and Aggregate Analysis)**

		Nitrogen Declaration		Number of cases (% of total)
		no	yes	
Sulfur Protocol (Ratification)	no	DDR, GR, IRL, PL, P, R, E, UK, YU (N=9)	-- (N=0)	N=9 (38%)
	yes	BG, CS, H, SU (N=4)	A, B, DK, SF, F, D, I, NL, N, S, CH (N=11)	N=15 (63%)
Number of cases (% of total)		N=13 (54%)	N=11 (46%)	N=24 (100%)

sources: Ågren (1989), UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution (1991, 16). Due to rounding, the margins do not necessarily sum up to 100%.

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5 The data utilized in this study were made available by the Inter-University Consortium for Political and Social Research. The data for Euro-Barometer 25 ("Holiday Travel and Environmental Problems, April 1986") were originally collected by Jean-René Rabier, Helene Riffault, and Ronald Inglehart. The data for Euro-Barometer 29 ("Environmental Problems and Cancer, March-April 1988") were originally collected by Karlheinz Reif and Anna Melich. Neither the collectors of the original data nor the Consortium bears any responsibility for the analyses or interpretations presented here.

6 The Department of Political Science of The University of Michigan, Ann Arbor, and Ricardo Rodriguiz were very helpful in accessing the data and in providing generous computational support.

7 As in Chapter 5, Luxembourg was omitted from the analyses due to its minor importance.

Table 6.2: Support for International Environmental Agreements: Distribution of Euro-Barometer/EC Countries (Mass Public Attitudes)

		Nitrogen Declaration		Number of cases (% of total)
		no	yes	
Sulfur Protocol (Ratification)	no	GR, IRL, P, E, UK (N=5)	-- (N=0)	N=5 (45%)
	yes	-- (N=0)	B, DK, F, D, I, NL (N=6)	N=6 (55%)
Number of cases (% of total)		N=5 (45%)	N=6 (55%)	N=11 (100%)

sources: Ågren (1989), UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution (1991, 16).

The Euro-Barometer surveys permit a first test of the political problem pressure component. Both surveys include specific variables representing postmaterialism and the salience of damage caused by acid rain.[8] In addition, variables on environmental movement membership (as a combination of membership in nature protection associations and the ecology movement) (in Euro-Barometer 25), as well as variables representing voting intentions for green or ecological parties (in Euro-Barometer 29) were included. Furthermore, a variable representing environment-macroeconomic trade-offs is included so as to control for the resource component of environmental regulation. All individual-level, non-missing data were aggregated to the country level for cross-national analysis. Following the research design outlined in the previous section, I expect the particular hypotheses to hold in a cross-national analysis of the mass public attitudes for the support of the Sulfur Protocol in 1985 (Euro-Barometer 25) and for support of the Nitrogen Declaration in 1988 (Euro-Barometer 29).

6.2.2. Elite/Expert Data

While the data on mass public attitudes only permit a limited test of the structural model introduced in Section 6.1., I undertook a series of 129 oral interviews with specialized elites or experts in nine countries between November 1990 and October 1991.[9] In addition, 90 participants

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8 The particular phrasing of the questions and the recoding procedures appear in Appendix 2.

9 The series of elite/expert interviews would not have been possible without the generous financial assistance received from the Institute for the Study of World Politics, Washington, D.C., the Population-Environment Dynamics Project (School of Public Health, The University of

also volunteered to return a *written questionnaire* which, in most cases, reached them in advance of the interview. The statistical analysis of the elite/expert data will be based on the completed, written questionnaires, however, references to oral interviews are based on (i) all oral interviews conducted in 9 countries, as well as (ii) interviews undertaken with the professional staff at the UNECE, Geneva, and (iii) the staff of the Directorate General for Environment (DG 11) of the Commission of the European Community, Brussels.

Originally, only 6 countries from Northern, Western, and Southern Europe were included in the study. However, shortly before the anticipated start of the field phase, the political changes in the East European countries made the inclusion of three East Central European countries feasible, and participation rates across the former political/economic East-West divide did not pose a problem. In effect, East Central European elites were as eager as their Western and Northern counterparts to participate in the study, potentially because environmental activities - including publication of monitoring results and epidemiological studies - had often been forbidden until the late 1980s. Thus, the subsample of 9 countries drawn from the set of 24 countries adequately replicates the distributional pattern of support for international environmental regulation (compare Table 6.1 with Table 6.3). In addition, the 9 countries included in the elite/expert study also show considerably variation across (i) the victim and polluter dimensions, (ii) types of (former) political systems, as well as (iii) economic wealth and access to abatement technologies. Therefore, patterns found for this subgroup of nine countries should approximate the relationships to be found in the set of all 24 countries.

Michigan, Ann Arbor, MI), the Horace H. Rackham School of Graduate Studies (The University of Michigan, Ann Arbor, MI), MacArthur Program for International Peace & Security Research (Center for Political Studies, The Institute for Social Research, Ann Arbor, MI), and the Germanistic Society of America, New York, NY.

Table 6.3: Support for International Environmental Agreements: Distribution of Countries Included in the Elite/Expert Study

		Nitrogen Declaration		Number of cases (% of total)
		no	yes	
Sulfur Protocol (Ratification)	no	PL, E, UK (N=3)	(N=0)	N=3 (33%)
	yes	CS, H (N=2)	F, D, NL, S (N=4)	N=6 (67%)
Number of cases (% of total)		N=5 (56%)	N=4 (44%)	N=9 (100%)

sources: Ågren (1989), UNECE/Executive Body for the Convention on Long-Range Transboundary Air Pollution (1991, 16).

In order to test the propositions of the model outlined in Section 6.1., experts were sought in the abovementioned set of countries which represent the

- national Ministry of Environment (or the equivalent regulatory body),
- Foreign Office,
- Committee of the Environment (federal legislature, or the respective committee),
- environmental interest groups,
- industry peak associations (or major industrial firms; regardless of type of ownership),
- natural scientists, and (varying by country)
- social scientists, representatives of political parties (if not already included in the abovementioned categories), labor or trade unions, and environmental consulting firms.

The qualifying characteristic for all participants was their *active* involvement the regulation of sulfur and nitrogen emissions.[10] Functional representation varied across countries. Officials of various Foreign Offices delegated responsibility (for participation in the interviews, and, in part, for international negotiations) to the Ministry of Environment, and Parliamentarians

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10 Without the generous help of many persons and institutes, I would not have been able to execute the interviews in such a diverse set of countries or institutions. I am especially grateful to Christer Ågren, Joseph Alcamo, Leen Hordijk, the International Institute for Applied Systems Analysis (Laxenburg) and their Regional Air Pollution Project in particular, Endre Kovács, Marc Levy, Vladimir Novotny, the Swedish Institute (Stockholm), Peter Sand, Peter H. Stief-Tauch, Lopez de Uralde, and Pierre Woltner for their kind assistance.

(or their assistants) were particularly hard to engage in interviews (with the noted exception of Sweden where transboundary acidification is "mainstream politics"). Natural scientists were particularly well represented in the East Central European samples, however, in general, they felt particularly at home in their respective disciplines and were less eager to talk about the political implications of their research or monitoring activities. Industry peak associations or representatives of firms showed particular interest in the interviews once they were convinced of the difference between investigative journalism and academic elite/expert interview techniques (with full confidentiality assured and a human subject release form in hand). In some countries, environmental interest groups were quite open to participate, in other countries they were too busy to spend time on an academic who will not assure them of immediate publicity (notably in the U.K.). Overall, the elite interviews provided an excellent source of information. The comprehensive test of the propositions outlined in the previous section would not have been possible without the participation of many interview partners in the written questionnaire.[11]

Most respondents received the written questionnaire two weeks in advance of the oral interview.[12] Persons not returning the questionnaire until shortly after the oral interview received two reminder letters with a new questionnaire enclosed with the cover letter. Overall, the response rate, based on those participating in the oral interviews, is 70% (see Table 6.4).[13] Only the case of Spain poses a problem of a very low response rate, however, it also has to be noted that the issue of the regulation of air pollutants is a *relatively* minor environmental issue in Spain. The same holds for the U.K. and Hungary. Particularly in the U.K., it was impossible to get a written questionnaire returned from the Ministry of the Environment despite oral interviews,[14] whereas British Parliamentarians could not be reached due to the onset of the "Gulf War" in early January 1991.

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11 The question wording pertaining to the relevant variables is reprinted in Appendix 3.

12 Peter Sand and Christer Ågren provided valuable assistance in improving question wording.

13 Roughly 20-30 persons per country were originally invited to participate in the study. However, due to the technical and highly specialized nature of the questionnaire (Sprinz 1992), only the persons counted in Table 6.4 participated in the study. While the particular response bias is not known, I suspect, based on oral and written communication, that persons who are less dedicated to the particular issue of the regulation of sulfur and nitrogen emissions will have disproportionately declined to participate. In conclusion, I assume that most of the active participants in the expert interviews constitute a representative sample of the *core* specialists in their respective countries. Biases towards inclusion in the sample are unknown beyond (i) knowledge of English (or, in a few cases, German) and (ii) familiarity with the subject matter.

14 As one British academic assured me, British researchers face the same problem.

In the analyses undertaken, all non-missing cases were aggregated without weighting, and at least two non-missing cases had to be present per variable to compute the country average.[15,16]

Table 6.4: **Response Rates in the Elite/Expert Study**

Country	No. or Oral Interviews	No. of Returned Written Questionnaires	Response Rate to Written Questionnaire[1)]
CSFR	17	14	82%
France	8	6	75%
FRG	18	14	78%
Hungary	13	7	54%
The Netherlands	13	12	92%
Poland	15	11	73%
Spain	12	4	33%
Sweden	22	16	73%
U.K.	11	6	55%
All Countries	129	90	70%

Note: In a few cases (N=4), an oral interview was not possible, *although* the questionnaire was returned. In these cases, the respondent was counted as having participated in the oral interview and as having returned the questionnaire. No more than one interview per country was affected by this procedure.

1) The response rate is defined as: $\left(\frac{\text{No. of Written Questionnaires Returned}}{\text{No. of Oral Interviews}} \times 100\right)$.

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15 Any proper weighting procedure has to rely on *a priori* knowledge of the distribution of a particular characteristic in the population. However, the "true" distribution of all potential participants across functional groups (see above) is unknown. Furthermore, the "true" distribution of functional groups is likely to vary across countries with natural scientists being particularly prominent in East Central Europe and Parliamentarians being particularly well-informed in Northern Europe. For the purpose of the cross-national analysis presented in Section 6.3.2., I have, therefore, decided to use *un*weighted national aggregates for the computation of the average score of each variable.

16 The coding rule of 2 non-missing cases balances the requirement of (i) de-emphasizing extreme scores with (ii) reducing the maximum sample size of 9 countries for the cross-national analysis. A requirement of 3 or more non-missing data per country would have led to the exclusion of the Spanish case in many instances. However, since Spain replicates the pollution situation of the U.K. for sulfur emissions to a considerable degree (and no other "substitute" is available in the remaining sample), the case selection would have become less balanced on theoretical grounds.

After introducing the data for the threefold analysis to be undertaken, the hypotheses put forward in Section 6.1 will be tested below.

6.3. Empirical Analysis of the Domestic Sources of International Environmental Regulation

In this section, I will first proceed with the analysis of mass public attitudes and then present a more detailed analysis with elite data.

6.3.1. The Analysis of Mass Public Attitudes

Due to limitations imposed by the data sources, I will limit the analysis of mass public attitudes to the building blocs of the mass political pressure component (see Figure 6.1). In addition, this part of the study is restricted to the member countries of the European Community.

Given the theoretical perspective chosen, postmaterialism and damages to the environment will influence environmental movement membership which consists of self-declared membership in environmental protection associations and the environment movement. To represent perceived damages to the environment, a variable capturing the explicit mentioning of acidification as one of three top environmental concerns was chosen. Postmaterialism follows the standard 4-item postmaterialism index developed by Inglehart (1977). Two different specifications for the organized non-industrial interest groups were undertaken. First, in Euro-Barometer 25, actual membership in natural protection associations and the environmental movement were grouped together. Second, for the analysis of Eurobarometer 29, an environmental movement variable was *not* available; therefore, I chose a variable representing voting intention for green or ecological parties as a suitable surrogate.[17] In order to provide a

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[17] The latter procedure could also be used for the analysis of Eurobarometer 25. However, support for environmental organizations is much more specific than support for green or ecological parties, because these parties also accommodate other new social movements (see Section 6.1.). In addition, in both Euro-Barometer studies, green or ecological parties were explicitly mentioned in some countries but not in others. In the latter case, they were coded as having zero support. As a consequence, the variable "voting intention" is unlikely to perform conceptually and statistically as well as an environmental movement variable. Some evidence to this point is the negative, cross-national association between environmental movement support and green party voting. This clearly contradicts theoretical expectations, especially since both, the environmental movement and green parties, are, in part, resulting from the rise of postmaterialism (Inglehart 1990a, ch. 11; Müller-Rommel 1989). However, green or ecological

partial analysis of the industry pressure dimension of international environmental regulation, I included a trichotomy index of environment-macroeconomic tradeoffs.[18]

Fortunately, Euro-Barometer 25 had been conducted shortly after the signing of the Sulfur Protocol. Therefore, support for the Sulfur Protocol (see Chapter 5) will be regressed on the independent variables as outlined in Figure 6.2. In addition, fieldwork for Euro-Barometer 29 took place parallel to the signing of the Nitrogen Declaration. Thus, support for the Nitrogen Declaration (see Chapter 5) was regressed on the independent variables as shown in Figure 6.3.

As expected from prior research by Ronald Inglehart (see Section 6.1.), postmaterialism and the awareness of environmental threats go hand in hand. In fact, this association lead to strong multicollinearity among the postdictors in the analysis of (i) membership in natural protection associations or the ecological movement (Euro-Barometer 25)[19] and (ii) voting intention for green or ecological parties (Euro-Barometer 29).[20] Since the *bivariate* regressions between (i) postmaterialism and (ii) environmental damages, on the one hand, and membership in environmental movements, on the other hand, show strong explanatory power (results not shown here), I retained both variables in the analysis (see Figure 6.2).

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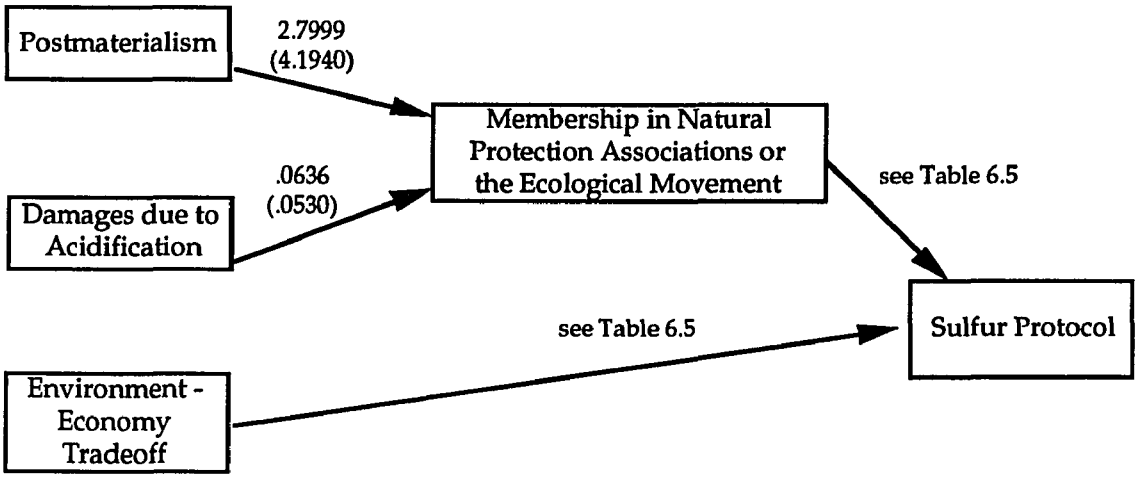
parties came into being in some countries only after 1988, particularly in the Netherlands (Müller-Rommel 1990, 216).

18 See Appendix 3.

19 Membership in the ecological movements and nature protection associations in Denmark and the Netherlands are 3-4 times higher as in the other EC countries. The reasons for this response pattern are unknown. To avoid undue impact of the scores for these two countries on the estimations in the cross-national analysis, I have rescaled these two scores by multiplying the raw scores by .40. This procedure clearly preserves the cross-national rank-order.

20 Multicollinearity will not influence the coefficient estimates, but it will inflate the variances of the estimates. As a consequence, significance test of coefficients are substantially affected (Hanushek/Jackson 1977, 86-93).

Figure 6.2: Mass Public Attitudes and Support for the Sulfur Protocol (Euro-Barometer 25; Path Analysis)

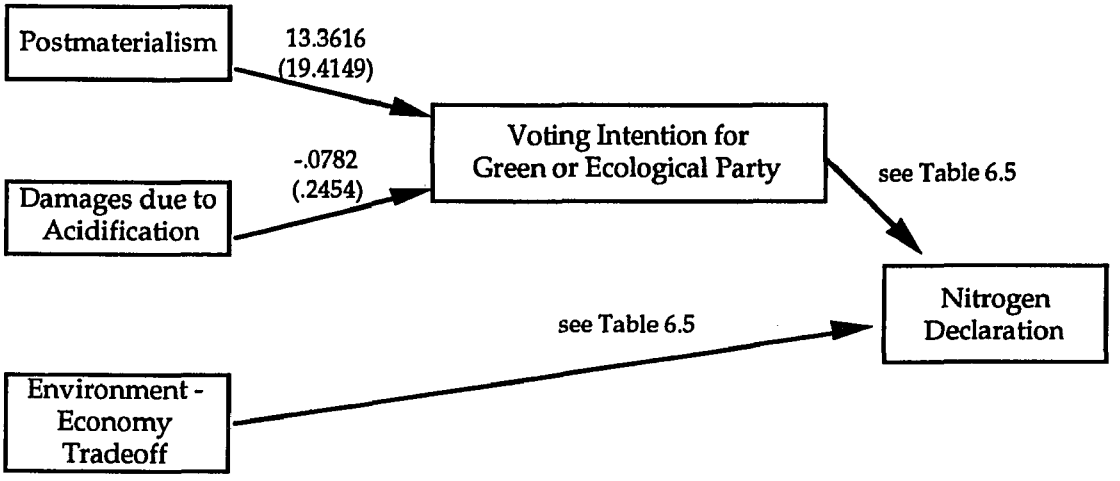


Note: N=11. The score for the membership variable has been rescaled for Denmark and the Netherlands. Entries are unstandardized OLS regression coefficients; standard errors of the coefficients appear in brackets.

In the parallel analysis for the Nitrogen Protocol (Euro-Barometer 29, see Figure 6.3), the voting variable had to be chosen instead of the (theoretically more appropriate) environmental movement variable. While the predictors of voting intention, namely postmaterialism and damages resulting from acidification, are strongly correlated, the variable representing damages shows a very weak *negative* association with voting intention while postmaterialism is positively associated with green voting.[21] In conclusion, I find that postmaterialism is positively associated with support for environmental movements, whereas perceived damages to the environment do not translate into intended voting behavior for green parties in a *cross-national* analysis.

21 See footnote 17.

Figure 6.3: Mass Public Attitudes and Support for the Nitrogen Declaration (Euro-Barometer 29; Path Analysis)



Note: N=11. Entries are unstandardized OLS regression coefficients; standard errors of the coefficients appear in brackets.

The second part of the analysis tests the impact of (i) environmental movement support (Euro-Barometer 25) or (ii) voting for green parties (Euro-Barometer 29) on international environmental regulation. In both cases, I controlled for the resource dimension by way of an environment-economy tradeoff variable (see Table 6.5). Regardless of the analysis undertaken, the analyses show theoretically predicted positive relationship between (i) pro-environmental group support and international environmental regulation, as well as (ii) a positive association between importance of environmental over economic goals and support for international environmental agreements. In particular, the coefficient for environmental movement support achieved a .10 significance level.[22] In substantive terms, a 1% point increase in the membership of ecological and nature protection associations translates into an odds ratio of support for the Sulfur Protocol of 4.90, and a 1% point increase in green voting doubles the odds of signing the Nitrogen Declaration. Furthermore, the economy-ecology trade-off variable also shows substantive coefficients in the theoretically predicted direction. As a consequence, the PRE measures show encouraging results which attest to some postdictive power of both estimation results.

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22 To simplify the analysis, I assumed uncorrelated errors among the dependent variables in all analyses of this chapter.

Table 6.5: **Mass Public Attitudes and Support for International Environmental Regulation**

	Sulfur (Euro-Barometer 25)			Nitrogen (Euro-Barometer 29)		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Membership in Nature Protection Assoc./ Ecological Movement	1.5922*	1.0139	1.57			
Voting for Green/Ecological Party				.7038	.5814	1.21
Environment/Economy Trade-off	12.0729	12.3484	.98	8.5828	9.4616	.91
Constant	-32.2125	30.8859	1.04	-22.7988	23.8876	.95
-2xLog Likelihood (-2LL)	7.107			7.853		
significance (-2LL)	.0286			.0197		
Proportional reduction of error (all cases)	.60			.80		

Note: N = 11 for the analysis of the Sulfur Protocol as well as for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. The score of the membership variable (Euro-Barometer 25) has been rescaled for Denmark and the Netherlands.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

In conclusion, the analysis of aggregated mass public attitudes of EC member countries shows some support for the propositions laid out in Section 6.1. In particular, specific damages and postmaterialism lead to a mobilized mass public in the form of environmental movements, while their impact on green party support is less clear in this cross-national analysis. Although the impact of environmental movement membership and voting attention on a country's support for the particular international environmental agreement does not show high levels of statistical significance, knowledge of the models tested above provides considerable guidance as shown by the indicator of the proportional reduction of error. Since only a partial test of the whole theoretical model was possible with mass public data, I turn to the analysis of elite or expert interviews which covers nearly all aspects of the theoretical model (see Section 6.1.).

6.3.2. The Analysis of Elite or Expert Perceptions

Surveys of mass public attitudes are rarely geared to answering specific questions about a single group of pollutants. Therefore, experts or elites in 9 polities, as described in Section 6.2., were invited to participate in a highly *specialized* survey on the regulation of transboundary air pollution in Europe. In particular, they were asked to respond to questions which capture the research design for this specific analysis (see Figure 6.1). While this degree of specificity is a particular advantage of elite interviewing, one has to expect to deal with a reasonably small group of persons per country. Furthermore, comparative elite studies rarely include more than a handful of countries. As a consequence, statistical "fit" in the cross-national analysis will *not* be comparable to so-called "large N" studies. However, the cross-national analysis of 9 countries will allow me to assess the hypotheses outlined in Section 6.1.

The analysis will proceed in three steps. First, I will analyze the effect of environmental damages on the level of perceived strength of non-industrial actors (mass political pressure component) (see Figure 6.1). Second, I will test which impact various types of resources have on the strength of industrial interests (industry pressure component). Third, I will assess the impact of each of these aggregates on international environmental regulation.

6.3.2.1. The Mass Political Pressure Component

The mass political pressure component assumes that environmental damages activate various political actors. In particular, elites were asked about the importance of the acid rain issue in their country as well as a host of *other* major environmental problems (World Resources Institute 1990). It is hypothesized that, from the perspective of these elites, environmental problems translate into pro-environmental concerns held by the mass publics, as well as into political strength of environmental movements, and green parties. In short, problem pressure activates actors who, in turn, influence governmental elites in their decision-making regarding international environmental agreements. In particular, governments of countries with well-developed non-industrial constituencies are much more likely to sign international environmental agreements as compared to countries where environmental issues are not yet well institutionalized.

The general public, environmental groups, and green parties are involved in the domestic *and* international regulation of sulfur and nitrogen emissions. Both, the domestic and international policy domains, are linked because of the transboundary nature of air pollution and the effects of policies. For this reason, the composite, average score of the impact of these three

actors on the (i) domestic and (ii) international regulations of air pollutants were computed and incorporated in the analyses.[23]

In the empirical analysis, two different approaches were taken to assess the impact of environmental problems on the mobilization of the non-industrial interests: First, it was assumed that *ecological vulnerability* to transboundary acidification would determine the issue-specific strength of the mass public, environmental movement, and green party. While the directional hypothesis was supported in all cases, the strength of association was generally weak.[24] Alternatively, one could assume that a few environmental problems (including acidification) mobilize non-industrial interests. In turn, any of these environmental problems is perceived to be capable to mobilize non-industrial actors on the subject matter of acid rain. In fact, this is underlying the concept of "induced variables" (Alwin 1988): One variable out of a group of *conceptually related* variables triggers variation in the dependent variable. Applied to the regulation of transboundary air pollution, this concept assumes that mobilization for any major environmental issue can be transferred, at least in part, to the regulation of acid depositions. This alternative operationalization was considered by including the importance attributed to

- transboundary acidification,
- population growth,
- decline of tropical rainforests,
- sideeffects of modern agriculture,

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23 In part, this procedure avoids misspecification in those cases where specific pro-environmental interests were prevailing only in the domestic sphere. For example, environmental groups may be very influential in arriving at strict domestic laws, however, they may be less efficient in mobilizing their constituencies for international regulatory processes. (The mobilization of the Franco-German anti-nuclear power movement - which protested the siting of nuclear power plants in Alsace and at Cattenom, are significant exceptions. With the internationalization of coordinated lobbying by Greenpeace International and Friends of the Earth International, my assumption may not hold in the future). However, a country with *strict* domestic regulation should theoretically be willing to sign more *lenient* international regulations, since no additional costs are involved. In the case of Spain, no score for the international component was available due to missing data. The "domestic" score was used as a substitute for the international component.

24 The bivariate regression results of the impact of ecological vulnerability to acid rain on the three non-industrial groups are:

general public:	.397
	(.365)
environment movement:	.287
	(.281)
green or ecological party:	.017
	(.398).

The entries are unstandardized OLS regression coefficients and their standard errors (listed in brackets below the coefficient).

- global climate change,
- biodiversity,
- oceans,
- freshwater, and
- toxic chemicals.

The *maximum score* across these 9 items was chosen for the analysis. Thus, the most important environmental component was assumed to trigger *acid rain-related* strength of mass publics, environmental groups, and ecological parties. This specification worked particularly well: Non-industrial actors may "acquire" political strength on a wide range of environmental issues and use this goodwill to lobby for the regulation of a *particular* environmental problem (see Figures 6.4 and 6.5).[25] In a broader sense, this implies for the case of global warming that countries which have been mobilized on at least one other major environmental problem are likely to respond to the extended greenhouse heating effect. In particular, the results of this study lead to the expectation that the EFTA countries, the Netherlands, and the FRG could be major proponents of stringent regulations on the release of greenhouse heating gases.

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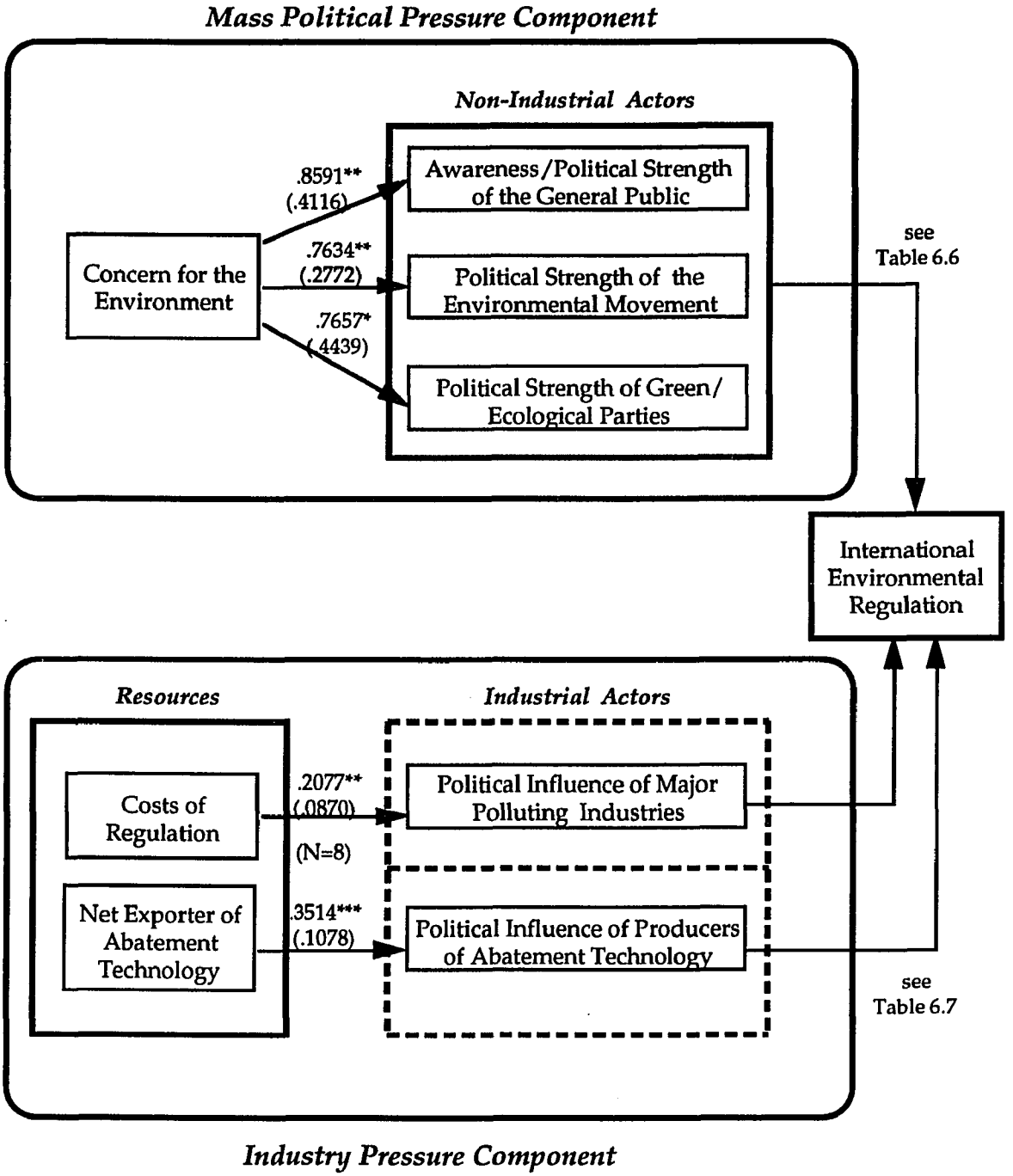
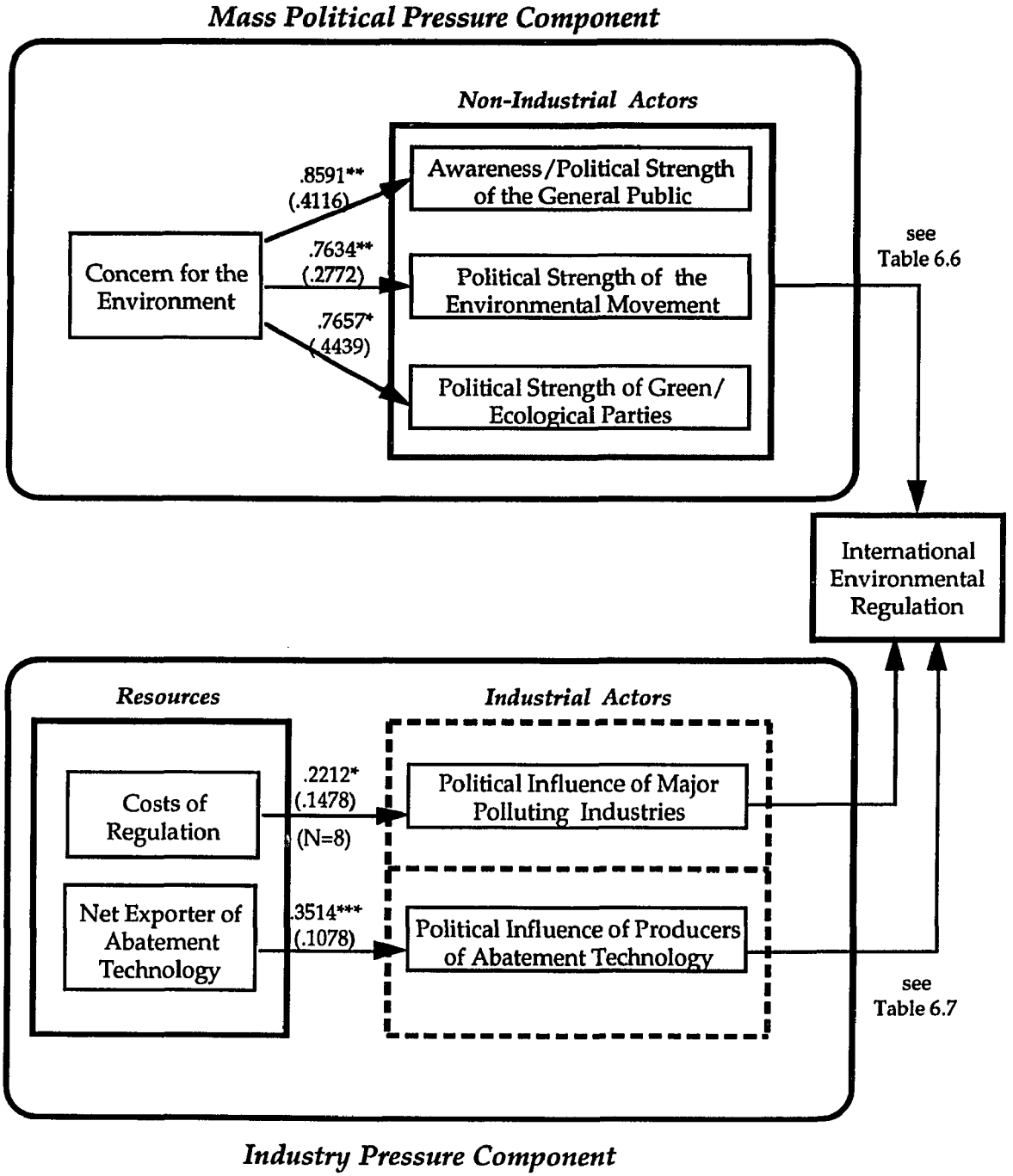
25 Nearly all questions used in the analyses reported here (excl. the costs of regulation) were made *without* specific reference to sulfur or nitrogen oxides. Therefore, most coefficient estimates reported in Figures 6.4 and 6.5 are identical. However, the logistic regression results presented in Tables 6.6 and 6.7 should be different due to differences in support for the Sulfur Protocol and the Nitrogen Declaration. This simplifying procedure had been chosen, since it is nearly impossible to find a substantially large group of experts with familiarity with the technical as well as political aspects of the regulation of air pollution. Many technically-oriented respondents eschewed answers to political questions in the oral interview, and more politically-oriented respondents relied on outside consulting on technological aspects.

Figure 6.4: The Analysis of Elite Perceptions - The Sulfur Protocol



Note: N=9. Entries are unstandardized OLS regression coefficients; standard errors of the coefficients appear in brackets below the coefficient estimates. All significance tests are one-tailed tests based on their predicted sign. All entries but "Costs of Regulation" are identical to the estimates for the Nitrogen Declaration (see Figure 6.5).
* denotes statistical significance at the .10 level, ** at the .05 level; *** at the 0.01 level.

Figure 6.5: The Analysis of Elite Perceptions - The Nitrogen Declaration



Note: N=9. Entries are unstandardized OLS regression coefficients; standard errors of the coefficients appear in brackets below the coefficient estimates. All significance tests are one-tailed tests based on their predicted sign. All entries but "Costs of Regulation" are identical to the estimates for the Nitrogen Declaration (see Figure 6.4).
* denotes statistical significance at the .10 level, ** at the .05 level; *** at the 0.01 level.

6.3.2.2. The Industry Pressure Component

While *non*-industrial interests are likely to be positively associated with support for international environmental regulation, the industry pressure dimension may limit the options which a government has at its disposal. In particular, I have suggested that perceived high costs of regulation will strengthen the position of major polluters, which, in turn, are normally opposed to national and international environmental regulation, particularly if their profitability is affected.[26] However, the opposite is true for the producers of abatement technology, since environmental regulation creates the demand for their products. For this group, I suggest that a net exporter position will strengthen the regulatory clout of technology producers which, in turn, should support international environmental regulation. In the analysis, substantial support for this differentiated perspective of industry interests was found for the case of the international regulation of sulfur emissions and to some degree for the case of nitrogen.[27] In particular, the political strength of abatement technology producers is positively related to their export position, while the costs of regulation spur resistance to regulation by major polluting industries. The theoretical expectations are supported for the industry pressure component (Figures 6.4 and 6.5).

6.2.3.3. The Impact of the Mass Political Pressure Component and the Industry Pressure Component on International Environmental Regulation

In this final step, non-industrial and industrial political strength have been combined in the analysis of support for international environmental regulation. The particular problems encountered in this part of the analysis are related to (i) the small sample size (N=9) in relation to

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26 Major polluting industries include private sector industries (like the German and Italian car manufacturing industry) and public sector industries (such as utilities in many countries and parts of the French automotive industry). Unless they are compensated by subsidies, as the Dutch and German subsidies for "clean" cars, these firms should have an interest in avoiding the higher costs of environmental regulation. However, the motive varies across type of ownership: Privately-owned major polluters might see environmental regulation as a threat to their profits, while publicly-owned major polluters may wish to protect their "x-inefficiency".

27 In the questionnaire, respondents were asked to evaluate the costs implied by the Sulfur Protocol and the Nitrogen *Protocol*. However, the costs associated with compliance with the Nitrogen *Declaration* should be uniformly higher than those for the Nitrogen *Protocol*. Since all nine countries included in this analysis have signed the Nitrogen Protocol as well as the Nitrogen Declaration, I assume that cross-national differences in perceived costs of compliance should roughly translate into similar cross-national cost differences for the implementation of the Nitrogen Declaration. In conclusion, while the first best variable has not been included in the questionnaire, the surrogate measure of perceived costs of the Nitrogen Protocol should still measure the underlying cost differences for complying with the Nitrogen Declaration.

the number of variables to be specified in the mass political pressure and industry pressure components (k=5) and (ii) "perfect fit" of the data (see below). To circumvent the first problem, I suggest to use the idea of an "induced variable" for a second time and apply it to the three non-industrial interests which shape the mass political pressure component. Substantively, this implies that any of the three groups could have had the decisive impact on government decision-makers. As in the previous application of the induced variable concept, the maximum score across the three groups was chosen to represent the impact of these three groups. Unfortunately, the same idea cannot be applied to the influence which the various industry groups hold, because major polluters are assumed to have *opposite* interests as compared to technology producers. However, taking the difference between the strengths of both groups preserves the directional hypothesis: If the influence of the major polluters is subtracted from the influence exerted by technology producers, I expect this composite variable to be *positively* related to support for international environmental regulations.[28] An example might clarify the point: In Sweden, technology producers seem to exert more influence than major polluters do (see Appendix 1, ININMAPO represented the influence of major polluters, and ININEOPT represents the influence of end-of-pipe technology producers). Thus, the difference is positive, and I expect Sweden to sign the various international agreements (other factors held equal). To the degree that polluter interests exceed the influence of technology producers, the composite score turns negatively, and countries shall be less likely to sign international environmental agreements.

These transformed predictor variables produce a *perfect* fit in the theoretically predicted direction for the case of the Sulfur Protocol. The estimation of the case of the Nitrogen Declaration can still proceed with logistic regression and shows theoretically predicted associations. While the coefficient estimates for the explanation of the Nitrogen Declaration do not show high statistical significance, the odds ratios for non-industrial interest representation are of substantial magnitude. This also holds for the PRE measures[29] As Figures 6.6 and 6.7 show for the case of the Sulfur Protocol, the transformed variables are perfectly associated with a country's international regulatory behavior: Countries with mobilized non-industrial interests sign the Sulfur Protocol, as is the case for countries with relatively influential technology producers. Since logistic regression can fit more than one (logistic) curve to these patterns, there

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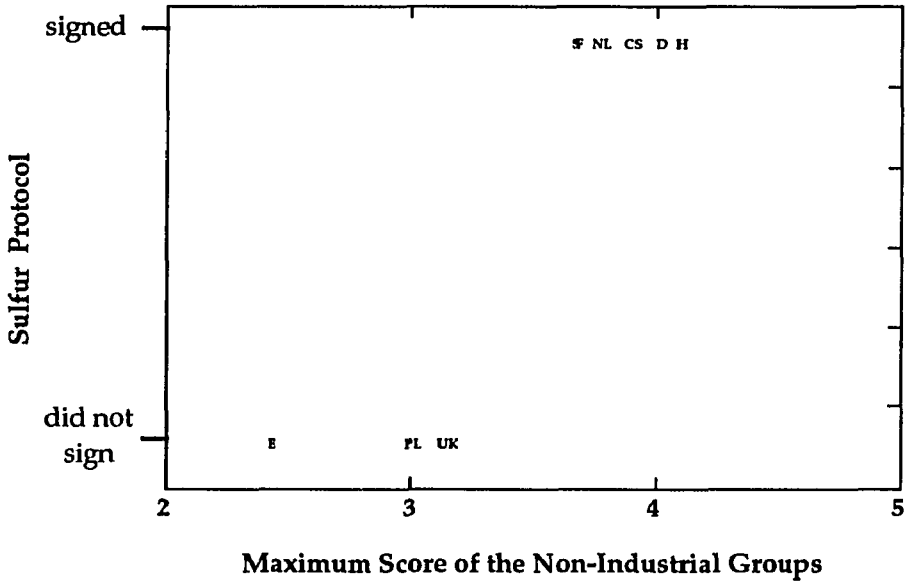
28 Participants in my expert interviews confirmed that end-of-pipe technologies have been widely used in Germany and Sweden as a consequence of domestic air pollution regulations. As a result, these countries have gained substantial experience with these technologies, and, as other countries have been adopting more stringent environmental regulations, Sweden and the FRG have turned into major exporters of abatement technologies. In turn, government officials conceded that this had a beneficial effect on their country's willingness to sign international agreements despite opposition from the major polluting industries.

29 The estimation problems also affect major subcomponents, and they are *not* generated by the induced variable procedure.

will be no unique solution to estimating the coefficients. Instead, the bivariate coefficients have been estimated with ordinary least squares (OLS) and a Weighted Least Squares (WLS) transformation suggested by Hanushek and Jackson (1977, 181-182).

Although OLS is normally *not* the appropriate techniques for the estimation of categorically dependent variables (ibid., 180-186), it provides a first approximation of the strength of relationship in the absence of a converging maximum likelihood (ML) estimation (see Tables 6.6 and 6.7).[30]

Figure 6.6: The Impact of Non-Industrial Interests (Sulfur Protocol)



30 In Table 6.6, Spain was omitted from the analysis of the Sulfur Protocol due to extreme values of regression diagnostics (Cook's D), whereas Hungary was omitted from the analysis of the Nitrogen Declaration for the same reason.

Figure 6.7: **The Impact of Industrial Interests (Sulfur Protocol)**

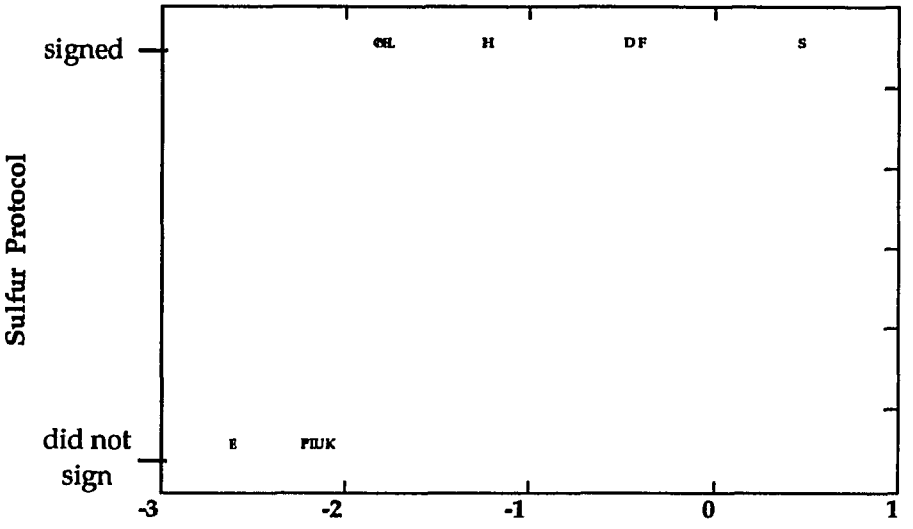


Table 6.6: **Elite Perceptions and Support for International Environmental Agreements: The Influence of Non-Industrial Interests**

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Maximum Score Non-Industrial Groups	1.2984***	.3157	4.11	5.5974	4.1822	1.34
Constant	-3.9331	1.1422	-3.44	-19.5442	14.8688	1.31
-2xLog Likelihood (-2LL)	n.a.			3.986		
significance (-2LL)	n.a.			.0459		
Proportional reduction of error (N=8)	1.00			.75		
Proportional reduction of error (all cases)	1.00			.50		

Note: N = 8 for the analysis of the Sulfur Protocol and for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, Spain was omitted; Hungary was omitted from the analysis of the Nitrogen Declaration. The entries of for the Sulfur Protocol are unstandardized *OLS* regression coefficients and their standard errors, whereas the entries for the Nitrogen Declaration are (unstandardized) *logistic regression* coefficients. Computation of the proportional reduction of error for the Sulfur Protocol is based on a threshold of .5 of the predicted value of signing this agreement. The results for the Sulfur Protocol should be interpreted with caution!

* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

Table 6.7: **Elite Perceptions and Support for International Environmental Agreements: The Influence of Industrial Interests**

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Relative Strength of Producers of Abatement Technology over Major Polluters	.3989**	.1449	2.75	3.2875*	2.0432	1.61
Constant	1.1812	.2240	5.27	4.0804	2.9769	1.37
-2xLog Likelihood (-2LL)	n.a.			6.354		
significance (-2LL)	n.a.			.0117		
Proportional reduction of error (all cases)	1.00			.50		

Note: N = 9 for the analysis of the Sulfur Protocol for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. The entries of for the Sulfur Protocol are unstandardized *OLS* regression coefficients and their standard errors, whereas the entries for the Nitrogen Declaration are (unstandardized) *logistic regression* coefficients. Computation of the proportional reduction of error for the Sulfur Protocol is based on a threshold of .5 of the predicted value of signing this agreement. The results for the Sulfur Protocol should be interpreted with caution!
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

While the OLS results quantify the visual pattern, it cannot capture the functional form of a logistic curve, and OLS cannot appropriately deal with predicted values outside the [0, 1] interval for a (2-level) categorically dependent variable (Hanushek/Jackson 1977, 185). To check for the plausibility of the substantive conclusions from the OLS results, the models in Tables 6.6 and 6.7 (Sulfur Protocol only) were reestimated with a Weighted Least Squares (WLS) procedure while forcing predicted values into the [.05, .95] interval.[31] The estimated results (see Table 6.8

31 The procedure adopted follows a recommendation by Hanushek and Jackson (1977, 181-182). In a first round, OLS estimation (see Tables 6.6 and 6.7) generates the weights to be attributed to each case. In addition, predicted values from the first round were truncated to the [.05, .95] interval so as to avoid too much influence by extreme values around "0" and "1". This specification procedure had a substantial impact on the weights to be attributed to the cases, however, the substantive results of the second round (WLS) estimations are independent of the particular truncation interval considered here.

for a comparison of *standardized* OLS results and Table 6.9 for the *standardized* WLS results)[32] point to much larger standardized coefficients in the WLS analysis, and, in one case, substantial improvement of statistical fit. In summary, the choice of procedure does not change the substantive conclusion that non-industrial and industrial interests are positively related to support for the Sulfur Protocol, and, to a lesser degree, this also holds for the explanation of the Nitrogen Declaration.[33] With respect to global warming, I expect that environmentally ambitious countries, which are likely to have domestic technology providers (such as Sweden and the FRG), will be pushing for the reduction of greenhouse heating gases. On the other extreme, Spain and Poland should be reluctant to join these countries due to the influence of major polluting industries (and lack of overall resources). Since the energy sector is of much importance for the regulation of acidifying pollutants as well as global warming, these conclusions may merit further attention.

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32 The WLS procedure lead some countries to show extreme values on regression diagnostics. For the analyses presented below, Spain has been removed from the analysis of the non-industrial interests, and Sweden was removed from the analysis of industrial interests. As Figures 6.6 and 6.7 suggest, both countries show extreme values in the respective analyses (Fox 1991, 34).

33 A simultaneous test of the impact of non-industrial *and* industrial interests on support for the regulation of sulfur shows substantively and statistically strong relationships between predictors and outcome variables in a WLS analysis. Inspection of these results point to a statistically stronger impact of the non-industrial groups than those of industrial groups on support for the Sulfur Protocol. In the analysis of the combined impact of industrial and non-industrial interests on the Nitrogen Declaration, the logistic regression results point to (i) a slightly positive association between the industrial interests and the dependent variable and (ii) an extremely small *negative* relation between non-industrial interests and the Nitrogen Declaration. It has to be noted that logistic regression, as an ML estimation technique, is normally more vulnerable to sample size (N=9) than OLS is. In fact, small sample properties of ML are generally unknown. Since substantive conclusions about the fit of models cannot be made across different estimation procedures (WLS versus ML for categorical variables), I cannot conclude that one international agreement is better explained than the other. However, visual inspection of the *bivariate* relationships of both predictors on the various agreements shows that the relationships in the case of sulfur regulation are always clearer than is the case of the regulation of nitrogen oxides. This lack of fit for the case of nitrogen oxides is due to the high scores of non-industrial interests for Hungary and the CSFR. These scores might more accurately reflect the situation in 1990-91 (when the interviews were conducted) than was the situation in 1985 and 1988 (conclusion of the various agreements). A prospective, diachronic research design would be helpful in clarifying this anomaly, however, this could not be done in the present analysis.

Table 6.8: **Ordinary Least Squares (OLS) Estimate of the Impact of Non-Industrial and Industrial Interests on Support for the Sulfur Protocol**

	Sulfur			Sulfur		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Maximum Score Non-Industrial Groups	.8592***	.2089	4.11			
Relative Strength of Producers of Abatement Technology over Major Polluters				.7783***	.2564	3.04
Constant	-3.9331	1.1422		1.4793	.3076	4.81

Note: N = 8 for each analysis. Entries are *standardized, bivariate* regression scores and their standard errors. In the analysis of non-industrial groups, Spain is omitted from the analysis, while Sweden is omitted from the analysis of the industrial interests. All significance tests for the coefficients are one-tailed tests based on their predicted sign.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

Table 6.9: **Weighted Least Squares (WLS) Estimate of the Impact of Non-Industrial and Industrial Interests on Support for the Sulfur Protocol**

	Sulfur			Sulfur		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Maximum Score Non-Industrial Groups	4.6533***	1.0119	4.60			
Relative Strength of Producers of Abatement Technology over Major Polluters				.9847***	.1907	5.16
Weight Variable	-3.7249	1.0119	-3.68	1.6442	.1907	8.62

Note: N = 8 for each analysis. Entries are *standardized, bivariate* regression scores and their standard errors. In the analysis of non-industrial groups, Spain is omitted from the analysis, while Sweden is omitted from the analysis of the industrial interests. All significance tests for the coefficients are one-tailed tests based on their predicted sign. Computation of the proportional reduction has been omitted due to the rescaling of variances associated with WLS.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

The analysis of the elite perspective on international environmental agreements showed that a (i) mass political pressure component and (ii) industry pressure component help to explain national positions on international environmental regulation. Although the small sample of countries included in the analysis (i) does not lend itself to strong statistical conclusions, and (ii) interpretation shall always proceed with caution in view of the assumptions explicitly made, the major propositions should hold for all 24 countries. A partial test of this proposition will be provided in Chapter 7.

6.4. Conclusions

In this chapter, I have developed a general model of the domestic sources of international environmental regulation. In particular, I hypothesized that ecological damages - in combination with the rise of postmaterialism - mobilize (i) mass publics, (ii) environmental movements, and (iii) green or ecological parties to demand international environmental agreements. This mass political pressure component has been juxtaposed with an industry pressure component. Particular emphasis has been placed on the influence which wealth and technology have. It was also hypothesized that a growing influence of technology providers will be positively associated with the support for international environmental regulation, whereas major polluters are likely to hold opposite preferences.

In the empirical analysis, data on mass public attitudes and elite perceptions were employed for the various components of this general model. In general, support was found for the major hypotheses, however, in most cases, there was stronger support for the case of the Sulfur Protocol than for the Nitrogen Declaration. Furthermore, the small ("most different cases") sample design provided particular challenges for the estimation with maximum likelihood, whereas the measure of proportional reduction of error points to the classificatory strength of the estimation results. While theoretical propositions shall always be tested for their external validity, it seems that the combination of mass political pressures and industrial interests provides adequate guidance for the study of international environmental regulation.

In a theoretical perspective, I have specified (in terms of political actors) how a combination of ecological pressures and economic factors (Jänicke/Mönch 1988) account for international environmental regulation, and I tested a more elaborate version of the "capacity hypothesis" (Prittwitz 1990a). Furthermore, the implications of an endogenous policy model were tested. Given the results of the various analyses presented above, I conclude that the ability of a country to further environmental quality in a world of transboundary pollution is well served by a mobilized citizenry in combination with economic and technological factors, and both are needed to turn the protection of the international environment into reality.

7. An Aggregate-Level Analysis of International Environmental Regulation with Objective Data

There is no such thing as a free lunch.

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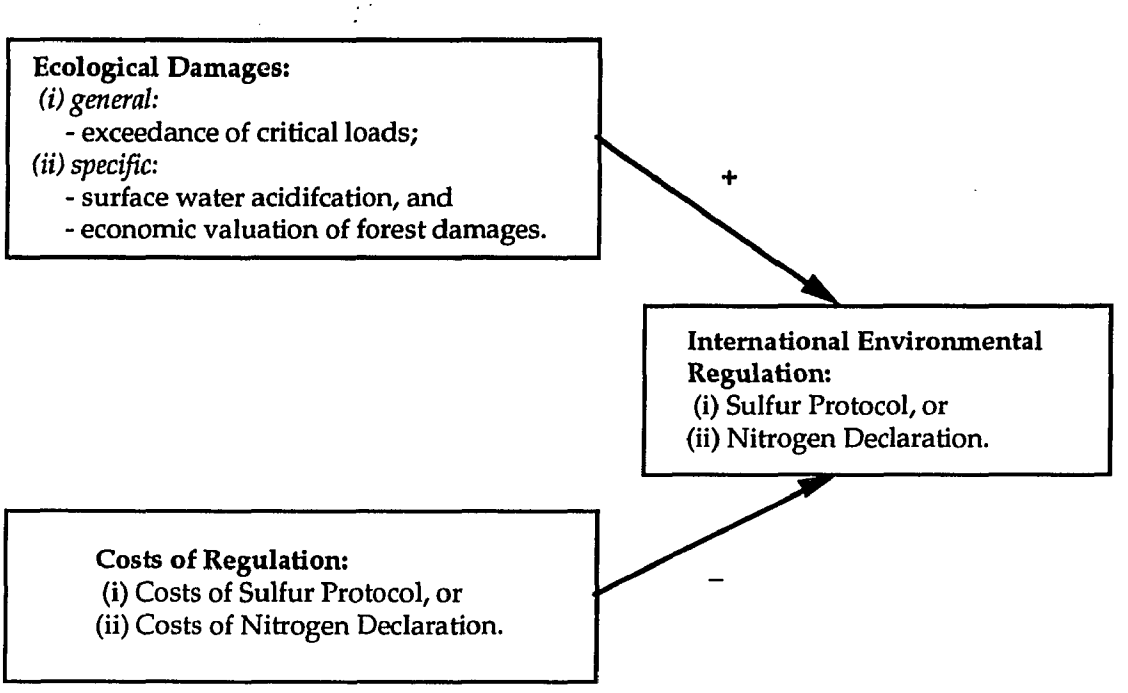
The purpose of the aggregate analysis is to provide a partial generalization of the basic argument presented in Chapter 6. In particular, I have suggested that, inter alias, (i) damage to ecosystems is "igniting" the mass political pressure component, and that (ii) costs of regulation account for the behavior of some important economic actors within a country. Since this theoretical model employed in Chapter 6 (see Figure 6.1) ultimately rests on the existence of environmental damages and a resource constraint, a test of the impact of these two crucial factors on international environmental regulation may provide evidence that the explanatory pattern pertains to *all* European countries. To this end, I will rely on engineering and ecological data.

In particular, I will test the hypotheses that (i) the extent of ecological damages is positively associated with support for international environmental agreements, and (ii) the relative costs of regulation are negatively related to international regulation (see Figure 7.1).

It has to be noted that sulfur and nitrogen emissions *simultaneously* contribute to the deterioration of ecosystems. Therefore, the scores on the variable representing ecological damages will be the same in the analysis of the Sulfur Protocol and the Nitrogen Declaration. However, the costs of regulation will be specific to the pollutant under consideration.

Figure 7.1: The Impact of Ecocological Damages and Costs of Regulation on International Environmental Regulation



7.1. Data Sources

Environmental damages will be represented by the "exceedance of critical loads" which have been introduced in Chapter 5. In addition to this generalized concept of an ecosystem's vulnerability, specific damages to ecosystems can alternatively be included into the analysis. As Chapter 4 has shown, surface water damages were of particular concern to the Nordic countries, and forest damages played a particular role for Central European countries. The data for *surface water acidification* were taken from a questionnaire which the UNECE sent to all signatories of the LRTAP Convention (UNECE 1989, 47-88). Since a comparative data base can not provided by this UNECE report, I qualitatively coded the data from a summary map (ibid., 80): All countries without any surface water damages received a code of "0", and countries with very minor regions (relative to total country size) being affected by surface acidification have been coded as "1". Countries with higher damages received a score of "2".

To evaluate *forest damages*, I relied on a study conducted the Forestry Project of IIASA. In essence, the Forestry Project estimated the damages to harvest reductions due to the air pollution

for a one-hundred year forest growth cycle (Nilsson 1991; Options 1990). For the purposes of this study, I focus on the estimated yearly damages to (i) roundwood and (ii) the forestry industry which are expressed in 1987 US Dollars (ibid.).[1,2] To make these damages comparable across countries, the damages were expressed as a *yearly* percentage of each country's Gross Domestic Product (GDP) (see below).[3]

Data on the cost of regulation for the set of all 24 countries are provided by the Regional Air Pollution Project (formerly: Transboundary Air Pollution Project) of IIASA (Amann/Kornai 1987; Amann 1989). Purposely, I chose data which were available *closest* to the conclusion of the Sulfur Protocol and the Nitrogen Declaration, since this procedure approximates the knowledge base which decision-makers might have had at the relevant points in time.[4]

First, for the case of the Sulfur Protocol, the *yearly* abatements costs for a 30% reduction of 1980 sulfur emission (by the year 2000[5]), mandated by the Sulfur Protocol, are based on policies which include "fuel substitution, use of low sulfur fuels, fuel desulphurization, combustion modification, ... flue gas desulphurization..., [and] high efficient flue gas cleaning methods" (Amann/Kornai 1987). Furthermore, the authors of the study assume a "competitive market for desulphurization equipment, accessible for all countries throughout Europe" (ibid., 2), while the option of an energy conservation strategy has been *ex*cluded (ibid., 3).

Second, for the reduction of nitrogen oxide emissions, the costs associated with the efficient use of (i) combustion modification techniques and selective catalytic reduction for stationary sources as well as (ii) various forms of catalytic converters for mobile sources have been evaluated (Amann 1989). The data used in the analysis reflect the costs of reducing 1980 (!) NOx emissions by 30% until the year 2000. As in the case of sulfur, only technological means had been considered by IIASA.[6]

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1 I have excluded non-wood (or social) benefits which are less well measured than (i) the reduction in forest growth as well as (ii) the associated impact on the forestry industry.

2 All data are taken from Options (1990, 6), except for Italy due to a potential misprinting; I substituted data from a more recent publication instead (Nilsson 1991, 111). For the former SU, only its European parts were included (as is the policy of EMEP, see Chapter 5) (Nilsson 1991, 112). Since data for Ireland and Spain are not available from any of the sources referred to, both countries had to be excluded from the specific analyses.

3 I did not convert 1987 (constant) USD to 1988 (constant) USD, because (i) such fine-grained, international economic data are not yet available (see below), and (ii) the lack of substantive importance that a conversion would have for a one-year time span.

4 These data are necessarily subject to revision, even for OECD member countries.

5 IIASA calculations (like Amann/Kornai 1987) are based on the year 2000 rather than the year 1993 (target year for the implementation of the Helsinki Protocol). The reason for this procedure is related to assumptions about the development of the energy market until the year 2000.

6 The Nitrogen Declaration permits stipulation of any base year between 1980 and 1986. The effect of this rule should be that countries will choose the year of *maximum* emissions between 1980 and 1986. However, no emission data base with *yearly* emissions of NOx could be found for

Since the yearly costs of abatement for both pollutants have been computed in German Marks (DM) for all countries, they were converted into US Dollars (USD) at an exchange rate of 2.22 DM/USD, the average exchange rate between both currencies between 1982 and 1990 (International Energy Agency/Organization for Economic Co-operation and Development 1991, 216).

In order to compare the *relative effort* to be faced by compliant countries, the costs of regulation were expressed in relationship to their Gross Domestic Product (GDP). However, economic comparisons between OECD member countries and the (former) members of the Council for Mutual Economic Assistance (CMEA, the former trading bloc of Eastern European countries) are particularly difficult. The current economic reassessments of East Central Europe also reveal that most Western statistics had *overestimated* the Net Material Product (NMP) of CMEA member countries; in part, this was due to administratively set exchange rates. An additional point of divergence between the computation of the NMP of CMEA member countries and the GDP of OECD countries has been the inclusion of services into the GDP and omission of certain services from the NMP. The Economist attempts adjustments for both factors of divergence (Economist 1990, 32-35).

7.2 Analysis of the Effect of Aggregate Factors

The test of the hypotheses will first proceed with the *generalized* concept of environmental damages, namely "exceedances of critical loads"[7] (see Chapter 5). In addition, *specialized* concepts of damages will be introduced in two additional analyses: the damage to surface waters (salient especially to the Nordic countries), and the economic damages to forestry (of particular importance to Central European countries and the Nordic countries, see Chapter 4). In any case, I suspect environmental damages to be positively associated with international environmental regulation, whereas I suggest the reverse effect of the costs of regulation (see Chapter 6).

The logistic regression analysis of the *general* case (see Table 7.1) shows for the Sulfur Protocol that the expectations are met: Ecological Damages are positively associated with international environmental regulation and high costs of implementation restrict the regulatory

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the period 1980-1986 to check the *substantive* impact of the particular obligation specified in the Nitrogen Declaration.

7 This concepts simultaneously incorporates the ecological vulnerability of soils, surface water, and forests.

ambitions of some countries.[8] For example, a 1 unit increase in the country-wide classification of the exceedances of critical loads makes this country 2.26 times as likely to sign the Sulfur Protocol as compared to not signing it; and a .1% point increase in the costs of implementing the Sulfur Protocol reduces support by one-half. In other words, the environmental problem pressure dimension and the resource dimension behaved as predicted and are of substantive magnitude. However, in the analysis of the Nitrogen Declaration, I found only support for the hypothesis that *higher* costs of regulation are detrimental to signing the Nitrogen Declaration. A more detailed, multinomial analysis of the regulation of nitrogen (results not shown here) points to a more differentiated picture: For the analysis of the differences between supporters of the Nitrogen Protocol and the Nitrogen Declaration, the findings reported above hold. However for countries not participating in *any* nitrogen-related agreement, costs are high and exceedances of critical loads are low. None of the coefficients for exceedances of critical loads approaches statistical significance in the multinomial analysis. In substantive terms, I suggest for the general case that ecological vulnerability and low costs are conducive to signing the Sulfur Protocol, whereas costs of nitrogen regulation seem to explain the tradeoff which *most* poorer countries face in view of impediments to the quality of their environments. Western and Northern European countries can respond to the environmental challenges, and environmental groups can push resource-rich countries. Their East Central European counterparts may be equally enthusiastic in terms of regulatory will, but they are less well endowed to meet the environmental challenges.

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8 The omitted case of Bulgaria, an extremely influential case in the estimation (Cook's D=2.26) shows extremely high costs of regulation of sulfur (3 times the average) and average ecological vulnerability.

Table 7.1 **The Effect of Ecological Damages and Costs of Regulation on International Environmental Regulation (I): The "General" Case**

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Exceedance of Critical Loads	.8147*	.5298	1.54	-.0423	.4043	.10
Costs of Regulation	-6.9197**	3.1259	2.21	-12.9441*	9.4359	1.37
Constant	-1.1357	1.8404	.62	1.3161	2.2215	.59
-2xLog Likelihood (-2LL)	14.586			10.057		
significance (-2LL)	.0007			.0065		
Proportional reduction of error (N=23)	.56			n.a.		
Proportional reduction of error (all cases)	.44			.45		

Note: N = 23 for the analysis of the Sulfur Protocol and N= 24 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, Bulgaria was omitted.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

For the analysis of *specific* damages, two salient ecosystems were substituted for the generalized concept of exceedances of critical loads: (i) surface water acidification and (ii) monetarized economic damages to the forestry sector. The analysis of the surface water specification (Table 7.2) shows substantial support for the impact of ecological vulnerability in the case of the Sulfur Protocol; however, this does not hold in the case of Nitrogen Protocol where the *inclusion* of the British case (Cook's D=1.04) would support the *misleading* generalization that surface water acidification was the decisive ecological factor involved in the decision to accede to the Nitrogen Declaration. The multinomial analysis of support for nitrogen regulation does not offer a different conclusion. In summary, the model presented in Table 7.2 and supplementary analyses point to the importance which surface water damages had played for the regulation of *sulfur*. The results replicate the early Scandinavian attempts to convince major emitters of acidifying pollutants to reduce their impact on Nordic surface water ecosystems (see Chapter 4).

Table 7.2: The Effect of Ecological Damages and Costs of Regulation on International Environmental Regulation (II): Surface Water Acidification

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Extent of Surface Water Acidification	1.4305**	.7577	1.89	11.8216	94.6446	.12
Costs of Regulation	-.3883	.7300	.53	-12.1793	18.4940	.66
Constant	-.6475	1.0160	.64	-11.6432	94.6607	.12
-2xLog Likelihood (-2LL)	8.947			25.053		
significance (-2LL)	.0114			.0000		
Proportional reduction of error (N=23)	n.a.			.73		
Proportional reduction of error (all cases)	.44			.64		

Note: N = 24 for the analysis of the Sulfur Protocol and N= 23 for the analysis of the Nitrogen Declaration. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Nitrogen Declaration, the U.K. was omitted.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

Whereas surface water acidification is of particular importance to the Nordic countries, monetarized forest damages (expressed in per cent of GDP) should be relevant to Scandinavian and Central European countries. The estimation of this particular specification of ecological damages points to the cost factor being a common restriction on the regulation of sulfur and nitrogen (see Table 7.3). However, forest damages have a slightly *positive* impact on signing the Sulfur Protocol and a slightly *negative* impact on support for the Nitrogen Declaration.[9] The results for the Nitrogen Declaration are sustained in a multinomial logit analysis of support for the various levels of nitrogen regulation. The result of the divergent signs seems to be an artifact of estimation: For the case of sulfur regulation, the estimated coefficients of forest damage and costs of regulation are strongly *negatively* related (Pearson r=-.82), whereas in the case of the regulation of nitrogen, these estimated coefficients are strongly *positively* correlated (Pearson

9 The cases of the Bulgaria (for the estimation of the Sulfur Protocol; high forest damages and high costs of regulation) and the U.K. (for the estimation of the Nitrogen Declaration; low costs of forest damage and low costs of regulation) were omitted due to their unusually strong impact on the estimation.

r=+.72). While it is unclear how forest damages relate to international environmental regulation, the analysis shows that the costs of regulation are a limiting condition for support for international environmental regulation. German mythological explanations of the impact of "Waldsterben" (forest dieback) on *national* regulatory efforts may not provide adequate guidance in a cross-national analysis in comparison to the role of economic factors. While the high intercorrelations among the estimated coefficients undermines statistical significance of the coefficients, the classificatory power of the models is appreciable.

Table 7.3: The Effect of Ecological Damages and Costs of Regulation on International Environmental Regulation (III): The Value of Forest Damages

	Sulfur			Nitrogen		
Explanatory Variable	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t	$(\hat{\beta}_i)$	$S.E.(\hat{\beta}_i)$	t
Value of Forest Reduction	2.0270	2.5698	.79	-11.1643	8.9400	1.25
Costs of Regulation	-10.1741*	6.1199	1.66	-18.1986*	10.6542	1.71
Constant	2.3677	1.0318	2.29	7.2269	4.9662	1.46
-2xLog Likelihood (-2LL)	14.594			24.206		
significance (-2LL)	.0007			.0.0000		
Proportional reduction of error (N=21)	.57			.80		
Proportional reduction of error (all cases)	.43			.73		

Note: N = 21 for the analysis of the Sulfur Protocol and N= 21 for the analysis of the Nitrogen Declaration. No data for the value of forest reduction are available for Ireland and Spain. All significance tests for the coefficients are one-tailed tests based on their predicted sign. For the analysis of the Sulfur Protocol, Bulgaria was omitted, and the U.K. was omitted from the analysis of the Nitrogen Declaration.
* denotes statistical significance at the .10 level; ** at the .05 level; *** at the .01 level.

In conclusion, the aggregate analyses show evidence that the costs of regulation have an unambiguous impact: Environmental quality is a "normal good": As regulation becomes more expensive, less of it seems to be desired. However, the evidence of the impact of ecological damages is not as clear. For the case of sulfur regulation, the directional hypotheses are always

supported. The substantive interpretation of the impact of ecological factors in the case of nitrogen regulation remains unclear. Despite these shortcomings, all model specifications display high classificatory power.

Overall, the dominant impact of the costs of regulations is not surprising. Ultimately, international environmental protection has to be affordable, because implementation is the decisive from an environmental standpoint. Budgets constrain political ambitions, even if a country has ecological incentive to accede to international regulations. If this reasoning is applied to the case of global warming, I expect the OECD countries to provide the impetus for the regulation of greenhouse heating gases. In view of the importance of the former SU, the Peoples Republic of China, as well as India towards any major reductions of these gases, too much optimism may be misplaced. Further research should be directed to the trade-off between environmental protection and the economic resources needed for this endeavor.

7.3. Conclusions

The purpose of this chapter was to test if damages to the environment and the costs of regulation could account for a country's preferences for international environmental regulation. The analysis included all 24 countries (as compared to Chapter 6), and points to three results.

First, the impact of objective environmental damages varies across countries and is rarely of convincing magnitude.

Second, the costs of regulation provide guidance in most cases: Costs constrain governmental positions. Inexpensive policies are easily pursued, but environmentally devastated countries - if they lack resources - should not be relied on to save the international environment. They may even not be able to save their own habitat.

Third, the incorporation of the domestic political component (see Figure 6.1) as intervening between damages and resources, on the one hand, and international regulation, on the other hand, is likely to generate much more convincing results - if data were available for all countries. Environmental damages and the costs of regulation are interpreted by political and economic actors who lobby their national government. The models specified in this chapter may reflect rational economic decision-making too closely, and, thereby, these models put too little emphasis on an earlier finding that political efficiency accounts for political outcomes -- at least in the short run.

8. Conclusions

> *Environmentalism runs riot.*
> *So effectively have environmentalists greened public opinion that it takes an unashamed reactionary to question the wisdom of becoming ever greener and cleaner. Most environmental pressure-groups are convinced that the environment is so important that standards cannot be set too high, and must be met regardless of cost. When an annual public-opinion poll asks Americans whether they share that view, a large majority agrees. Europeans, too, now tend to believe that anything greener must be better. Such belief will gradually come to haunt greenery's advocates. For nothing - not even cleanliness - comes free; and the costs of environmental policies are likely to rise sharply over the rest of the century. If the green enthusiasm generated over the past four years is to survive in public policy, the enthusiasts must learn the language of priorities, and of costs and benefits.*
>
> Editorial Comment, The Economist (08 August 1992)

> *Two villains - nature and the rest of us people - dominate your life and prevent you from all you want.*
>
> Arman A. Alchain and William R. Allen

As Alchain and Allen remind us, the world's wealth is limited: The sum of human demands often exceeds the available resource base. Consequently, in the microeconomic world of allocation theory, every good is scarce - even clean air. People may not be accustomed to paying for something that was for free. Resources have been shifted in favor of environmental protection due to societal demands. But there are doubts, if the new emphasis on environmental quality will pay off. In my view, some of the conclusions of this study clearly point to the shortcomings of such a narrow, economic focus on the determinants of environmental regulation. Economics just offers one yardstick for assessing optimal resource allocation, especially at the country-level. Political efficiency provides an *alternative* yardstick for the evaluation of environmental policy. In any case, since the protection of the international environment is an international public goods problem, it is unlikely that the international community will enjoy too much environmental quality.

In the following section, I will summarize the findings of this study (Section 8.1.). I will also point to some implications of the study for international environmental policy (Section 8.2.),

and I will highlight some pertinent gaps in our understanding of international environmental policy in the social sciences (Section 8.3.).

8.1. An Overview of the Research Findings

The basic research question addressed in this study reads as follows: Why do countries spend scarce resources on the protection of the international environment? In other words: Which factors determine a country's support for costly international environmental agreements?

Different strands of international relations theory and comparative political theory were meshed together with the emerging writing in the field of international environmental policy in this research. The interdependence approach, the foreign environmental policy approach, and various more recent syntheses of the preceding two approaches generated a set of expectations about the relationship between (i) environmental degradation and (ii) national preferences for international environmental regulation. In addition, theories of postmaterialism, the (European) new social movements, as well as previous research findings on green party support provided guidance for the human, non-economic response to environmental degradation. Furthermore, interest-based theories of political economy were shown to account for the opposing interests of major polluting industries and abatement technology providers (Chapter 2).

These theories were integrated with the help of (i) an amended externality model of the domestic preferences for international environmental regulation and (ii) a probabilistic voting model which emphasizes the transmission of interests into governmental positions. In the tradition of "second image" reasoning, governmental positions on international policies were systematically linked to domestic factors (Chapter 3).

In order to yield insight into international environmental regulation that accomplished more than "diplomatic successes", the regulation of European transboundary air pollution was chosen for testing the hypotheses postulated in this study. This case combines several major advantages. First, substantive international environmental agreements have been concluded, and they are supposed to lead to actual reductions in pollutant emissions and effects. Second, as a regional, reciprocal environmental problem with many emitters and receivers of pollution, some of the results may guide the study of global environmental problems.[1] An introduction to the natural science and diplomatic aspects of the regulations of European transboundary air pollution assisted the evaluation of the empirical findings (Chapter 4).

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1 Additional justifications for the selection of the case can be found in Chapter 4.

The empirical parts of the study employed (i) aggregate data on pollutants, costs of regulation, and degradation of the environment, (ii) aggregated micro-level data representing mass public and elite attitudes on various aspects of air pollution regulation, and (iii) objective data on environmental damages as well as abatement costs.

First, the analyses of the pollution-based explanations of international environmental regulation showed the merits of victim-based and polluter-based perspectives, either in their most parsimonious or in their extended form. From a theoretical perspective, the extended tests are preferable since they do not only rely on pollution exchange, but they also incorporate the *environmental damage* caused by these pollutants. In addition, more complex, interest-based explanations combine the victim perspective, the polluter perspective, and the impact of past abatement policies. The parsimonious models as well as the more complex models were well supported in the analysis of the determinants of the regulation of sulfur and nitrogen oxides among all 24 European countries (Chapter 5).

Second, the empirical tests of the human response to environmental degradation followed a hierarchical modeling perspective: Environmental degradation, costs of regulation, and availability of technology determine the position taken by the mass public as well as the lobbying efforts of interest groups. The lobbying activities of these interest groups explain the degree of national support for given international environmental agreements. In comparison to the pollution-based explanations (see above), the analyses of the human response had to rely on an even smaller sample of 9 to 11 countries. The interpretation of the results should take the sample size into account. The analyses show that (i) the mobilization of interest groups is explained by perceived damages to the environment, the impact of the costs of regulation, and technology, and (ii) the impact of these interest groups on a country's accession to international environmental agreements is in the predicted direction. The theories which have been integrated for this analysis provided good theoretical guidance and, given the limitations of the data, the empirical results suggest that the theories could be well supported in larger samples (Chapter 6).

Third, an analysis of the effects of (i) environmental damages and (ii) costs of regulation on international environmental regulation (with objective data) highlighted the role of economic resources, whereas the impact of environmental damages on environmental regulation varies. It is suggested that a political module be included when conducting research on national support for international environmental regulation (Chapter 7).

In conclusion, pollution-based theories and human response models help to explain governmental support for international environmental regulation in the case of transboundary air pollution in Europe. Rather than relying on ad hoc modeling (as to be found with most theories of international regimes and epistemic communities), a simple endogenous policy model has been employed to intervene between environmental damages and resources, on the one hand,

and support for international environmental regulation, on the other hand. While the selection of the factors incorporated in the model was guided by past research, these public choice models provide unambiguous directional hypotheses. The strength of these effects were assessed in the empirical analyses.

In general, the model used in these analyses can be generalized to various international environmental problems. In particular, it can accommodate research questions pertaining to the regulation of the extended greenhouse heating effect. Furthermore, the basic research design can also be used to study the domestic-international link in other domains of the field of international political economy. For example, the model can be reformulated so as to study support for international trade, international migration policies, or international communication policies. However, adjustments would have to be made depending on the *particular* substantive domain chosen.

8.2. Implications for International Public Policy

International politics is fundamentally about the international distribution of welfare. While many students of international relations have focused on the determinants of power and the role of international organizations, only consequences of these factors ultimately matter. Applied to international environmental policy, research should ultimately relate the intertemporal shifts in environmental quality to human actions. From a policy perspective, the impact of political-economic variables on ecological (natural science) indicators will measure the success or failure of domestic and international environmental policies. Having international environmental agreements is just one way of improving environmental quality. International agreements can only be considered valuable if they account for improvements of the state of the environment. This is a standard approach for economists, since they focus on the consequences of human actions on individual or aggregate welfare. Students of international politics - more often than not - are fascinated by the conclusion of international agreements.

Political and economic interest groups assure that the consequences of international policies will not ultimately be overlooked. This is supposed to hold since the anticipated consequences of policies affect the welfare of utility-maximizing, selfish interest groups. This conceptualization of international politics resembles the "domestic table" in Putnam's two-level analysis of international negotiations (Putnam 1988). If the configuration of the "domestic table" varies *across* countries, it should be expected that different degrees of national support for international policies will be observed. International regimes (i.e., the "international table") matter to a limited extent: They provide an institutional bargaining table, coordinate research,

and provide equal access to information. In fact, it is not surprising that international organizations are often of limited importance and command little resources. Students of international relations often emphasize the reluctance of countries to cede sovereignty to international institutions, but there may be a more important reason why these highly aggregative institutions experience difficulties in sustaining long-term support. What is known as the Arrow Paradox can also be described as the impossibility to aggregate national utility functions into an international welfare function in the absence of a dictator.[2] However, the prospects for the international environment are not necessarily bleak.

Much of the pessimism regarding the prospects of international environmental policy stems from the continued failure of countries to honor Principle 21 of the 1972 Stockholm Conference on the Human Environment: Countries deprive each other of environmental quality, or, as Odén has so eloquently described it, there is "an insidious 'chemical war' among the nations of Europe." Furthermore, in most cases, international polluters do not compensate the victims of pollution exports. As a consequence, the polluter-pays-principle may be economically and ethically efficient, but the victim-pays-principle may be *politically and ecologically* efficient: If victim countries command sufficient economic resources as well as political will, they can compensate polluters for reductions of polluting activities. Given enforceable property rights (or their equivalents) in tandem with economic transfers, *wealthy* victims can (i) provide environmental quality more efficiently if the domestic provision is more expensive than international resource transfers or (ii) if higher levels of environmental quality are demanded by domestic constituencies which a country itself cannot achieve. Using the analogy of economic theory, an international market for pollution rights could lead to less expensive provision of international environmental quality. I wish to briefly illustrate this idea in the context of transboundary air pollution in Europe.

Let me assume that major emitting countries are willing to sell their emissions in return for economic transfers. I also assume that victim countries are willing to buy emission reduction rights if this is economically feasible and if it is politically less expensive than domestic abatement policies. In return for the economic transfers, recipient countries would have to offer political-economic collateral (e.g., special drawing rights of the International Monetary Fund or international private loans to major polluting countries) to assure implementation. Furthermore, I assume that the UNECE could function as a stock exchange with a known set of operating rules and the contemporary levels of emissions are defined as each country's set of initial pollution

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2 For Arrow's assumptions regarding these utility functions, please consult Mueller (1989, 385-386).

rights.[3] Under this set of assumptions, a pollution stock exchange should yield at least the same level of international environmental quality as is currently prevailing, i.e., no country is willing to make its pollution policy dependent on the purchase of its pollution rights. However, if buyers value pollution reduction certificates higher than the sellers of these certificates, standard neo-classical price theory suggests that the transaction would take place until the prices match the value of pollution (reduction) rights (other factors being held constant).[4] This bold scheme of non-traditional international environmental policy has not yet been implemented, although the same amount of expenditures could yield better results for the domestic and international environment. I suspect that the reliance on *domestic* pollution abatement is still more politically efficient than more unconventional environmental policies, though domestic abatement policies are not necessarily economically efficient.

In my view, most international environmental agreements are attempts by ambitious countries to get environmentally less advanced countries to upgrade their policies. As a consequence of the internationalization of positive external effects, the ambitious country will now receive a higher return on its environmental policies as compared to the absence of upgraded environmental standards in the *reluctant* country.[5] The German attempts to Europeanize its domestic abatement program for large combustion plants should be seen in the same light as the attempts of the Stockholm Group to push for cleaner cars.

The case of transboundary air pollution was also selected so as to provide initial guidance for the regulation of the extended greenhouse heating effect. Four *tentative* conclusions can be drawn.

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3 To accommodate practical problems related to the initial allocation of pollution rights, late developers may be allocated the European-wide average per capita emissions from the outset.

4 Some readers may ask for a practical illustration of this idea. Assume that the Scandinavian countries, a group of victim countries, are members of a pollution fund. Assume, that the Nordic Investment Bank is the fund manager. Furthermore, assume that domestic abatement costs for one kg of sulfur deposited on the territory of Scandinavia is higher than those for an "imported" kg of sulfur depositions to Scandinavia from Poland. As long as the Scandinavian countries are capable of avoiding an internal "fee rider problem," the funds manager should buy Polish sulfur "imports" until import prices match average domestic abatement costs of the members of the Scandinavian coalition. In fact, some Scandinavian policy-makers were contemplating such a scheme, and a small scale project was ultimately launched in the form of development aid to Poland. In addition, IIASA's Regional Air Pollution Project is regularly computing the gains from various arrangements that would follow this basic rationale. A potential reason why such a scheme is not used instead of traditional international environmental diplomacy is the problem of overcoming the "free rider" problem among the buyers of pollution rights.

5 If no country upgrades its policy for an international environmental agreement, international agreements could be seen as the *documentation* of existing domestic policies. Clearly, this would be a second characteristic of "diplomatic success" in the field of environmental regulation. These agreements have purely *informational* value.

First, in analogy to the 1979 LRTAP Convention and the EMEP Protocol, framework conventions without substantive obligations should command universal support, because they entail little costs. However, support for a framework convention neither offers positive environmental consequences, nor does it assure support for a costly abatement program.

Second, early stringent regulators, much like Schumpeterian entrepreneurs, are likely to gain a competitive advantage since they will turn into producers of advance abatement technologies or process technologies.[6] Advanced industrial economies certainly hold a comparative advantage in this respect and are likely to turn into exporters of environmental technologies and services.

Third, as the VOC Protocol suggests, *differential* obligations may allow every country to sign international environmental agreements. If it is assumed that positions of countries on international environmental regulation cannot be easily changed (except by side-payments or subsidies), then the sum of the "contributions" to environmental protection across countries is the revealed world-wide preference for the avoidance of global warming. Countries dissatisfied with the worldwide level of resources devoted to this cause may wish to upgrade their own contributions, or they may alter the domestically generated preferences of countries by subsidizing pro-environmental interest groups *abroad*.[7]

Fourth, international environmental regulations can be compromises between the technology-forcing emphasis on the precautionary principle and the cost-effectiveness of the abatement programs justified on the basis of scientifically established present damages. The latter approach may be most useful for *reversible* environmental damages, whereas the precautionary principle may be most helpful for cases of *irreversible* damages. The case of global warming clearly leans more towards the former than to the latter type of damage. Different styles of regulation will lead to different consequences. Therefore, the relative weight of interest groups, their preferred style of regulation, and the "willingness to pay" for the prevention of critical levels of global warming will have substantial effects as they mediate between environmental damages and international environmental policies.

In conclusion, the study of transboundary air pollution suggested a number of expected findings for the regulation of global warming. Adherents of the "environmental catastrophe" approach will be disenchanted, because too little will be done to avoid global warming. However, they rarely ask: What insurance premiums are countries willing to pay in exchange for the partially avoided greenhouse heating effect? Given a low preference to pay for

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6 This effect also limits the "free rider" problem.

7 This has happened on various occasions in North America and in Europe for the case of transboundary air pollution.

environmental quality, citizens and decision-makers in advanced industrial countries will most likely not be spared uncomfortable questions from members of future generations.

8.3. Suggestions for Future Research

Research projects routinely generate more interesting questions than can possibly be answered in a single study. Therefore, I suggest a few extensions of my line of research below.

First, the versatility of the research design should be tested in different pollution domains such as international water pollution, the international transport of hazardous materials, or the greenhouse heating effect. These parallel studies would shed light on the external validity of my research findings.

Second, research should shift from the study of substantive international environmental agreements to the implementation and consequences of international and domestic environmental policies (see Chapter 1). Rational choice models are needed to model the outcomes of domestic conflicts over environmental protection, and simulation models should be employed to study their consequences.[8] Furthermore, the international aggregation mechanism has to be modeled explicitly so as to advance a theory of endogenous international environmental agreements.

Third, the effects of international regimes have to be assessed in the presence of domestic factors as well as pollution-based explanations. Research along these lines would shed light on the pertinent question if international regimes could be more effective than a mere (pollution) stock exchange.

Fourth, if international pollution exchanges are understood as an "insidious war among ... nations," then further quantification of these international welfare transfers is needed. This requires the integration of natural science and social science knowledge in the decision-making on the international environment. Much remains to be done in this respect.

Fifth, I have assumed in this study that the same political-economic response mechanisms work across countries. However, the idea of "equifinality" suggests that different policy instruments could lead to the same environmental consequences. This argument underlies the policy "styles" argument (Vogel), and it could be applied to devise "equitable, but not equal" contributions of countries to the protection of the international environment.

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8 The author of this study will pursue this goal in a project sponsored by the Commission of the European Community during 1992-1994.

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Why did I undertake this study on the international environment? Most likely, I welcomed the challenge to integrate and advance social science theory in a field which has received little attention in the past. Since many (but not all) environmental problems are the result of human actions, the human species has to be part of any solution. In the long run, technological solution will not suffice; social scientists will have to devise ways to modify human behavior in a way that is culturally acceptable. While social science knowledge is needed to inform decision-makers and educate the public on international environmental policy, the gaps in social science research on the protection of the international environment remain substantial. If this study has contributed to narrowing this gap in knowledge, it was certainly worth the effort.

Appendices

Appendix 1: Data

COUNTRY	SOPRRAT	NOPRSIG	NODEC	NOSUM	PCRESE05	PCRENE08
Description	Ratification of Sulfur Protocol	Signature of NOx Protocol	Signature of NOx Declara-tion	NOx Summary Variable	%Reduction of Sulfur Emissions 1980-85	%Reduction of NOx Emissions 1980-88
Source	(UNECE)	(UNECE)	(Ågren)	(UNECE)	(EMEP)	(EMEP)
Type of Data	1	1	1	1	1	1
A	1	1	1	2	52	9
B	1	1	1	2	45	33
BG	1	1	0	1	-6	0
CS	1	1	0	1	-2	21
DK	1	1	1	2	24	-3
SF	1	1	1	2	35	-5
F	1	1	1	2	56	11
D	1	1	1	2	24	4
DDR	0	1	0	1	-25	-44
GR	0	1	0	1	-25	0
H	1	1	0	1	14	5
IRL	0	1	0	1	37	-67
I	1	1	1	2	34	-15
NL	1	1	1	2	41	-1
N	1	1	1	2	31	-24
PL	0	1	0	1	-5	-3
P	0	0	0	0	26	27
R	0	0	0	0	0	0
E	0	1	0	1	33	0
S	1	1	1	2	47	2
CH	1	1	1	2	24	1
UK	0	1	0	1	24	-3
SU	1	1	0	1	13	-25
YU	0	0	0	0	-15	-37
Sum	15	21	11			
Average	0.63	0.88	0.46	1.33	20	-5
S.D.	0.49	0.34	0.51	0.70	24	22
Minimum	0	0	0	0	-25	-67
Maximum	1	1	1	2	56	33

Note: The codes for the type of data are:
(1) objective/macro data, (2) mass public attitudes, and (3) elite/expert interviews.
Sources: See Chapters 5 through 7 for details.

COUNTRY	PCIMDES0	PCIMDEN5	EXCLDO	PCEXEMS0	PCEXEMN5	EXCLEXSU
Description	% Imported Deposition (incl. background) (OEP 1980)	% Imported NO2 Deposition (incl. background) (IA 1985)	Exceedance of Critical Loads (total acidity, 5th percentile)	% Exported Emissions of Sulfur in 1980 (OEP 1980)	% Exported Emissions of Nitrogen in 1985 (IA 1985)	Exceedance of Critical Loads of S Major Receiver (total acidity, 5th percentile)
Source	(RAINS 5.1)	(RAINS 5.1)	(RIVM)	(RAINS 5.1)	(RAINS 5.1)	(RIVM)
Type of Data	1	1	1	1	1	1
A	90	94	6.0	69	83	6.0
B	71	87	6.0	83	94	4.3
BG	61	85	4.2	54	73	1.2
CS	59	84	6.0	70	84	6.0
DK	75	93	5.7	80	95	3.3
SF	77	88	3.1	49	70	3.3
F	44	62	4.3	48	64	6.0
D	60	59	6.0	62	76	3.3
DDR	38	84	6.0	68	88	6.0
GR	69	83	1.2	36	64	3.3
H	53	87	3.5	71	85	3.3
IRL	55	90	4.6	43	84	2.4
I	34	63	2.5	42	63	3.0
NL	86	83	6.0	78	94	6.0
N	93	95	3.5	44	68	3.8
PL	57	80	6.0	52	75	3.3
P	46	69	2.8	38	66	2.0
R	63	81	3.9	46	65	3.3
E	24	58	2.0	26	40	4.3
S	81	90	3.8	47	71	3.3
CH	90	91	5.8	59	81	6.0
UK	14	39	2.4	42	75	4.3
SU	26	41	3.3	14	16	3.1
YU	68	86	3.0	47	65	3.9
Sum						
Average	60	78	4.2	53	72	3.9
S.D.	22	16	1.5	17	18	1.4
Minimum	14	39	1.2	14	16	1.2
Maximum	93	95	6.0	83	95	6.0

COUNTRY	EXCLEXNO	EMSU80EM	EMSU80RA	EMSU85EM	EMSU85RA
Description	Exceedance of Critical Loads of N Major Receiver	SO2 Emissions in 1980 [kt S/year] (total acidity, 5th percentile)	SO2 Emissions in 1980 [kt S/year]	SO2 Emissions in 1985 [kt S/year] (OEP 1980)	SO2 Emissions in 1985 [kt S/year] (IA 1985)
Source	(RIVM)	(EMEP Data)	(RAINS 5.1)	(EMEP Data)	(RAINS 5.1)
Type of Data	1	1	1	1	1
A	3.0	185	165	89	100
B	6.0	414	411	226	239
BG	3.9	517	507	547	535
CS	3.3	1,550	1,550	1,575	1,550
DK	3.3	224	222	170	165
SF	3.3	292	285	191	177
F	6.0	1,669	1,746	735	903
D	3.3	1,605	1,574	1,225	1,204
DDR	6.0	2,132	2,503	2,670	2,540
GR	4.2	200	259	250	263
H	3.3	816	809	702	773
IRL	2.4	111	105	70	68
I	3.0	1,900	1,920	1,252	1,255
NL	6.0	233	231	138	140
N	3.8	71	68	49	50
PL	3.3	2,050	1,926	2,150	1,819
P	2.0	133	132	99	132
R	3.3	900	847	900	869
E	4.3	1,625	1,554	1,095	1,512
S	3.3	257	247	135	136
CH	6.0	63	63	48	45
UK	4.3	2,424	2,416	1,838	1,781
SU	3.9	6,400	10,608	5,555	8,706
YU	3.9	650	594	750	673
Sum		26,421	30,736	22,459	25,631
Average	4.0	1,101	1,281	936	1,068
S.D.	1.2	1,371	2,142	1,228	1,772
Minimum	2.0	63	63	48	45
Maximum	6.0	6,400	10,608	5,555	8,706

COUNTRY	EMNO80EM	EMNO80RA	EMNO85EM	EMNO85RA	EXEMSU80
Description	NOx Emissions in 1980 [kt NO2/year]	NOx Emissions in 1980 [kt NO2/year] (OEP 1980)	NOx Emissions in 1985 [kt NO2/year]	NOx Emissions in 1985 [kt NO2/year] (IA 1985)	Allocable Emission Exports of Sulfur in 1980 [kt S] (OEP 1980)
Source	(EB AIR Data)	(RAINS 5.1)	(EMEP Data)	(RAINS 5.1)	(RAINS 5.1)
Type of Data	1	1	1	1	1
A	233	243	230	250	61
B	442	442	281	416	225
BG	150	352	150	367	113
CS	1,204	791	1,127	769	686
DK	241	254	258	268	84
SF	264	238	251	230	72
F	1,823	2,019	1,615	1,796	523
D	2,980	2,917	2,930	2,830	606
DDR	701	845	955	875	1,124
GR	746	246	746	288	26
H	273	302	262	273	384
IRL	73	96	91	89	18
I	1,480	1,501	1,595	1,563	337
NL	548	579	544	588	98
N	181	168	203	166	11
PL	1,500	1,110	1,500	1,248	622
P	166	158	96	157	18
R	390	646	390	604	212
E	950	983	950	991	143
S	398	340	394	339	57
CH	196	188	214	203	19
UK	2,418	2,361	2,278	2,322	449
SU	3,369	8,970	3,369	9,156	671
YU	350	388	400	420	165
Sum	21,076	26,137	20,829	26,208	6,724
Average	878	1,089	868	1,092	280
S.D.	934	1,838	916	1,864	293
Minimum	73	96	91	89	11
Maximum	3,369	8,970	3,369	9,156	1,124

COUNTRY	EXEMNO85	GDPCAP88	COPRSU	COPRNO	PCFODAGD
Description	Allocable Emission Exports of Nitrogen in 1985 [100 t N] (IA 1985)	GDP/capita in 1988 [USD]	Annual % GDP Costs of 30% Reduction of SOx from 1980 level until 2000 (2.22 DM/USD)	Annual % GDP Costs of 30% Reduction of NOx from 1980 level until 2000 (2.22 DM/USD)	% Value of Forest Reduction as a Share of 1988 GDP due to Air Pollution (Roundwood and Industrial Products)
Source	(RAINS 5.1)	(The Economist)	(Amann)	(Amann)	(Options)
Type of Data	1	1	1	1	1
A	235	16,675	0.04	0.02	0.31
B	652	15,394	0.00	0.04	0.07
BG	169	2,217	1.81	1.70	1.15
CS	982	2,737	0.16	0.01	2.13
DK	362	20,988	0.04	0.03	0.05
SF	214	21,156	0.00	0.11	0.53
F	1,663	17,004	0.00	0.02	0.06
D	3,398	19,743	0.05	0.02	0.14
DDR	1,253	5,256	0.87	0.02	0.55
GR	96	5,244	0.60	0.50	0.02
H	393	2,625	0.32	0.02	1.18
IRL	67	9,181	0.14	0.05	
I	817	14,432	0.01	0.07	0.06
NL	878	15,421	0.05	0.03	0.01
N	91	21,724	0.12	0.08	0.11
PL	1,426	1,719	0.69	0.10	1.65
P	90	4,017	0.22	0.42	0.38
R	419	1,374	2.42	1.52	1.28
E	286	8,668	0.13	0.27	
S	309	21,155	0.01	0.02	0.40
CH	147	27,748	0.04	0.01	0.15
UK	1,756	14,477	0.04	0.04	0.07
SU	1,286	2,055	0.39	0.30	0.51
YU	310	2,279	4.36	0.78	0.55
Sum	17,299				
Average	721	11,387	0.52	0.26	0.52
S.D.	778	8,287	1.01	0.46	0.59
Minimum	67	1,374	0.00	0.01	0.01
Maximum	3,398	27,748	4.36	1.70	2.13

COUNTRY	SUWAACID	DAARE29	ENECE29	PME29	VOINE29
Description	Countries with surface water acidification	% Top Three Damages to the Environment: Acid Rain Which Attacks Wood and Forests (Country Means)	Environ-ment-Economy Trade-off (Country Means)	Post-materia-lism (Country Means)	% Green or Ecological Party Voting in Hypothetical Election Next Week (Country Means)
Source	(UNECE)	(Eurob 29, 1988, v181)	(Eurob 29, 1988, v221)	(Eurob 29, 1988, v443)	(Eurob 29, 1988, v422)
Type of Data	1	2	2	2	2
A	2				
B	2	28	2.33	1.85	13.59
BG	0				
CS	1				
DK	2	43	2.60	1.93	1.84
SF	2				
F	1	22	2.51	1.90	8.65
D	2	29	2.56	2.04	8.38
DDR	0				
GR	0	6	2.51	1.63	0.00
H	0				
IRL	1	15	2.25	1.80	0.63
I	1	16	2.56	1.86	5.33
NL	2	42	2.48	2.10	0.00
N	2				
PL	1				
P	0	6	2.30	1.56	0.00
R	0				
E	0	13	2.63	1.75	0.00
S	2				
CH	2				
UK	2	35	2.45	2.02	2.16
SU	1				
YU	0				
Sum					
Average	1.08	23.2	2.47	1.86	3.69
S.D.	0.88	13.3	0.13	0.17	4.66
Minimum	0.00	6.0	2.25	1.56	0.00
Maximum	2.00	43.0	2.63	2.10	13.59

COUNTRY	DAARE25	ENECE25	MENPAE25	MEENME25	MEMOVE25
Description	% Top Three Damages to the Environment: Acid Rain Which Attacks Wood and Forests (Country Means)	Environ-ment-Economy Trade-off (Country Means)	% Member-ship in Nature Protection Associations (Country Means)	% Member-ship in Ecology Movement (Country Means)	% Member-ship in Ecology Movement or Nature Protection Associations (Country Means)
Source	(Eurob 25, 1986, v172)	(Eurob 25, 1986, v218)	(Eurob 25, 1986, v276)	(Eurob 25, 1986, v277)	(Eurob 25, 1986)
Type of Data	2	2	2	2	2
A					
B	27	2.29	3.50	1.10	3.1
BG					
CS					
DK	28	2.59	20.20	0.70	15.7
SF					
F	24	2.46	1.50	0.50	1.4
D	26	2.50	2.80	0.90	2.3
DDR					
GR	3	2.43	0.80	0.50	0.7
H					
IRL	10	2.18	1.00	0.80	1.1
I	10	2.52	2.60	1.30	2.3
NL	50	2.39	11.20	3.30	10.4
N					
PL					
P	5	2.32	0.10	0.10	0.1
R					
E	7	2.47	1.20	1.00	1.0
S					
CH					
UK	23	2.40	2.90	1.10	3.0
SU					
YU					
Sum					
Average	19.4	2.41	4.35	1.03	3.7
S.D.	14.0	0.12	6.05	0.83	4.8
Minimum	3.0	2.18	0.10	0.10	0.1
Maximum	50.0	2.59	20.20	3.30	15.7

COUNTRY	PME25	VOINE25	IMARGE	ECOVULAR	COSTSU
Description	Post-materialism (Country Means)	% Green or Ecological Party Voting in Hypothetical Election Next Week (Country Means)	General Importance of Acid Rain in Respondent's Country (Country Means)	Ecological Vulnerability to Acid Rain in Respondent's Country (Country Means)	Costs of Imple-menting Sulfur Protocol (Country Means)
Source	(Eurob 25, 1986, v310)	(Eurob 25, 1986, v286)	(Elite Dataset, v14)	(Elite Dataset, v17)	(Elite Dataset, v37)
Type of Data	2	2	3	3	3
A					
B	1.68	8.14			
BG					
CS			2.71	4.36	4.23
DK	1.96	1.30			
SF					
F	1.79	5.08	3.00	2.80	2.33
D	2.04	5.86	4.00	3.79	2.42
DDR					
GR	1.61	0.00			
H			2.57	2.86	3.67
IRL	1.75	0.34			
I	1.69	0.00			
NL	2.09	0.00	4.18	3.92	1.67
N					
PL			2.91	4.18	4.63
P	1.56	0.00			
R					
E	1.73	0.00	3.00	2.75	
S			4.25	4.56	1.43
CH					
UK	1.93	0.35	4.00	3.17	4.00
SU					
YU					
Sum					
Average	1.80	1.92	3.40	3.60	3.05
S.D.	0.18	2.97	0.69	0.71	1.23
Minimum	1.56	0.00	2.57	2.75	1.43
Maximum	2.09	8.14	4.25	4.56	4.63

COUNTRY	COSTNO	STDOGRPA	STDOGEPU	STDOENGR	STINGRPA
Description	Costs of Nitrogen Protocol (Country Means)	Domestic Strength of Green Party (Country Means)	Domestic Strength of General Public (Country Means)	Domestic Strength of Environmental Groups (Country Means)	International Strength of Green Party (Country Means)
Source	(Elite Dataset, v38)	(Elite Dataset, v111)	(Elite Dataset, v112)	(Elite Dataset, v113)	(Elite Dataset, v127)
Type of Data	3	3	3	3	3
A					
B					
BG					
CS	4.00	3.33	3.83	3.83	3.40
DK					
SF					
F	2.83	3.17	2.83	3.67	3.33
D	2.55	3.36	4.17	3.67	3.56
DDR					
GR					
H	3.83	3.33	3.43	3.71	4.67
IRL					
I					
NL	2.00	3.29	3.56	4.00	3.14
N					
PL	4.38	2.90	2.33	3.11	3.00
P					
R					
E		2.50	1.50	2.00	
S	2.36	2.69	3.60	3.71	2.25
CH					
UK	3.50	1.20	3.17	3.50	1.60
SU					
YU					
Sum					
Average	3.18	2.86	3.16	3.47	3.12
S.D.	0.86	0.70	0.82	0.60	0.91
Minimum	2.00	1.20	1.50	2.00	1.60
Maximum	4.38	3.36	4.17	4.00	4.67

COUNTRY	STINGEPU	STINENGR	TRCOTEAR	ININMAPO	ININEOPT
Description	International Strength of General Public (Country Means)	International Strength of Environ-mental Groups (Country Means)	Trade Position of Respondent's Country on Control Technology for Acid Rain (Country Means)	Regulatory Influence of Major Polluting Industries (Country Means)	Regulatory Influence of Producers of End-of-Pipe Abatement Technology (Country Means)
Source	(Elite Dataset, v128)	(Elite Dataset, v129)	(Elite Dataset, v151)	(Elite Dataset, v152)	(Elite Dataset, v153)
Type of Data	3	3	3	3	3
A					
B					
BG					
CS	3.30	3.73	1.50	3.64	2.00
DK					
SF					
F	3.00	3.50	2.50	3.50	3.00
D	3.67	3.56	3.90	3.50	2.92
DDR					
GR					
H	3.50	4.00	1.29	3.71	2.57
IRL					
I					
NL	2.86	3.29	2.00	3.73	2.10
N					
PL	2.11	3.11	1.22	3.90	1.88
P					
R					
E			1.00	4.00	1.50
S	3.14	3.43	4.60	2.93	3.29
CH					
UK	2.60	3.00	3.40	4.20	2.25
SU					
YU					
Sum					
Average	3.02	3.45	2.38	3.68	2.39
S.D.	0.50	0.32	1.31	0.36	0.59
Minimum	2.11	3.00	1.00	2.93	1.50
Maximum	3.67	4.00	4.60	4.20	3.29

COUNTRY	IMPOP	IMRAINFO	IMEFAG	IMGCC	IMBIODIV
Description	Importance of Population Growth in Respondent's Country (Country Means)	Importance of Decline in Rainforests in Respondent's Country (Country Means)	Importance of Side-effects of Agriculture in Respondent's Country (Country Means)	Importance of Global Climate Change in Respondent's Country (Country Means)	Importance of Biodiversity in Respondent's Country (Country Means)
Source	(Elite Dataset, v164)	(Elite Dataset, v165)	(Elite Dataset, v166)	(Elite Dataset, v167)	(Elite Dataset, v168)
Type of Data	3	3	3	3	3
A					
B					
BG					
CS	1.77	1.38	3.71	3.64	2.71
DK					
SF					
F	2.67	3.83	4.67	1.33	2.83
D	2.44	3.82	3.69	1.77	2.38
DDR					
GR					
H	1.67	1.17	3.71	3.67	3.67
IRL					
I					
NL	2.73	3.67	4.75	1.25	2.58
N					
PL	1.90	1.44	3.00	3.45	2.82
P					
R					
E	2.33	2.00	2.67	2.67	3.67
S	1.80	3.21	3.56	1.86	2.50
CH					
UK	2.60	3.00	3.00	1.40	2.75
SU					
YU					
Sum					
Average	2.21	2.61	3.64	2.34	2.88
S.D.	0.43	1.11	0.71	1.03	0.47
Minimum	1.67	1.17	2.67	1.25	2.38
Maximum	2.73	3.83	4.75	3.67	3.67

COUNTRY	IMOCEAN	IMFRESWA	IMTOXCHE
Description	Importance of Oceans in Respondent's Country (Country Means)	Importance of Freshwater in Respondent's Country (Country Means)	Importance of Toxic Chemicals in Respondent's Country (Country Means)
Source	(Elite Dataset, v169)	(Elite Dataset, v170)	(Elite Dataset, v171)
Type of Data	3	3	3
A			
B			
BG			
CS	4.73	1.57	1.79
DK			
SF			
F	2.17	1.67	2.17
D	2.46	2.31	2.00
DDR			
GR			
H	5.00	2.29	2.00
IRL			
I			
NL	2.42	2.33	1.92
N			
PL	2.55	1.64	2.00
P			
R			
E	2.33	2.33	2.67
S	1.81	3.25	2.38
CH			
UK	2.60	2.40	2.60
SU			
YU			
Sum			
Average	2.90	2.20	2.17
S.D.	1.14	0.52	0.31
Minimum	1.81	1.57	1.79
Maximum	5.00	3.25	2.67

Appendix 2: Question Wording of Mass Public Attitude Data

Euro-Barometer 25

source: Rabier et al. (1988).

Note: All cases with missing data codes were omitted by variable (except if explicitly mentioned). All data were recoded so as to follow the directional hypotheses outlined in Section 6.1. Missing data codes are not included in this listing.

Postmaterialism: variable 310 (composite 4-item index, see Inglehart 1977).

Damages due to Acidification: variable 172

"When we talk about possible damage to the environment, what do you think of above all? Would you please choose from this list the three things that come immediately to mind? ... Acid rain which attacks woods and forests.

0. not mentioned;
1. mentioned."

Environment-Economy Tradeoff: variable 218

"I would like to give you some opinions which are often expressed about the problems of the environment. Which of these opinions are you most in agreement with?

1. Development of the economy should take priority over questions of the environment.
2. Sometimes it is necessary to make a judgment between economic development and protection of the environment.
3. Protecting the environment and preserving natural resources are necessary conditions to assure economic development."

Membership in Natural Protection Associations or the Ecology Movement: variables 276 and 277

"There are a number of groups and movements seeking support of the public. For each of the following movements, can you tell me ... whether you are a member, or might join, or would certainly not join?

var 276: ... The Nature Protection Associations
var 277: ... The Ecology Movement

1. is a member;
2. might join;
3. would not join."

Coding:
Both variables were crosstabulated (incl. missing data), and all persons who are at least a *member* of one of these two movements were included in the computation of membership for the combined movements.

Euro-Barometer 29

source: Reif/Melich (1990).

Note: All cases with missing data codes were omitted by variable (except if explicitly mentioned). All data were recoded so as to follow the directional hypotheses outlined in Section 6.1. Missing data codes are not included in this listing.

Postmaterialism: variable 443 (composite 4-item index, see Inglehart 1977).

Damages due to Acidification: variable 181

"When we talk about possible damage to the environment, what do you think of above all? Would you please choose from this list the three things that come immediately to mind? ... Acid rain which attacks woods and forests.

0. not mentioned;
1. mentioned."

Environment-Economy Tradeoff: variable 221

"I would like to give you some opinions which are often expressed about the problems of the environment. Which of these opinions are you most in agreement with?

1. Development of the economy should take priority over questions of the environment.
2. Sometimes it is necessary to make a judgment between economic development and protection of the environment.
3. Protecting the environment and preserving natural resources are necessary conditions to assure economic development."

Voting Intention for Green or Ecological Party: variable 422

"If there were a general election tomorrow (say if contact under 18: and you had a vote), which party would you support?"

- France: 50. Ecologistes
- Belgium: 55. Ecologiste
- The Netherlands: *no green or ecological party explicitly listed*
- Germany: 50. Die Grünen
- Italy: 50. Verdi
- Denmark: 50. De Groenne
- Ireland: 50. Ecology Party
- U.K.: 51. Ecology Party
- Greece: *no green or ecological party explicitly listed*
- Spain: *no green or ecological party explicitly listed*
- Portugal: *no green or ecological party explicitly listed.*"

coding:

Green or ecological party support was computed as a percentage of all non-missing data.

Appendix 3: Question Wording of Elite/Expert Data

source: Sprinz (1992).

Note: All cases with missing data codes were omitted by variable (except if explicitly mentioned). All data were recoded so as to follow the directional hypotheses outlined in Section 6.1. Missing data codes are not included in this listing.

Concern for the Environment: variables 14, variables 164 through 171

var 14 "In your view, how prominent has the acid rain problem been in the 1980's relative to other environmental problems in your country?

1. much more
2. more
3. roughly equal
4. less
5. not at all."

v164-v171 "Which environmental problems *other* than acid rain are of great concern to your country?

var 164 Population growth
var 165 Decline of tropical rainforests
var 166 Side-effects of modern agriculture
var 167 Global climate change
var 168 Biodiversity (incl. protection of flora and fauna)
var 169 Ocean and coastal pollution
var 170 Freshwater pollution
var 171 Toxic chemicals

1. very high
2. high
3. medium
4. low
5. very low."

coding:

All scores for non-missing cases (by variable) were aggregated separately and by country; the maximum score across all variables (by country) was used in the analysis.

Strength of General Public, Environmental Movement, and Green/Ecological Parties: variables 111 through 113, variables 127 through 129

"How do you assess the strength of various groups or organizations in the domestic political decision-making process on national and international acid rain regulation? Please use a scale ranging from "1" ("very strong") to "5" ("very low") for the domestic and the international process. If an item seems to be inappropriate in your country, please enter "9".

domestic regulation

var 111 - green or ecology party
var 112 - concern of the mass public
var 113 - environmental groups

international regulation

var 127 green or ecology party
var 128 concern of the mass public
var 129 environmental groups

1. very strong
2. strong
3. medium
4. weak
5. very weak
9. inappropriate."

coding:

The scores of the domestic and international regulation (excl. "9") were combined for each of the three groups.

Costs of Regulation: variable 37, variable 38

"Within the framework of the United Nations Economic Commission Europe (UNECE), several pieces of international regulation have been concluded. Some countries and the European Communities joined these agreements and have begun to implement them, while other countries have abstained from parts of UNECE-sponsored international regulation.

Please compare the standards called for by the international agreements listed below with the respective regulatory standards in your country before the conclusion of the UNECE-sponsored international treaties. Were the costs associated with international regulation higher than the costs associated with the domestic standards at that point in time? For the temporal domains, please find the year(s) mentioned in brackets with each legal instrument.

var 37 Sulfur Oxide Protocol (1985, provision: reduction of sulfur emissions or their fluxes by 30% until 1993 compared to 1980; so-called "30% Club")

var 38 Nitrogen Oxide Protocol (1988, provision: standstill agreement on nitrogen emissions or their fluxes by the end of 1994 compared to 1987)

1. much higher
2. higher
3. roughly equal
4. lower
5. much lower."

Net Exporter of Abatement Technology: variable 151

"Is your country a net exporter or a net importer of acid rain control technologies?

1. Major exporter
2. Minor exporter
3. Exports match imports
4. minor importer
5. major importer."

Influence of Major Polluting Industries and of Producers of Abatement Technology: variables 152 and 153

"How strong would you rate the influence which various industries (private or public) have on acid rain regulation in your country?

var 152 major polluting industries

var 153 producers of end-of-pipe technologies

1. very high
2. high
3. medium
4. low
5. very low."

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