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# The interest-based explanation of international environmental policy

Detlef Sprinz and Tapani Vaahtoranta

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Despite growing international environmental interdependence, the international system lacks a central authority to foster environmental protection. As a consequence, countries have adopted different policies to reduce international environmental problems. More specifically, costly regulations are not universally supported. In order to explain the success and failure of international environmental regulation, it is necessary to systematically focus on the factors that shape the environmental foreign policy of sovereign states. Since such an approach is missing from the literature, we develop an interest-based explanation of support for international environmental regulation and postulate what impact it should have on state preferences for international environmental regulation. Specifically we apply our framework to two prominent cases of negotiations on atmospheric pollution control, namely, efforts to protect the stratospheric ozone layer and the regulation of transboundary acidification ("acid rain") in Europe.

After presenting the interest-based approach to international environmental regulation, we will briefly review the relevant literature on the environmental domains chosen. We shall then apply this concept to two prominent cases of international air pollution regulation and compare our findings. Finally, in the article's last section, we point to some factors that merit attention in future research.

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## The interest-based explanation

The interest-based explanation of the international politics of environmental management focuses on those domestic factors that shape a country's position in international environmental negotiations. In other words, the interest-based explanation is a unit-level explanation of international relations.<sup>1</sup> Unit-level explanations refer to elements located at the national or subnational levels, whereas systemic explanations suggest that differences at the unit level produce less variation in outcomes than one would expect in the absence of systemic constraints. While unit-level explanations emphasize the varying characteristics of countries, systemic theories suggest that countries with different internal characteristics tend to behave in the same way if they are similarly positioned in the international system.

The interest-based perspective on international environmental regulation offers a partial but parsimonious view of how a country's preferences for international regulations are shaped. It focuses on a few unit-level factors that shape a country's behavior toward controlling international ecological problems. These preferences may change during international negotiations if the domestic characteristics of a country change. In addition, the bargaining process itself is a potential source of change. However, including a bargaining theory of international negotiations is beyond the scope of this article. The aim of this article is to present a parsimonious explanation by concentrating on two unit-level factors of major importance, namely, a country's ecological vulnerability toward pollution and the economic costs of pollution abatement.<sup>2</sup>

In our analysis we assume that each country is a self-interested actor that rationally seeks wealth and power by comparing the costs and benefits of alternative courses of action. To assert that countries pursue their national interest or seek wealth and power does not tell us what their specific preferences might be in a given situation. Thus, it is assumed for the issue-areas of ozone depletion and transboundary acidification that states are pursuing two main goals with the help of their environmental foreign policies. First, each country seeks to avoid vulnerability to air pollutants.<sup>3</sup> Each state is concerned in the first place with its own territory and pays only lip service to the idea of "spaceship Earth." In particular, countries pursue policies that minimize adverse environmental effects on their own citizens and ecosystems ("ecological vulnerability"). Second, states are more inclined to participate in environ-

1. See J. David Singer, "The Level-of-Analysis Problem in International Relations," in Klaus Knorr and Sidney Verba, eds., *The International System: Theoretical Essays* (Princeton, N.J.: Princeton University Press, 1961), pp. 77–92.

2. The term "abatement costs," as used in this article, reflects the resource outlays associated with a governmental position. It does not reflect damage costs. For international comparisons, abatement costs are expressed as a share of gross domestic product (GDP) or gross national product (GNP) so as to reflect a country's "relative effort."

3. Robert O. Keohane and Joseph S. Nye, *Power and Interdependence* (New York: Harper Collins, 1989).

mental protection when the costs of compliance are relatively minor. In addition a country may promote regulations that would benefit it by increasing international demand for its pollution abatement technology and its substitute compounds.

If all states pursue these goals, why do some promote international regulations vigorously while other countries do not? What makes some countries strive for tight international emission controls? Why do other countries try to prevent or slow internationally coordinated action toward environmental protection?

In most cases environmental policy is a reaction to environmental problems. Without actual or anticipated environmental degradation, there would be no need for environmental protection. Conversely, we hypothesize that the worse the state of the environment, the greater the incentives to reduce the ecological vulnerability of a state. National environmental policies, however, do not depend only on the degree of ecological vulnerability. There are several examples of countries that have not taken effective measures to address serious environmental problems in their territories. This holds because environmental policies are also shaped by socioeconomic and institutional capacities to protect the environment.<sup>4</sup> We wish to emphasize the role that economic capacity plays in determining the ability of the state to strive for tight emission controls. We furthermore suggest that different degrees of ecological vulnerability and of economic capacity explain much of the cross-national variance found in support for international environmental regulation (see below).

States are not equally affected by atmospheric pollution. A state can be a source of international pollution, its victim, or both. A victim country A, that is, a country that is ecologically vulnerable to emissions emanating from country B, should try to improve the state of its environment by asking country B to reduce its emissions. Therefore, we expect victim countries to favor international environmental protection. If the environment of a country is affected by domestic emissions, it is expected to favor international harmonization of environmental policies in order to avoid disadvantages in international competitiveness. Thus, there are two major reasons for a vulnerable country to push for international regulations. First, a country's unilateral abatement activities may be insufficient to substantively improve the state of its environment; and second, it would like to avoid putting its polluting industries at a comparative disadvantage in international markets. Conversely, if a country is in a position where foreign or domestic emissions do not much degrade its environment, it should be less eager to promote international environmental regulation.

Our understanding of the role of knowledge in environmental policymaking is somewhat different from that of the proponents of the theory of epistemic

4. Volker von Prittwitz, *Das Katastrophenparadox: Elemente einer Theorie der Umweltpolitik* (The catastrophe paradox: Elements of a theory of environmental policy) (Opladen, Germany: Leske and Budrich, 1990), pp. 103–15.

community.<sup>5</sup> According to this theory, the role of knowledge-based experts is significant in shaping a country's environmental policy. For example, Peter Haas suggests that those countries where policymakers turn to experts for advice are likely to become "pushers" for stringent international controls: "The pacing of national response [to the ozone threat] can be explained largely in terms of the extent of the epistemic community's influence on various governments and its ability to help them interpret the emerging scientific consensus and articulate appropriate policies."<sup>6</sup>

We do not deny the influence of the knowledge of experts on policy but emphasize the contents of knowledge rather than its mere existence. Since countries are often unequally affected by environmental problems, we expect that epistemic communities in ecologically vulnerable countries will exert stronger effects on governmental elites to seek international regulations as opposed to their impact in less ecologically vulnerable countries.<sup>7</sup>

In addition, a country's capacity to abate pollution influences its propensity to seek international environmental regulation. In general we expect that the greater the abatement costs of emission reductions, the more reluctant a country should be to support international regulations (other factors being equal). If, on the other hand, international environmental protection is relatively inexpensive, a country should be more inclined to subscribe to international environmental regulations. In particular abatement cost functions are influenced by the state of abatement (or prevention) technology, behavior modification (which can lead to price changes), and other factors. New and cost-reducing abatement technologies may reduce the (actual or anticipated) socioeconomic effort needed to support substantive regulations of the environment.

By combining indicators of a country's ecological vulnerability (low and high) with abatement costs (low and high), countries can be classified into four categories: "pushers," "intermediates," "draggers," and "bystanders" (see Figure 1). It is hypothesized that countries in cell 2 of Figure 1 (i.e., those expected to act as pushers in international negotiations) strive for stringent international regulation, while countries in cell 3 (i.e., draggers) oppose international environmental regulation. The countries falling in cell 4, namely, intermediate countries, find themselves in a particularly precarious situation. On the one hand they have ecological incentives to participate in international

5. The term "epistemic community" refers to a knowledge-based transnational network of specialists whose members share common views about the causes of environmental problems and the policies to control them. See Peter M. Haas, *Saving the Mediterranean: The Politics of International Environmental Cooperation* (New York: Columbia University Press, 1990).

6. Peter M. Haas, "Banning Chlorofluorocarbons: Epistemic Community Efforts to Protect Stratospheric Ozone," *International Organization* 46 (Winter 1992), pp. 189-224 and p. 215 in particular.

7. This possibility is also mentioned by the proponents of the theory of epistemic communities. See p. 30 of Peter Haas, "Introduction: Epistemic Communities and International Policy Coordination," *International Organization* 46 (Winter 1992), pp. 1-35.

|                 |             | Ecological vulnerability |                   |
|-----------------|-------------|--------------------------|-------------------|
|                 |             | <i>Low</i>               | <i>High</i>       |
| Abatement costs | <i>Low</i>  | (1) Bystanders           | (2) Pushers       |
|                 | <i>High</i> | (3) Draggers             | (4) Intermediates |

**FIGURE 1.** *Classification of a country's support for international environmental regulation*

environmental regulation, while on the other hand they may not be willing to shoulder the substantial costs involved. Finally, countries falling into cell 1 (bystanders) should have little ecological interests in international regulations, but they are likely to take more ambitious positions than draggers because of the low costs associated with their negotiation position.

Besides typifying the anticipated behavior of states, we also suggest an ordinal ordering of intensity of support for substantive (rather than purely declaratory) environmental regulation. We expect that pusher countries take more stringent environmental positions than intermediate countries do, while the latter group is expected to favor environmental protection more often than draggers. The likelihood of bystanders' supporting environmental protection should fall between those for pushers and draggers; however, no direct comparison with the intermediate group seems to be appropriate on theoretical grounds.

The purpose of the remainder of this article is to assess the extent to which state policies toward controlling air pollution conform to the interest-based hypothesis outlined above. The empirical analysis of state policies is based on the negotiations leading to the signing of the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer (control of stratospheric ozone-depleting substances) and the 1985 Helsinki Protocol (control of transboundary acidification), which are the first two major multilateral agreements that oblige national governments to reduce harmful air pollutants.

## Review of the literature

Before turning to the empirical assessment of the interest-based hypothesis, we briefly summarize the contemporary social science literature on national

policies toward the Montreal and the Helsinki Protocols. The negotiations on these international environmental agreements were chosen for several reasons. First, regulations of air pollutants, especially chlorofluorocarbons (CFCs) and sulfur dioxides, cut across many vital industries of advanced industrial countries (utilities, transport, refrigeration, etc.). Therefore, the cases chosen imply that international regulations may involve substantial economic burdens rather than merely declarations of ecological goodwill. Second, the cases chosen are of importance for future regulation of the enhanced greenhouse effect (global warming). In particular CFCs are major greenhouse gases, and the larger complex of acid rain regulations also covers nitrogen oxides, another greenhouse gas. From a historical perspective, the regulation of sulfur emissions can be seen as a predecessor of the regulation of nitrogen oxides, and the variance of political and economic systems found across European countries (both Eastern and Western) during most of the 1980s is suggestive of the challenges of regulating the global environment.<sup>8</sup> Third, the literature and the availability of data on international air pollution regulations seem to be best developed for social science research as compared with other environmental domains. Given the current scientific and public discussions on global warming, we expect this academic and policy emphasis on the regulation of air pollutants to continue.

### *The Montreal Protocol*

Because of the depletion of the stratospheric ozone layer, increased ultraviolet radiation may pose significant threats to human health (especially skin cancer, eye damage, and adverse impact on the immune response system) as well as to aquatic and terrestrial ecosystems. In order to limit these effects, international cooperation was sought to control the emission of substances that are believed to deplete the stratospheric ozone layer. As a first step, the Vienna Convention for the Protection of the Ozone Layer was signed in 1985. It places emphasis on cooperation in research and exchange of scientific information. Building on the Vienna Convention, the 1987 Montreal Protocol contains specific obligations to reduce the production and consumption of five CFCs by 50 percent between 1989 and 1999, using 1986 as a base year, and to freeze the production and consumption of three halons at their 1986 levels by 1994. The regulations were tightened in 1990 in London, where states agreed to a total phase-out of fifteen CFCs, three halons, carbon tetrachloride, and methyl chloroform during the next ten to fifteen years. Furthermore, in late 1992 it was decided in Copenhagen that current restrictions shall be implemented faster

8. See Detlef F. Sprinz, "Why Countries Support International Environmental Agreements: The Regulation of Acid Rain in Europe," Ph.D. diss., Department of Political Science, The University of Michigan, Ann Arbor, 1992).

than envisioned in London; in addition, the new Copenhagen regulations are more inclusive than those agreed upon in Montreal or London. Given the optimism stemming from the London agreement, Joseph Glas concluded that "through efforts to address the ozone depletion issue, we appear finally to have found a way to behave as a global community and make a commitment to reduce the overall risks to society in the future."<sup>9</sup> However, it is assumed by the interest-based explanation pursued in this article that national interests shape state policies toward protecting the stratospheric ozone layer. Despite the growing interest of social scientists in the politics of global environmental pollution, relatively little work has been done on explaining the policies undertaken by countries to protect the stratospheric ozone layer.

In general, six factors have been emphasized in the literature as having been conducive to the process of negotiating the Montreal Protocol: (1) the role of scientific understanding of ozone depletion, (2) the impact of public pressure on decision makers, (3) the role of technological developments, (4) the leadership role played by the United States, (5) the role of the epistemic community, and (6) the role of international institutions.

The writings of Glas, Peter Morrisette, and Richard Benedick emphasize the crucial role that the evolving scientific understanding of the causes, extent, and consequences of ozone depletion has played for the conclusion of the Montreal Protocol.<sup>10</sup> By the mid-1980s, a strong scientific consensus had developed demonstrating that anthropogenic emissions pose a threat to the stratospheric ozone layer. The knowledge of ozone depletion caused concern among the mass publics and put pressure on decision makers to protect the ozone layer. Furthermore, it is assumed that the ability of industry to produce CFC substitutes made it easier for governments to reduce the production and consumption of CFCs. Benedick, the chief U.S. negotiator of the Montreal Protocol, emphasizes the role of political leadership. According to him, the U.S. government played a crucial role in persuading hesitant governments to agree to international regulations.<sup>11</sup> Approaching the issue from a different perspective, Haas focuses on the role of the epistemic community in shaping attitudes of states toward protecting the stratospheric ozone layer.<sup>12</sup> Furthermore Edward Parson emphasizes that international institutions—and the

9. See pp. 152–54 of Joseph P. Glas, "Protecting the Ozone Layer: A Perspective from Industry," in Jesse H. Ausubel and Hedy E. Sladovich, eds., *Technology and Environment* (Washington, D.C.: National Academy Press, 1989), pp. 137–55.

10. See *ibid.*; Peter M. Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion," *Natural Resources Journal* 29 (Summer 1989), pp. 793–820; Richard E. Benedick, "Ozone Diplomacy," *Issues in Science and Technology* 6 (Fall 1989), pp. 43–50; and Richard E. Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet* (Cambridge, Mass.: Harvard University Press, 1991).

11. See Benedick, "Ozone Diplomacy"; and Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet*.

12. Haas, "Banning Chlorofluorocarbons."



United Nations Environment Program (UNEP) in particular—were increasing the willingness of countries to agree to CFC controls.<sup>13</sup> While scientific knowledge, expert opinion, public concern, bargaining process, and technological development undoubtedly contributed to the signing of the Montreal Protocol, the analyses do not sufficiently explain why some governments had stronger preferences to regulate ozone-depleting substances than other countries. Whereas Benedick refers to several potentially influential factors, Haas concentrates on a monistic explanation. In explaining why the United States began pushing for stringent international controls on ozone-depleting substances earlier than the European Community (EC), Haas refers to the different strengths of the epistemic community, the tradition of pro-environmental sentiment, and the differences in the relations between the scientific community and the governments on both continents.<sup>14</sup> One would expect that these differences also have an impact on policies in other issue-areas. However, this does not seem to be the case. For example, the EC is more eager to control the emissions of carbon dioxide than is the United States. Thus we suggest that besides the impact of scientific knowledge and epistemic communities, policies are mainly shaped by a country's ecological vulnerability and economic capacity to control environmental degradation.

### *The Helsinki Protocol*

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)<sup>15</sup> has received considerable attention, relatively few social science publications have predominantly focused on the origins and consequences of the 1985 Helsinki Protocol.<sup>16</sup> This is the more surprising since the Helsinki Protocol is the first substantive agreement among a subset of signatories of the

13. Edward A. Parson, "Protecting the Ozone Layer," in Peter M. Haas, Robert O. Keohane, and Marc A. Levy, eds., *Institutions for the Earth: Sources of Effective Environmental Protection* (Cambridge, Mass.: MIT Press, 1993), pp. 27–73.

14. Haas, "Banning Chlorofluorocarbons."

15. The LRTAP Convention 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). Canada and the United States are members of the UNECE as are all European countries.

16. For examples of the literature on the LRTAP, see C. Ian Jackson, "A Tenth Anniversary Review of the ECE Convention on Long-range Transboundary Air Pollution," *International Environmental Affairs* 2 (Summer 1990), pp. 217–26; Armin Rosencranz, "The ECE Convention of 1979 on Long-range Transboundary Air Pollution," in *Zeitschrift für Umweltpolitik* 4 (December 1981), pp. 511–20; Volker Prittwitz, *Umweltaussenpolitik: Grenzüberschreitende Luftverschmutzung in Europa* (Foreign environmental policy: Transboundary air pollution in Europe) (Frankfurt a.M.: Campus, 1984); and Gregory Wetstone and Armin Rosencranz, *Acid Rain in Europe and North America—National Responses to an International Problem* (Arlington, Va.: Environmental Law Bookcrafter, 1983).

LRTAP Convention and mandates signatories to the protocol to reduce sulfur emissions or their transboundary fluxes by at least 30 percent by 1993 (compared with 1980).

In general, three tiers of literature related to negotiations on international regulations of sulfur emissions can be distinguished: (1) historical and legal perspectives, (2) descriptions of emission control policies of specific countries, and (3) policy assessments of support for sulfur regulations. Only the last two categories are of particular interest to this article.

The literature on the emission control policies of various countries describes the foundation for country positions on international sulfur regulations. The two volumes edited by Barbara Rhode as well as the studies by Helmut Weidner, by Sonja Boehmer-Christiansen and Jim Skea, and by Gregory Wetstone and Armin Rosencranz summarize and assess the following factors for various countries: (1) institutional setting of air pollution control (e.g., legal regulation and its history, monitoring, and enforcement); (2) damage caused by air pollutants to humans, ecosystems, and materials; (3) technological capacity to reduce the emission of air pollutants; (4) national decision making on emission policies; and (5) the environmental impact of national policies on foreign countries.<sup>17</sup>

While these studies contribute country-specific information needed for comparative assessments of air pollution policies, they normally lack a normative, theoretical, or empirical framework.<sup>18</sup>

The literature on policy assessments sheds light more narrowly on the factors that explain why some countries support sulfur regulations and why other countries are reluctant to do so. In his article on international policy responses to transboundary air pollution in Europe, Peter Sand stresses the impact that 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.<sup>19</sup> However, Sand falls short of providing an explanatory theory for the variance found among countries in support of the Helsinki Protocol. Conversely, Rosencranz chose to explain why Poland, the United Kingdom (UK), and the United States have declined to push for

17. See Barbara Rhode, ed., *Air Pollution in Europe*, vol. 1, *Western Europe*, and vol. 2, *Socialist Countries*, (Vienna: European Coordination Centre for Research and Documentation in the Social Sciences, Vienna Centre, 1988); Helmut Weidner, *Air Pollution Control: Strategies and Policies in the Federal Republic of Germany* (Berlin: Edition Sigma, 1986); Helmut Weidner, *Clean Air Policy in Great Britain: Problem Shifting as Best Practicable Means* (Berlin: Edition Sigma, 1987); Sonja Boehmer-Christiansen and Jim Skea, *Acid Politics: Environmental and Energy Policies in Britain and Germany* (London: Belhaven Press, 1991); and Wetstone and Rosencranz, *Acid Rain in Europe and North America*.

18. The study by Boehmer-Christiansen and Skea, *Acid Politics*, shows an explicit comparative research design, but the number of explanatory factors exceeds by far the number of cases. Therefore, the conclusions are unlikely to be robust unless different research methods are employed.

19. Peter Sand, "Air Pollution in Europe: International Policy Responses," *Environment* 29 (December 1987), pp. 16–20 and 28–29.

stringent sulfur regulations for economic, meteorological, scientific, or political reasons.<sup>20</sup> Although Marc Levy offers the most detailed account of the reasons why various prominent countries have pursued more or less ambitious regulations, he does not put forward a systematic explanation of state behavior toward international environmental regulation.<sup>21</sup>

Since a systematic explanation of state support for international environmental regulation is lacking from existing studies, we propose that a country's interests are defined by differences in ecological vulnerability and economic abatement costs. In the following sections, we will test our propositions by choosing the negotiations that led to the conclusion of the Montreal and Helsinki Protocols as our case studies.

### **Policies toward stratospheric ozone**

In the case of stratospheric ozone depletion, we hypothesize that a country's preference for international controls is determined by the vulnerability of its population to increased ultraviolet radiation and the economic cost of reducing CFCs.

UNEP played a major role in making ozone protection a top priority by funding research on the issue and sponsoring international meetings. In 1978 a scientific committee established by UNEP issued an assessment of the scientific evidence of ozone depletion and noted "the consistency in model predictions" but also recognized the continued existence of "large uncertainties in both the predicted ozone depletions and the understanding of their consequences."<sup>22</sup> In the mid-1980s, major difficulties concerning processes and observation of ozone depletion were not yet resolved. For example, it was difficult to quantify future ozone depletion: the estimates varied from 3 to 20 percent. This problem notwithstanding, all models predicted that the continued release of CFCs would damage the ozone layer. The general conclusions drawn by observers were incorporated in a report by UNEP in 1985 that summarized the contemporary understanding of stratospheric ozone depletion in the following way: "Nothing has been discovered to disturb the basic premise, identified some two decades ago, that the ozone layer is likely to be depleted if concentrations of trace gases, particularly chlorine containing substances,

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20. Armin Rosencranz, "The Acid Rain Controversy in Europe and North America: A Political Analysis," in John E. Carroll, ed., *International Environmental Diplomacy: The Management and Resolution of Transfrontier Environmental Problems* (Cambridge, England: Cambridge University Press, 1988), pp. 173–87.

21. Marc A. Levy, "European Acid Rain: The Power of Toteboard Diplomacy," in Haas, Keohane, and Levy, *Institutions for the Earth*, pp. 75–132.

22. Thomas B. Stoel, Jr., "Fluorocarbons: Mobilizing Concern and Action," in David A. Kay and Harold K. Jacobson, eds., *Environmental Protection: The International Dimension* (Totowa, N.J.: Allenheld, Osmun, 1983), pp. 45–74. The quotations are drawn from p. 57.

continue to increase. . . . Refinement of chemical theory points unwaveringly toward the existence of a problem of ozone layer modification and impacts for man and his environment that are universally bad.”<sup>23</sup>

By the mid-1980s, sufficient consensus among natural scientists existed to start formal negotiations on the ozone regime, but governments could still point to the lack of hard evidence regarding the theory of stratospheric ozone depletion.

Increased ultraviolet radiation is believed to have several adverse effects, but we concentrate here on a direct human health effect, skin cancer. During the early 1980s more was known about human health effects than other consequences, and state representatives had been predominantly concerned with skin cancer.<sup>24</sup> It was known that ultraviolet light can produce considerable mortality and morbidity through the induction of skin cancer in white populations who live close to the equator and are therefore more exposed to ultraviolet radiation. Dark-skinned populations as well as populations living farther away from the equator were considered to be less affected by ultraviolet radiation. The threat of the effect of evenly spread global ozone depletion would have amplified the occurrence of skin cancer and exposed larger populations to the conditions found in equatorial regions.<sup>25</sup> In order to determine the vulnerability of a country to global ozone depletion, one would ideally combine its latitude and the skin type of its population. Since no data were found for the latter indicator, the ecological vulnerability of states is determined on the basis of the incidence of skin cancer among their populations in the mid-1970s. No assumption was made regarding the relationship between the local variation in the degree of ozone depletion and skin cancer incidence because of lack of adequate data during the early 1980s. The analysis that follows assumes that the division of populations into categories of high and low skin cancer incidence as observed in the mid-1970s remained unchanged until the mid-1980s. During the negotiations the incidence of skin cancer was linked to policies toward ozone depletion. A representative of Australia mentioned the high incidence in his country to explain Australia's interest in having the ozone layer protected.<sup>26</sup> In the words of a delegate from

23. UNEP, “Assessment of Risks to the Ozone Layer,” 1st Meeting of Steering Committee to Plan Workshops on Chlorofluorocarbons, 17–18 September 1985, mimeograph, p. 6.

24. We refer to the knowledge available to decision makers in the early 1980s rather than since the late 1980s. Only after the conclusion of the Montreal Protocol did it become evident that the thinning of the stratospheric ozone layer disproportionately affects the polar regions.

25. Robin R. Jones, “Consequences for Human Health of Stratospheric Ozone Depletion,” in R. Russell Jones and T. Wigley, eds., *Ozone Depletion: Health and Environmental Consequences* (New York: John Wiley & Sons, 1989), pp. 207–27.

26. UNEP, Ad Hoc Working Group of Legal and Technical Experts for the Preparation of a Protocol on Chlorofluorocarbons to the Vienna Convention for the Protection of the Ozone Layer (Vienna Group), “Report of the Ad Hoc Working Group on the Work of Its Second Session,” UNEP/WG 167/2, 4 March 1987, p. 7.

Malaysia, "Skin cancer doesn't seem to occur in tropical countries, which have been by and large bystanders" in the negotiations.<sup>27</sup>

Besides ecological vulnerability, the economic costs of reducing harmful emissions is assumed to shape a country's preferences and to affect its environmental foreign policy. Specifically we hypothesize that the higher the consumption of CFCs is per unit of gross national product (GNP), the higher the abatement costs should be and vice versa.

The incidence of skin cancer as well as the "intensity" of CFC consumption—measured as the amount of CFC consumption in relation to GNP per capita (for those states that attended most of the sessions of the working groups on the ozone regime and played visible roles in the negotiations)—are displayed in Table 1.<sup>28</sup>

On the basis of the data, we hypothesize that the ecological vulnerability of Australia, North America, and Northern Europe had been particularly high, and we expect the countries of these regions to favor strict environmental regulations. If the threshold of three cases of skin cancer per 100,000 inhabitants is employed to classify environmental vulnerability, ozone depletion should not have been regarded as a particularly serious problem in the Federal Republic of Germany (FRG), France, Italy, Japan, and the UK. Of the fourteen countries listed in Table 1, the former Soviet Union and the United States stand out because of their particularly high CFC intensity. Using a threshold of 3 metric tons per U.S. dollar of CFCs, the costs of reducing CFCs should also be relatively high in France, the FRG, Italy, Japan, and the UK. In the 1980s, these states should have had a strong economic interest in *opposing* significant reductions of CFC production and consumption.

Combining the vulnerability dimension and the abatement cost dimension, Figure 2 displays the categorization of individual countries according to the interest-based hypothesis that was displayed in Figure 1.

The states in the upper right-hand cell of Figure 2 (pushers), namely, Australia, Canada, Denmark, Finland, Norway, Sweden, and Switzerland, should have had both ecological and economic incentives to support significant emission reductions. Their populations are vulnerable to increased ultraviolet radiation, and emission reductions should not impose a great economic burden on them. Ecological and economic constraints should have made France, the FRG, Italy, Japan, the former Soviet Union, and the UK the most visible dragger states in the negotiations. According to our classification, the United States qualifies as an intermediate country.

27. Quoted from Craig R. Whitney, "EC Official Says Europeans Soon Can Shield Ozone Layer," *International Herald Tribune*, 6 March 1989, p. 5.

28. Skin cancer may also be caused by other factors. However, given the small number of cases, a multiple regression analysis of the various causes of skin cancer appears not to be feasible.

**TABLE 1.** *Ecological vulnerability and abatement costs: stratospheric ozone depletion<sup>a</sup>*

| Country                     | Rate of skin cancer<br>(number of cases per<br>100,000 inhabitants),<br>mid-1970s | Intensity of CFC consumption<br>in 1986 (net atmospheric<br>increase in relation to<br>GNP per capita) <sup>b</sup> |
|-----------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Australia                   | 16.3                                                                              | 1.1                                                                                                                 |
| Canada                      | 3.2                                                                               | 1.5                                                                                                                 |
| Denmark                     | 5.4                                                                               | 0.3                                                                                                                 |
| Federal Republic of Germany | 2.1                                                                               | 3.6                                                                                                                 |
| Finland                     | 3.9                                                                               | 0.3                                                                                                                 |
| France                      | 2.5                                                                               | 3.7                                                                                                                 |
| Italy                       | 3.0                                                                               | 4.7                                                                                                                 |
| Japan                       | 0.3                                                                               | 4.5                                                                                                                 |
| Norway                      | 8.3                                                                               | 0.1                                                                                                                 |
| Soviet Union                | NA                                                                                | 22.2 <sup>c</sup>                                                                                                   |
| Sweden                      | 5.5                                                                               | 0.3                                                                                                                 |
| Switzerland                 | 5.2                                                                               | 0.3                                                                                                                 |
| United Kingdom              | 2.6                                                                               | 4.5                                                                                                                 |
| United States               | 7.2 <sup>d</sup>                                                                  | 11.3                                                                                                                |

<sup>a</sup>Only countries that were participating actively in the negotiations are listed. No data were available for the former Soviet Union, but it was considered to be a country with a low incidence of skin cancer (see Thomas B. Stoel, Jr., Alan S. Miller, and Breck Milroy, *Fluorocarbon Regulation: An International Comparison* [Lexington, Mass.: D.C. Heath, 1980]).

<sup>b</sup>Calculated in metric tons per U.S. dollar. GNP = gross national product.

<sup>c</sup>GNP per capita in 1980.

<sup>d</sup>White U.S. population only.

*Sources.* Data on skin cancer incidence are from J. Waterhouse et al., eds., "Cancer Incidence in Five Continents," in *LARC Scientific Publications* 4 (No. 42) (Lyon: International Agency for Research on Cancer), pp. 730–31. Data on CFC consumption are from World Resources Institute, *World Resources 1990–91* (New York: Oxford University Press, 1990), pp. 348–49. Data on GNP are from Tilastokeskus (Statistics Finland), *Suomen tilastollinen vuosikirja* (Statistical yearbook of Finland) (Helsinki: Valtion Painatuskeskus, 1988 and 1989), pp. 514–15 and 512–13, respectively.

### *Evaluation of the interest-based explanation*

The negotiations on the protection of the stratospheric ozone layer began when an ad hoc working group established by UNEP met for the first time in Stockholm in 1982. It held four sessions before the conclusion of the Vienna Convention on the Protection of the Ozone Layer three years later. Following this agreement, a new working group for the preparation of a protocol on emission reductions met three times in 1986–87 so that the Montreal Protocol could be signed in 1987. In order to assess the positions taken by countries during the negotiations, we rely mainly on written documentation. A time series of policy positions of all countries is unfortunately not available from

|                 |      | Ecological vulnerability                                                               |                                                                  |
|-----------------|------|----------------------------------------------------------------------------------------|------------------------------------------------------------------|
|                 |      | Low                                                                                    | High                                                             |
| Abatement costs | Low  | —                                                                                      | Australia, Canada, Denmark, Finland, Norway, Sweden, Switzerland |
|                 | High | France, Federal Republic of Germany, Italy, Japan, former Soviet Union, United Kingdom | United States                                                    |

FIGURE 2. Predicted position of countries: stratospheric ozone depletion

accessible documentation. Country positions ranged from “no reductions” to virtual elimination of commercial use of CFCs.

The Nordic countries, namely, Denmark, Finland, Norway, and Sweden, strove for stringent internationally binding regulations from the very beginning of the negotiation process. Only the Netherlands clearly supported the Nordic initiative at the first session. In addition, Australia, Canada, and Switzerland were believed to be particularly interested in 1982 in bringing about an internationally binding treaty.<sup>29</sup> Before 1983 the United States had regarded further scientific evidence as a prerequisite for international regulations because of the socioeconomic consequences of emission controls.<sup>30</sup> By 1983 U.S. representatives pointed to the potentially serious impact of CFCs on the ozone layer and regarded it as prudent to take specific steps to control CFC emissions. However, while having banned all aerosol uses of CFCs in 1978, the U.S. government considered restrictions put on nonaerosol uses of CFCs as “inappropriate at this point in time.”<sup>31</sup>

In 1984 Canada invited the most active states pushing for international regulations to Toronto to add momentum to the diplomatic process. Seven states besides Canada attended the meeting: Austria, Denmark, Finland, Norway, Sweden, Switzerland, and the United States.<sup>32</sup> While the goal of the “Toronto Group” was to offer an agreement on reducing the use of (aerosol)

29. Harald Heimsoeth, “The Protection of the Ozone Layer,” *Environmental Policy and Law* 10 (April 1983), pp. 34–36.

30. *Ibid.*, p. 35.

31. UNEP, Ad Hoc Working Group of Legal and Technical Experts for the Elaboration of a Global Framework Convention for the Protection of the Ozone Layer (hereafter Working Group for Ozone Layer Protection), “Draft Annex Concerning Measures to Control, Limit, and Reduce the Use and Emissions of Fully Halogenated Chlorofluorocarbons (CFCs) for the Protection of the Ozone Layer, Submitted by Finland, Norway, and Sweden,” UNEP/WG 94/4 Add. 3, 17 October 1983, pp. 1–2.

32. Australia had also been invited, but it did not participate in the conference.

CFCs in spray cans and to sign the Vienna framework convention, besides the Toronto Group, only the Netherlands was willing to support a control protocol in 1984.<sup>33</sup> During the negotiations in 1986–87, the members of the Toronto Group began to demand that virtually all CFC emissions should be stopped. The United States in particular was active in pushing for significant reductions of ozone-depleting emissions. In 1987 it proposed that the production of CFCs and halons first be frozen at 1986 levels and later eliminated step by step except for uses for which substitutes were not commercially available.<sup>34</sup> Furthermore Canada, the Netherlands, and the Nordic countries were also pushing for large reductions in CFC production. The policy of the FRG also had changed by that time. As late as 1984 it had belonged to the group of dragger states. But the FRG acknowledged in 1987 that sufficient proof of CFC involvement in ozone layer modification had been accumulated to “justify immediate and world-wide action to restrict severely all CFC emissions.”<sup>35</sup>

France, Italy, Japan, and the UK tried most consistently to prevent the adoption of drastic reductions in CFC production and consumption. Since three of these countries belonged to the EC, the EC views reflected their interests. In the beginning these states were reluctant even to discuss a control protocol, since they either did not regard it as necessary<sup>36</sup> or thought that any regulation concerning CFCs should be decided on after opening the framework convention for signature.<sup>37</sup> A recommendation put forward in 1984 by six countries, including France, the FRG, Italy, and the UK, was typical of the dragger states’ attitude. It contained two modest measures. First, it recommended that the effects of potentially harmful substances on the ozone layer be investigated within three or five years before any decisions on regulations were to be taken. Second, the recommendation encouraged the establishment of a code of conduct for enterprises producing CFCs.<sup>38</sup>

The controversy between the actual (versus the predicted) pusher states (Canada, the Nordic countries, and the United States) and some dragger states (the EC and Japan) characterized the negotiations on the Montreal Protocol. During 1985–86 the EC was willing to limit only the production capacity of

33. UNEP, Working Group for Ozone Layer Protection, “Article II to the Protocol: Control of Use of CFCs, Proposal by the Expert from the Netherlands,” UNEP/WG 110/CRP.5, 23 October 1984.

34. UNEP, Vienna Group, “Report of the Ad Hoc Working Group on the Work of Its Third Session,” UNEP/WG 172/2, 8 May 1987, p. 5.

35. *Ibid.*, p. 7.

36. UNEP, Working Group for Ozone Layer Protection, “Report of the Working Group,” UNEP/WG 78/13, 17 June 1983, p. 3.

37. UNEP, Working Group for Ozone Layer Protection, “Draft Annex Concerning Measures to Control, Limit, and Reduce the Use and Emissions of Fully Halogenated Chlorofluorocarbons (CFCs) for the Protection of the Ozone Layer, Submitted by Finland, Norway, and Sweden,” UNEP/WG 94/4 Add. 1, 15 September 1983, p. 3.

38. UNEP, Working Group for Ozone Layer Protection, “Recommendation of the Ad Hoc Working Group of Legal and Technical Experts for the Elaboration of a Global Framework Convention for the Protection of the Ozone Layer for a Decision to be Taken by the Governing Council of UNEP,” UNEP/WG 94/CRP 34, 19 January 1984.



CFCs. The proposed ceiling was higher than the then-current production levels within the EC.<sup>39</sup> However by 1987 the EC was convinced that more stringent international action was necessary to control emissions. The new policy of the EC included, besides the freeze on the production of CFCs, an automatic reduction in CFC production and imports of 20 percent, based on 1986 levels.<sup>40</sup> In particular, Denmark, the FRG, and the Netherlands were pushing the EC to accept significant reductions in CFC production, while France and the UK still opposed tighter regulations. The Japanese policy also began to change by the end of the decade. In 1987 a representative of Japan considered it “realistic to establish immediate measures such as regulations on CFC-11 and CFC-12 and to consider to control other substances.”<sup>41</sup>

The arguments used by the former Soviet Union during the negotiations resembled those of the dragger states, but the overall policy of the Soviet Union was cautious. Although Winfried Lang, who chaired the sessions that prepared the Montreal Protocol, described the Soviet stand in 1986–87 as “friendly to reductions” (“*eine reduktionsfreundliche Haltung*”),<sup>42</sup> and the press reported in 1987 that the Soviet Union favored big reductions, analysts of the negotiations tend to place the Soviet Union together with the EC and Japan as opponents of international regulations.<sup>43</sup>

Building on this summary of the negotiation process, we assess the validity of the impact of ecological vulnerability and abatement costs on a country's position in international environmental negotiations. The states in the upper right-hand cell of Figure 2 correspond well with our hypotheses. These states acted as the most consistent pushers in the negotiations. In addition, Austria and the Netherlands (with low CFC production intensities of 0.5 and 1.0, respectively) were supportive of the position of the predicted pushers.<sup>44</sup>

As expected on the basis of ecological and economic constraints, France, Italy, Japan, and the UK were the most visible dragger states in the negotiations. And the behavior of the former Soviet government is not necessarily surprising.

39. See UNEP, Conference of Plenipotentiaries on the Protection of the Ozone Layer, “Final Report of the Ad Hoc Working Group of Legal and Technical Experts for the Elaboration of a Global Framework Convention for the Protection of the Ozone Layer,” UNEP/IG 53/4, Annex II, 28 January 1985, p. 4; and UNEP, Vienna Group, “Draft Report of the Ad Hoc Working Group on the Work of Its First Session,” UNEP/WG 151/L.4, 15 January 1987, pp. 6–7.

40. UNEP/WG 172/2, pp. 5–6.

41. UNEP/WG 167/2, p. 6.

42. Winfried Lang, “Diplomatie zwischen Ökonomie und Ökologie: Das Beispiel des Ozonvertrags von Montreal” (Diplomacy between economics and ecology: The case of the Montreal Protocol), *Europa-Archiv* 43 (25 February 1988), p. 108.

43. See Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet*, p. 85; and Haas, “Banning Chlorofluorocarbons,” p. 209.

44. Unfortunately, no data are available on the rate of skin cancer in the mid-1970s for Austria or for the Netherlands.

While the policies of the foregoing countries seem to support the interest-based explanation of support for international environmental regulation, the categorization of the FRG as a dragger state and of the United States as an intermediate is more problematic. Despite their domestic characteristics, both states began to support large reductions by the end of the negotiations. The United States unilaterally banned the aerosol use of CFCs as early as 1978, joined the Nordic countries in 1983 by calling for an international ban on the use of CFC-11 and CFC-12 in aerosol cans, and began to demand an end to all uses in 1986–87. The FRG opposed international regulations, though it reduced the use of aerosol CFC in the early 1980s. Its policy changed significantly in 1987 when the German representatives sought large international reductions in all CFC emissions and announced that they would aim to end production and consumption by the end of the century.

### *The impact of technology on reducing abatement costs*

Improvements of the state of technology seem to have played a major role in persuading the FRG and the United States to accept deep cuts in the production and consumption of CFCs. It appears that the environmental foreign policy of these countries toward ozone depletion changed as a result of the success of their industries in substituting new compounds for CFCs. In general the ability to produce substitutes reduces abatement costs and allows countries to favor more stringent regulations.

The covariation between the development of alternative compounds and policy is particularly evident in the United States. As mentioned above, the United States unilaterally banned the manufacture and shipment of CFC-propelled aerosols in 1978. The industry's response was muted, since technically feasible and economically acceptable alternatives existed for most propellant uses of CFCs.<sup>45</sup> Another reason for the relatively low cost of the ban was that, from an economic perspective, aerosol use was not as important as were other uses of CFCs, such as for refrigeration and for air-conditioning.

With respect to international controls on CFCs, the United States had concluded by the early 1980s that it would not profit from being the only country to invoke stringent domestic standards on the use of CFCs. Accordingly the U.S. government continued to oppose international regulations with the exception of controls on the aerosol use of CFCs. In 1986–87 however the U.S. government began to strive for ending all uses for CFCs. It is noteworthy that the first reports about the development of new substitutes for CFCs appeared in the press at this point in time. It was generally believed that the

45. Thomas B. Stoel, Jr., Alan S. Miller, and Breck Milroy, *Fluorocarbon Regulation: An International Comparison* (Lexington, Mass.: D.C. Heath, 1980), p. 221.

new position of the United States was bolstered by success in developing new forms of chemical compounds.<sup>46</sup>

Industrial representatives originally opposed controls on CFCs, but by 1986 their opposition had softened considerably. In 1986 the Alliance for Responsible CFC Policy, an industry lobby group, announced that its members were prepared to support a global limit on the growth of CFC production. Du Pont, a company based in the United States and the largest single producer of CFCs, took an even stronger position by calling for a worldwide limit on emissions of the chemicals. This new attitude toward CFC regulation was preceded by extensive industry research on substitutes for CFC-11 and CFC-12. Du Pont, for example, initiated a large research effort as early as the mid-1970s. It ceased this line of research in the beginning of the 1980s, but by 1986 the company had reactivated its research program and announced that suitable alternatives could be available within five years.<sup>47</sup> Two years later Du Pont announced plans to build the world's first commercial-scale plant to produce a substitute for CFC-12<sup>48</sup> and supported "an orderly transition to a total phaseout" of the most harmful CFCs.<sup>49</sup> It was later specified that the target was to complete the phaseout by no later than the end of the century.

Availability of substitutes for specific CFCs could also explain why the policy of the FRG toward regulating CFCs changed. Its government asked the chemical industry in 1987 for a near-total elimination of CFC production and consumption by the year 2000. The government announced that the reduction would begin by concentrating on the aerosol industry, and industry was willing to comply with the plan since it had already gone a long way toward the elimination of all but essential aerosol uses of CFCs.<sup>50</sup>

The significance of the change in positions of the FRG and the United States is even more evident if compared with the situation in the main dragger states. Before the policies of the EC and Japan began to change, their representatives expressed concern during the negotiations that U.S. companies, with their successful development of substitutes, might enjoy a significant competitive advantage if drastic international regulations were adopted. Although the

46. *International Herald Tribune*, 19 December 1986, p. 4.

47. See pp. 357–58 of James K. Sebenius, "Challenging Conventional Explanations of International Cooperation: Negotiation Analysis of the Case of Epistemic Communities," *International Organization* 46 (Winter 1992), pp. 323–65; and Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet*, p. 33; and Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion," pp. 815–16.

48. Glas, "Protecting the Ozone Layer," p. 150.

49. DuPont is quoted in *International Herald Tribune*, 29 March 1988, p. 4.

50. Steven Dickman, "West Germany Strides Towards CFC Elimination by 2000," *Nature* 327 (14 May 1987), p. 93. A similar observation has been made by Benedick. In explaining the differences in 1990 within the EC on the policy toward regulation, Benedick remarks that the FRG announced that it will phase out CFCs in 1995 and other ozone-depleting substances before the end of the century. This took place after the federal government of the FRG had concluded that alternatives to the major harmful chemicals were close to commercial feasibility for nearly all applications. See Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet*, pp. 164–65.

aerosol use of CFCs had declined steadily in the EC as a result of increased substitution by less-expensive propellants.<sup>51</sup> EC representatives complained in 1987 that U.S. companies would benefit from a control protocol with drastic regulations, since they were ahead in the search for substitutes.<sup>52</sup> In the words of a Japanese representative to the ozone negotiations, it was "very important that contracting parties to the protocol should have common access to technological information on substitute chemicals." He also proposed that "a system of international cooperation should be established with a view to making technological information available to all contracting states, thus avoiding the monopoly of that information by specific countries."<sup>53</sup>

Given the positive covariation between the development of CFC substitutes and the more pro-regulatory preferences of national governments, two causal chains might be suggested. First, technological advances led to more ambitious preferences for environmental regulation. Second, public policy can force the development of more efficient environmental technologies. The latter causal chain is emphasized by Benedick, who suggests that changing scientific knowledge and public perceptions of environmental problems are needed to persuade industries to prepare themselves for more stringent environmental regulations.<sup>54</sup> Similarly Alan Miller believes that without anticipation of a regulatory intervention, industry has little incentive to search for alternatives for existing products or production methods.<sup>55</sup> These hypotheses are compatible with the interest-based explanation of international environmental regulation: a growing public perception of the severity of adverse ecological effects puts pressure on governments and creates expectations about regulatory policy. As a result, industry starts preparing itself for more stringent environmental controls by improving the state of abatement technology. As a consequence, lowered abatement costs enhance the likelihood of substantive international environmental regulation.

In conclusion, as a result of a growing perception of the vulnerability to ozone depletion in combination with advances in developing substitutes for CFCs, all states began gradually to perceive common interests in protecting the stratospheric ozone layer by phasing out harmful chemicals.

### Policies toward acid rain

As in the case of negotiations on the regulation of CFCs, for the case of European acid rain regulation we hypothesize that increased ecological

51. James K. Hammitt, et al., *Product Uses and Market Trends of Potential Ozone-depleting Substances, 1985–2000* (Santa Monica, Calif.: Rand Corporation, 1986), p. 17.

52. Debora MacKenzie, "Chemical Giants Battle over Ozone Holes," *New Scientist* 114 (23 April 1987), p. 22.

53. UNEP/WG.172/2, p. 6.

54. Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet*, pp. 30–31.

55. Alan Miller, "The Development of Substitutes for Chlorofluorocarbons: Public-Private Cooperation and Environmental Policy," *Ambio* 19 (October 1990), pp. 338–40.

vulnerability and low abatement costs allow countries to favor strict international environmental regulations as opposed to countries with opposite characteristics.

Due to its suspected strong adverse impacts on the environment, transboundary acid rain in Europe ranked high on government agendas in many European countries. Since the early 1970s the scientific discussion on the linkage of acidification to adverse impacts on lakes, forests, soils, monuments, crops, and human health has led to international research efforts sponsored by the Organization for Economic Cooperation and Development,<sup>56</sup> the Cooperative Program for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), and research coordinated by the United Nations Economic Commission for Europe (UNECE). One major conclusion of these research efforts was the substantiation of the long-range and transboundary nature of acidification in Europe, which made many countries vulnerable to the emission policies of foreign countries.

Parallel to improved knowledge of the ecological effects of sulfur and nitrogen oxides and volatile organic compounds, international efforts were undertaken to reduce the problem by way of internationally coordinated emission reductions. The LRTAP Convention, a framework convention that mirrors the Vienna Convention on the Protection of the Ozone Layer, had been concluded in 1979 as a result of a Swedish initiative on the occasion of the 1972 United Nations Conference on the Human Environment and proposals by then Soviet Secretary General Brezhnev during the Conference on Security and Cooperation in Europe to hold a series of conferences inter alia on the European environment. After coming into force in 1983, the LRTAP Convention had been augmented by (1) the 1984 protocol to the LRTAP Convention on long-term financing of the EMEP; (2) the 1985 Helsinki Protocol regarding a reduction of sulfur emissions or their transboundary fluxes by at least 30 percent; (3) the 1988 Sofia Protocol on the freeze of the emissions of nitrogen oxides; and (4) the 1991 Geneva Protocol on the control of emissions of volatile organic compounds.

The diplomatic process leading to the 1985 Helsinki (or Sulfur) Protocol received much public attention, since this protocol represents the first agreement that may require its signatories to allocate substantial (additional) resources toward air pollution abatement. It basically stipulates that signatories must reduce either their national sulfur emissions or their transboundary fluxes by 30 percent by 1993, using 1980 data as the reference base. The protocol was signed by all of its supporters on 9 July 1985 and was entered into force on 9 September 1987. Although the basic provisions may not be considered very demanding from an ecological perspective, a significant

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56. Organization for Economic Cooperation and Development (OECD), *The OECD Programme on Long Range Transport of Air Pollutants: Measurements and Findings*, 2d ed. (Paris: OECD, 1979).

subgroup of the signatories of the 1979 LRTAP Convention decided *not* to sign the Helsinki Protocol.

Building on the notion and propositions related to the interest-based approach developed above and applied to the problem of stratospheric ozone depletion, we focus on indicators of ecological vulnerability and abatement costs for the analysis of negotiation positions on transboundary acidification in Europe.<sup>57</sup> For the positions taken by countries in the negotiations, we rely on expert interviews and written documentation to assess the policy positions of countries.<sup>58</sup> Regrettably, a time series of policy positions of all countries is not available. The positions ranged from advocating no emission reductions to 50 percent emission reductions.

The degree of susceptibility to acidic depositions varies from country to country, and we expect that ecologically vulnerable states are more likely to promote international agreements than less vulnerable countries. Since "critical loads" reflect the level of acidification that an ecosystem can sustain without long-term damage, an indicator based on exceeding critical loads ("exceedance") reflects increasing deviations from the long-term sustainability of a country's ecosystems.<sup>59</sup> For the initial analysis to follow, the maximum exceedance for a country in 1988 was chosen to represent ecological vulnerability.<sup>60</sup> Countries with a maximum exceedance above 5 were coded as highly ecologically vulnerable, and those with maximum exceedances of 5 or lower were coded as low ecological vulnerability (see Table 2 and Figure 3).

Remedial action is likely to lead to resistance by those groups that have to bear the immediate economic burden, namely, industries burning fossil fuels (such as the utility sector). Since governments have to make judgments about the feasibility of environmental regulations, we expect countries with low abatement costs to favor stringent environmental regulations with a higher probability than countries facing high abatement costs. The yearly abatements costs for a 30 percent reduction of 1980 sulfur emission by the year 2000, a prominent position in the negotiations since the late 1970s, are based on

57. Geographically small countries or those with extremely small emissions have been excluded from the analysis. Canada, Turkey, and the United States were not included in the analysis since they are not (or are insufficiently) covered by EMEP. In addition, EMEP monitors only the European part of the former Soviet Union.

58. The interviews of experts were undertaken by Detlef Sprinz as part of a larger research effort on the international regulation of transboundary air pollution in Europe. For details, see Sprinz, "Why Countries Support International Environmental Agreements."

59. Jean-Paul Hettelingh, Robert F. Downing, and Peter A.M. de Smet, *Mapping Critical Loads for Europe*, Coordination Center for Effects (CCE) technical report no. 1 (Bilthoven: CCE, National Institute of Public Health and Environmental Protection, the Netherlands, 1991).

60. Using 1991 data is only a second-best strategy, since abatement policies during the 1980s have been asymmetric across countries. However, the procedure can be justified on the basis of the failure of previous abatement efforts to lead to a major improvement of the state of the ecosystems. Therefore, the incentive structure for countries to reach additional emission-reduction protocols had not changed. Furthermore, our dichotomous classification is likely to reduce the errors introduced by asymmetric emission policies across nations. In conclusion, the data resemble the basic ecological vulnerability of states in 1985.

policies that include “fuel substitution, use of low sulfur fuels, fuel desulphurization, combustion modification, . . . flue gas desulphurization, . . . [and] high efficient flue gas cleaning methods.”<sup>61</sup> The cost estimates derived by Markus Amann and Gabor Kornai are based on the assumption of a “competitive market for desulphurization equipment, accessible for all countries throughout Europe,” while the option of an energy conservation strategy has been excluded.<sup>62</sup> Total annual abatement costs were then reexpressed as a percentage of gross domestic product (GDP). A threshold level of 0.52 percent of GDP/year, the European average abatement costs for a 30 percent reduction in sulfur emissions, was used to distinguish between low and high abatement cost countries (see Table 2 and Figure 3).

Combining indicators of ecological vulnerability and abatement costs, Figure 3 displays the categorization of countries by way of the interest-based hypothesis.

### *Evaluation of the interest-based explanation*

In the case of the Montreal Protocol, the behavior of most countries could be explained by the interest-based approach to international environmental regulation. Does this finding also hold for the case of transboundary acidification in Europe?

Although most of the pusher countries (upper right-hand cell of Figure 3) finally supported strict regulations in the mid-1970s, it was Norway and Sweden that convinced the remaining Nordic countries to promote strict international regulation. Before 1982 the early calls for standstill and rollback clauses were fiercely opposed by the FRG and the UK for reasons of perceived high abatement costs in the late 1970s and distrust in the assessments of cause-effect relationships of transboundary acidification. In addition the UK had already reduced sulfur emissions to a considerable degree in the 1970s before sulfur regulation became an international issue.<sup>63</sup> As a consequence of the resistance of the FRG and the UK, the 1979 LRTAP Convention does not introduce any costly regulation except for the need to study the problem or, in the view of Rosencranz, to provide “the perfect solution to the victim countries’ need for international recognition of the acid rain problem, and the polluting countries’ need to continue to pollute.”<sup>64</sup>

However, the position of the FRG dramatically changed after the release of its first comprehensive forest survey in 1982. This survey demonstrated that

61. Markus Amann and Gabor Kornai, “Cost Functions for Controlling SO<sub>2</sub> Emissions in Europe,” Working Paper Series of the International Institute for Applied Systems Analysis, WP-87-065, Laxenburg, Austria, mimeograph, 1987.

62. Ibid., pp. 2 and 3, respectively.

63. It must be noted that the UK objected to 1980 as the reference year since it would have easily fulfilled the obligations with a base year chosen from the early 1970s; personal communication.

64. Rosencranz, “The ECE Convention of 1979 on Long-range Transboundary Air Pollution,” p. 517.

**TABLE 2.** *Ecological vulnerability and abatement costs: transboundary acidification in Europe*

| Country                     | Maximum exceedance<br>of critical loads<br>(total acidity,<br>5th percentile) <sup>a</sup> | Annual cost of a 30 percent<br>reduction of SO <sub>2</sub> from 1980<br>levels by the year 2000<br>(percentage of GDP) <sup>b</sup> |
|-----------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Austria                     | 6                                                                                          | 0.04                                                                                                                                 |
| Belgium                     | 6                                                                                          | 0.00                                                                                                                                 |
| Bulgaria                    | 5                                                                                          | 1.81                                                                                                                                 |
| Czechoslovakia              | 6                                                                                          | 0.16                                                                                                                                 |
| Denmark                     | 6                                                                                          | 0.04                                                                                                                                 |
| Finland                     | 5                                                                                          | 0.00                                                                                                                                 |
| Federal Republic of Germany | 6                                                                                          | 0.05                                                                                                                                 |
| France                      | 6                                                                                          | 0.00                                                                                                                                 |
| German Democratic Republic  | 6                                                                                          | 0.87                                                                                                                                 |
| Greece                      | 3                                                                                          | 0.60                                                                                                                                 |
| Hungary                     | 6                                                                                          | 0.32                                                                                                                                 |
| Ireland                     | 5                                                                                          | 0.14                                                                                                                                 |
| Italy                       | 6                                                                                          | 0.01                                                                                                                                 |
| Netherlands                 | 6                                                                                          | 0.05                                                                                                                                 |
| Norway                      | 6                                                                                          | 0.12                                                                                                                                 |
| Poland                      | 6                                                                                          | 0.69                                                                                                                                 |
| Portugal                    | 5                                                                                          | 0.22                                                                                                                                 |
| Romania                     | 6                                                                                          | 2.42                                                                                                                                 |
| Soviet Union                | 6                                                                                          | 0.39                                                                                                                                 |
| Spain                       | 5                                                                                          | 0.13                                                                                                                                 |
| Sweden                      | 6                                                                                          | 0.01                                                                                                                                 |
| Switzerland                 | 6                                                                                          | 0.04                                                                                                                                 |
| United Kingdom              | 6                                                                                          | 0.04                                                                                                                                 |
| Yugoslavia                  | 6                                                                                          | 4.36                                                                                                                                 |
| Average                     | 5.7                                                                                        | 0.52                                                                                                                                 |
| Standard deviation          | 0.7                                                                                        | 1.01                                                                                                                                 |

<sup>a</sup>Exceedances were measured in eq H<sup>+</sup> ha<sup>-1</sup> yr<sup>-1</sup> (equivalents of hydrogen per hectare per year). The following recoding rule was employed: <0 eq H<sup>+</sup> ha<sup>-1</sup> yr<sup>-1</sup> = 1; 0–200 eq H<sup>+</sup> ha<sup>-1</sup> yr<sup>-1</sup> = 2; 200.1–500 eq H<sup>+</sup> ha<sup>-1</sup> yr<sup>-1</sup> = 3; 500.1–1,000 eq H<sup>+</sup> ha<sup>-1</sup> yr<sup>-1</sup> = 4; 1,000.1–2,000 eq H<sup>+</sup> ha<sup>-1</sup> yr<sup>-1</sup> = 5; and > 2,000 eq H<sup>+</sup> ha<sup>-1</sup> yr<sup>-1</sup> = 6. At least one-quarter of a 150 × 150 km Cooperative Program for Monitoring and Evaluation of the Long-range Transmission of Air Pollution in Europe (EMEP) grid must be located inside a country to qualify as the maximum exceedance of a country. The maximum exceedance for total acidity was chosen because it reflects the overall vulnerability of ecosystems to the impact of transboundary acidification.

<sup>b</sup>SO<sub>2</sub> = sulfur dioxide; GDP = gross domestic product. Abatement cost data were converted from deutsche marks to U.S. dollars by applying an exchange rate of DM 2.22 per U.S. dollar (the average exchange rate between 1982 and 1990). The cost functions reflect the additional resources needed to reduce sulfur emissions by 30 percent over and above original government emission policies for the years 1980–2000. Economic data for Central and Eastern Europe should be interpreted with caution.

*Sources.* Data for critical load exceedances are from Jean-Paul Hettelingh, Robert F. Downing, and Peter A.M. de Smet, *Mapping Critical Loads for Europe*, Coordination Center for Effects (CCE) technical report no. 1 (Bilthoven, the Netherlands: CCE, National Institute of Public Health and Environmental Protection, 1991), p. 19. GDP data for 1988 are from *The Economist*, *The Economist Book of Vital World Statistics* (London: Random House, 1990), pp. 32–33, since standard economic sources did not provide adequate data for all economies in transition for the particular period under consideration. Abatement cost data are derived from Markus Amann and Gabor Kornai, “Cost Functions for Controlling SO<sub>2</sub> Emissions in Europe,” working paper series of the International Institute for Applied Systems Analysis, WP-87-065, Laxenburg, Austria, mimeograph, 1987. Exchange rate data are from International Energy Agency/Organization for Economic Cooperation and Development (OECD), *Coal Information 1991* (Paris: OECD), p. 216.



|                 |      | Ecological vulnerability          |                                                                                                                                                                                      |
|-----------------|------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 |      | Low                               | High                                                                                                                                                                                 |
| Abatement costs | Low  | Finland, Ireland, Portugal, Spain | Austria, Belgium, former Czechoslovakia, Denmark, Federal Republic of Germany, France, Hungary, Italy, Netherlands, Norway, former Soviet Union, Sweden, Switzerland, United Kingdom |
|                 | High | Bulgaria, Greece                  | former German Democratic Republic, Poland, Romania, former Yugoslavia                                                                                                                |

FIGURE 3. *Predicted position of countries: transboundary acidification in Europe*

large parts of its forests were classified as being damaged. Its position taken at the 1982 Stockholm Conference on Acidification of the Environment presented a clear turnaround. The FRG not only acknowledged the impact of sulphur dioxide and nitrogen oxide on forest decline but also called for intensified efforts at the international level.<sup>65</sup> Consequently only the UK persisted in actively dragging the negotiations while the FRG joined the Nordic countries and Canada called for the formation of a “30 percent club” of like-minded countries.

Formalized at the 1984 Ottawa International Conference of Ministers on Acid Rain this initiative followed early Norwegian and Swedish demands for a 30 percent reduction of 1980 sulfur emissions.<sup>66</sup> Roughly half of the countries classified as pushers, namely, Austria, Denmark, the FRG, France, the Netherlands, Norway, Sweden, and Switzerland, have belonged to the 30 percent club that convened at the 1984 Ottawa conference. In order to broaden the scope beyond largely wealthy, Nordic and West European countries and Canada, the FRG hosted the 1984 Munich Conference on the Environment. That international conference led to the addition of most of the Central and Eastern European supporters of the Helsinki Protocol.

Despite pressure from the Nordic countries because of the major impact of British emissions on their countries, the UK resisted joining the 30 percent club due both to consideration of the costs and distrust in scientific findings of the

65. Swedish Ministry of Agriculture, *Proceedings of the 1982 Stockholm Conference on Acidification of the Environment, June 21–30, 1982* (Stockholm: Swedish Ministry of Agriculture, 1982), p. 37.

66. The 30 percent level was chosen for purely political reasons and is not based on (narrow) ecological considerations.

cause-and-effect relationship.<sup>67</sup> The UK remains the only country classified as a pusher that continues to oppose strict sulfur regulations.<sup>68</sup>

While the pushers by and large acted in the predicted way, this cannot be said of the draggers. In fact Bulgaria and Greece seem never to have played an active role in the negotiations, and the cost implications are likely to have induced them not to support substantive reductions in sulfur emissions. However, despite the very high abatement costs, Bulgaria accepted the 30 percent reduction goal most likely due to pressure from the former Soviet Union (see below). Unlike their active opposition during the negotiations on the Montreal Protocol, the draggers opted out and refused to take an active role in the negotiations on the Helsinki Protocol.

The intermediate group comprises only East Central European countries, namely, the former German Democratic Republic, Poland, Romania, and the former Yugoslavia. None of these countries can be described as having been active in the negotiations process of the mid-1980s or as being particularly attentive to environmental issues in the 1980s. In addition, the relatively high abatement costs did not provide incentives to take strict regulatory positions in international negotiations.

The bystanders in our analysis fall into two groups. The first subgroup comprised Finland, which found itself in a fortunate situation: its energy policies announced in the early 1980s would cause no additional abatement costs. Like many other European countries (especially France), it had responded to the oil price changes in the early 1970s with a shift toward nuclear energy generation. As a consequence, its sulfur dioxide emissions declined over the 1980s, and it was estimated that a 30 percent reduction in sulfur emissions could be accomplished at no additional cost. The members of the second subgroup, Ireland, Portugal, and Spain, also face a combination of relatively low abatement costs and low ecological vulnerability. In these comparatively poor member countries of the EC, transboundary air pollution issues have not ranked high on the environmental agenda; consequently, these countries have not actively participated in the negotiations on the Helsinki Protocol. In conclusion the group of bystanders largely behaved as predicted, and the internal split can partially be accounted for by differences in intragroup abatement costs.

In many respects, the former Soviet Union played an unusual role in the negotiations on transboundary acidification in Europe. As the initiator of the diplomatic process, it had taken a special interest in the conclusion of international sulfur regulations because of the cooldown of relations among the

67. See Prittwitz, *Umweltaussenpolitik—Grenzüberschreitende Luftverschmutzung in Europa*, p. 143; and Boehmer-Christiansen and Skea, *Acid Politics*, p. 216.

68. Although the British Department of the Environment was willing to sign the Helsinki Protocol, this was overruled by Prime Minister Thatcher. See Boehmer-Christiansen and Skea, *Acid Politics—Environmental and Energy Policies in Britain and Germany*, p. 216.

superpowers in the mid-1980s. As a participant in the negotiations on the Helsinki Protocol pointed out in an interview, the Soviet Union strongly urged the East Central European countries to sign the Sulfur Protocol. Their signatures were of particular importance because of the all-European nature of the environmental problem at hand and the minimum requirement of sixteen signatures needed for the protocol to enter into force. However, Poland and Romania (as well as the former Yugoslavia) were unwilling to commit themselves to ambitious policies. That the Soviet Union used its influence to offer signatories a choice between reducing their emissions *or* their *transboundary* fluxes can be interpreted as a cost-saving measure for a particularly large country. Thus, the position of the former Soviet Union can be explained by the interest-based hypothesis as well as by its desire to improve East–West relations in the late 1970s and early 1980s.

In conclusion, only the group of pushers conclusively acted as predicted: they actively supported the diplomatic process leading to the Helsinki Protocol. Draggers, intermediates, and bystanders (with the exception of Finland) behaved rather passively. However, this behavior is likely to have dampened short-term aspirations of the most vigorous pusher countries. In the case of transboundary acidification, the extent of abatement costs seems to have a more substantial effect on state behavior than ecological vulnerability.

We conclude that the hypotheses related to the interest-based explanation of international environmental regulation hold for the group of pushers, but they do not well explain the differentiation among the remaining three groups.

### *The impact of technology on reducing abatement costs*

In the case of stratospheric ozone regulation, we found strong evidence for the proposition that the existence and economic feasibility of substitutes allowed the FRG and the United States to favor the reduction of CFCs. This also holds for the negotiations leading to the Helsinki Protocol, since feasible sulfur control technologies were available in 1985.<sup>69</sup> Moreover the FRG and Sweden were not only interested in reducing their ecological vulnerability to pollution imports but also represented what Volker Prittwitz has called “third-party interests” (“*Helferinteressen*”) because of the existence of significant environmental industries in their countries.<sup>70</sup> In both countries substantial environmental industries for the removal of sulfur emissions have emerged, and they have become major exporters of these technologies on the European market. Furthermore, several experts from Nordic countries concluded that

69. UNECE, *Air Pollution Across Borders*, Air Pollution Studies, no. 2 (Geneva: UNECE), pp. 129–33.

70. See Volker Prittwitz, “Several Approaches to the Analysis of International Environmental Policy,” Working paper series of the Abteilung Normbildung und Umwelt des Forschungsschwerpunkts Technik-Arbeit-Umwelt, FS II 88-308, Wissenschaftszentrum Berlin, mimeograph, 1988, pp. 8–9; and Prittwitz, *Das Katastrophenparadox*, pp. 115–29.

regulating polluting industries has in fact given them an international competitive advantage, because regulation has forced industries to introduce new and more efficient production processes (besides pollution control devices or integrated technologies) even earlier than competitors in other countries.

While availability of indigenously developed abatement technology has served as an incentive for some countries to push for stricter regulation, other countries have been less fortunate. Being largely dependent on imported technology or having to rely on technological cooperation with foreign producers of abatement technology, the former Czechoslovakia, Hungary, Poland, and Spain have lacked strong incentives to become active pusher countries. Abatement efforts are under way via international technology transfer to Spain and successful development of indigenous combustion control technology in Hungary. In addition, the former Czechoslovakia and Hungary reduced their emissions involuntarily in the late 1980s as a consequence of economic recessions. In conclusion, some of the most active pushers also had economic incentives to strive for international environmental agreements since international regulations would benefit their abatement technology providers.

### **Comparing negotiations on the Montreal and Helsinki Protocols**

A comparison of the two international negotiations can be conducted on two levels. First, we will briefly compare the diplomatic process across environmental issue-areas; and second, we will compare the explanatory power of the interest-based approach across cases.

In both international environmental regimes, the Nordic countries were early pushers for international regulation.<sup>71</sup> The state of natural science knowledge, in addition to the perceived costs of abatement, did not allow for fast international agreements to reduce pollutants in either case. Over time, maturing scientific research led to an acknowledgment of basic cause-effect relationships and a higher likelihood of early active dragger countries to be more inclined toward international environmental regulation. Specifically, the changes in the position of the FRG in 1982 on transboundary acidification and in 1987 on stratospheric ozone regulation strengthened the position of active pusher countries and reduced the impact of France, Italy, and the UK. Since the changes in the FRG's positions seem in part to be driven by a changing evaluation of natural science findings, we find *partial* support for the suggestion that conclusive and shared natural science evidence is positively related to international environmental regulation. Conversely, for the case of stratospheric ozone depletion and for transboundary acidification in Europe, the absence of an early agreed upon natural science basis for international

71. They were normally supported by Austria, the Netherlands, and Switzerland.

regulation originally contributed to agreements that did not require active regulation.<sup>72</sup> As scientific evidence matured, pollution reduction became more attractive to various countries. In addition, advances in abatement technologies also played an important role in both cases by reducing abatement costs.

Turning to the propositions of the interest-based explanation of international environmental regulation, the basic predictions hold reasonably well for the explanation of the process leading to the Montreal Protocol: pushers, intermediates, as well as active draggers fulfill theoretical expectations. In the case of the Helsinki Protocol, most countries classified as pushers undertook diplomatic activities in accordance with their predicted position. Members of the other three groups were largely inactive during the negotiations.

Overall our theoretical propositions explain much of the positions taken during the negotiations on the Montreal Protocol as well as the Helsinki Protocol. Given the huge disparity in abatement costs, the discussion on the European-wide reduction of acidifying pollutants partially focuses on West-to-East resource transfers in order to permit these countries to lower their impact on the pushers.

### **Concluding remarks and suggestions for future research**

We hypothesized that the interest-based approach provides a parsimonious explanation of support for international environmental regulation. Operationalized as the degree of ecological vulnerability and the costs of abatement, we expected that countries could be typified as pushers, intermediates, draggers, and bystanders in international negotiations. In addition, we found that technological factors may lessen actual or anticipated abatement costs and thereby increase the propensity of a country to support international environmental regulation.

While many of the basic propositions have been supported by the national positions during the negotiations on both the Montreal and the Helsinki Protocols, it remains unclear why we have two different types of draggers and more universal support for international regulation in the former case than in the latter case. Therefore, we suggest a few additional domestic factors for future research that could increase explanatory power for both negotiations.

Changes in value preferences, domestic interest representation of mass political attitudes, and industry lobbying efforts could each play an important role. As can be shown for the member countries of the EC, value change, that is, the shift from an emphasis on materialist values to postmaterialist values,<sup>73</sup> is

72. This applies both to the Vienna and the LRTAP Conventions.

73. See Ronald Inglehart, *The Silent Revolution: Changing Values and Political Styles Among Western Publics* (Princeton, N.J.: Princeton University Press, 1977); and Ronald Inglehart, *Culture Shift in Advanced Industrial Society* (Princeton, N.J.: Princeton University Press, 1990).

strongly related to environmental concern and environmental action.<sup>74</sup> In addition, Western government officials stress the role that public attitudes on the environment play in bringing about domestic and international regulation of pollutants. In parallel to the increasing importance of environmental issues to the general public, green or ecological parties have developed in many countries in Western, Central, and Eastern Europe. Furthermore, traditional parties have discovered the importance of the issue in sustaining electoral support. The study by Gudrun Schwarzer on transboundary acidification provides some clues in favor of this argument. Schwarzer's analysis suggests that nearly all countries showing high political pressure ultimately favored stringent regulation of their sulfur emissions.<sup>75</sup> Only among countries with low political pressure do we find regulatory preferences to covary with in the degree of ecological vulnerability.

In addition to these mass political pressures on national governments, a differentiated industry pressure model could be developed. By explicitly linking abatement costs and international trade in environmental technologies, on the one hand, to the interests of major polluting industries and the abatement technology sector, on the other hand, a differentiated model of industry support for international environmental regulation can be developed.<sup>76</sup>

In conclusion, the interest-based approach provides a parsimonious explanation of the positions taken by governments on the protection of the international environment. More detailed modeling of the domestic policy component may enhance our understanding of why countries wish to allocate scarce resources to substantial improvements of the international environment.

74. See Detlef Sprinz, "Environmental Concern and Environmental Action in Western Europe: Concepts, Measurements and Implications," presented at the 86th annual meeting of the American Political Science Association, 30 August–2 September 1990, San Francisco.

75. Gudrun Schwarzer, *Weiträumige grenzüberschreitende Luftverschmutzung: Konfliktanalyse eines internationalen Umweltproblems* (Transboundary air pollution: Conflict analysis of an international environmental problem), Tübinger Arbeitspapiere zur internationalen Politik und Friedensforschung, no. 15 (Tübingen, Germany: Arbeitsgruppe Friedensforschung, Institut für Politikwissenschaft, Universität Tübingen, 1990).

76. See Sprinz, "Why Countries Support International Environmental Agreements," chaps. 5–7.