Common versus Differentiated Goals in the Face of Between-Country Inequities:

Evaluating the Effectiveness of the Helsinki and Oslo Protocols on the Reduction of Sulfur Emissions

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Introduction

In the 1960s and 70s a growing group of scientists began reporting on a strange phenomenon in Scandinavia: the acidification of lakes and forests, leading to relatively large-scale ecosystem deaths. Although it had been believed that the effects of fossil fuel production were largely local in character, some scientists claimed that this acidification was due to pollutants from the UK and continental Europe (Levy 1993, 79). In response to this growing concern, in 1979 42 European and North American countries signed LRTAP: the UN ECE Convention on Long-Range Transboundary Air Pollution. While LRTAP expresses concern about the transboundary pollution problem, it contains no specific pollution reduction mandates. Rather, its primary function has been as a framework for concrete reduction protocols. It provides formal organization and information-gathering tools. EMEP, founded in 1984, was the institution primarily tasked with gathering sulfur emissions information (Wettestad 2000, 96-99; Wettestad 2001, 199). In 1985 the first binding pollution reduction mandates were issued with the signing of the Helsinki *Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulphur Emissions or Their Transboundary Fluxes by at Least 30 Per Cent* by 21 countries (UNECE 1985). This Protocol, which took effect in 1987, regulated the transboundary fluxes of sulfur, and mandated a 30% reduction in sulfur emissions by 1993 (UNECE 1985; Churchill et al. 1995, 177) . After two protocols regulating other acid rain precursors, in 1994 the Oslo *Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions* was signed. It responded to criticisms that while the Helsinki protocol had perfect compliance, its mandated emissions cuts were not meaningful in the context of reducing environmental damage from sulfur emissions (Churchill et al. 1995, 169). Basing its emissions targets instead on the theory of "critical loads," the Oslo

Protocol went into effect in 1998 (Finus and Tjotta 2003, 2034).

Although characterized by almost perfect compliance, these two protocols have been both lauded as a success and lambasted as ineffective validations of countries' own self-interested behavior (Churchill et al. 1995; Levy 1993; Murdoch and Sandler 1997; Finus and Tjotta 2003). Receiving particular attention has been the evolving incorporation of science into the mandated emissions goals: while the Helsinki Protocol mandated uniform emissions cuts of 30% from 1980 levels, the Oslo Protocol mandated country-specific emissions cuts reflecting environmentally-targeted goals, averaging out to 50.8% reductions from 1980 levels (Churchill et al. 1995, 183).

How effective have these two treaties been overall in reducing sulfur emissions? In this paper, I will explore whether, and how the Helsinki and the Oslo Protocols influenced emissions behavior, and whether the use of differentiated targets increased the effectiveness of the Oslo Protocol.

The data I will present suggests that while the existence of the Oslo Protocol was probably more likely due to its use of differentiated goals, differentiated goals in general did not have an appreciable effect on emissions reductions behavior because of the way in which the goals were set, and because of other variables which had a much stronger effect on the outcome of the treaty. I will conclude that while the overall amount of sulfur emissions decreased during the period in which the treaties were in effect, the treaties caused a portion of these reductions in only a limited number of countries, and other, unrelated factors likely caused the bulk of emissions reductions.

Theoretical Argument

Evaluating Effectiveness

Although the ultimate aim of the Helsinki and Oslo Protocols was to reduce the environmental problems associated with the acid rain caused by excessive sulfur emissions, environmental quality is a poor indicator of treaty effectiveness. As summarized by Wettestad, environmental quality is only indirectly related to sulfur emissions: other compounds also cause acid deposition, and some environmental destruction takes a long time to heal after the reduction of emissions (Wettestad 2001, 203-204). Furthermore, the understanding of how sulfur emissions affected the environment changed over time, so this would be an uneven indicator of effectiveness. Instead, the indicator of treaty influence (the dependent variable) used to analyze the success of the 1985 and 1994 Sulfur Protocols under LRTAP is the behavior the treaties regulated: the amount of sulfur emitted annually by each country.

Ultimately, an environmental treaty is effective if the behavior of its members is better than it would have been otherwise. In the case of sulfur emissions, this could mean less sulfur emissions overall. It could also potentially mean more countries reducing their emissions. Additionally, a treaty can also have an effect on some countries, but not others. There are many mechanisms through which international environmental agreements can influence member behavior.

Common versus Differentiated Obligations

Recently, scholars studying the effectiveness of international environmental regimes have placed emphasis on the role of differentiated obligations in regime effectiveness (French 2000). Classically, common yet differentiated obligations are theorized to recognize the common duty

of states' to refrain from harming the environments of other states', yet allocate responsibility for behavior change differently across states (French 2000, 45). The rationale for differentiated behavior change goals is recognition of either differing capacities to solve the problem, or recognition of different responsibilities in causing the problem: in essence, to distribute obligation equitably. Assigning differentiated obligations is hypothesized to increase the likelihood of successful treaty negotiation, and increase compliance because countries are more likely to participate if they feel the terms are equitable (Jacobson and Brown Weiss 1998, 523).

In the case of the 1994 Oslo Protocol, the differentiated obligations were based on the "critical loads" established for sulfur emissions. These critical loads were regionally-specific emissions targets below which there would be no observable environmental effects from sulfur emissions (Churchill et al. 1995, 172, 183; Wettestad 2001, 203). Due to weather patterns and country sizes and locations, the emissions reduction targets varied considerably between countries. The model also took economic efficiency into account, minimizing the overall cost to LRTAP members. Ideally, countries were responsible for reducing their domestic emissions to the point where they were not imposing environmental effects on other countries or themselves. The critical loads emissions targets were supposed to make Oslo a more effective treaty through focusing the issue on environmental rather than political objectives, thus increasing participation and compliance (Churchill et al. 1995, 183). Unlike many other differentiated obligations, the original critical load-based sulfur emissions targets did not take into account the differing capacities of nations to reduce their sulfur emissions: the emissions targets optimized environmental effects and regional costs, not cost by country (Churchill et al 1995, 182). Thus while the Oslo emissions targets aimed to be effective in remedying environmental problems associated with sulfur, the differentiated targets were not designed to increase treaty

effectiveness through increasing equity. The treaty would only be more equitable if the emissions caps coincidentally coincided with countries' ability to reduce emissions, or if there were no significant capacity problems across countries. Another way to look at this point is that the differentiated loads of the Oslo protocol were not increasing effectiveness through increasing equity, but by sidestepping political negotiations through reframing the problem as scientific. Thus, the mechanism by which the differentiated goals were to work in the Oslo Protocol was through increasing scientific information incorporated in the agreement (Churchill et al. 1995, 196). This mechanism is somewhat different than the typical mechanism through which differentiated goals increase treaty effectiveness (French 2000).

Other Treaty Outcome Variables

Other factors besides the existence of differentiated goals may also predict individual country participation in and compliance with international environmental agreements. One factor to consider is administrative capacity. Countries that are wealthier and more democratic are likely to have better compliance and participation in international environmental treaties than poorer, less democratic countries (Jacobson and Brown Weiss 1998, 530). Extrapolating, we can theorize that treaties which address this capacity barrier may have wider membership and be more effective than treaties which do not. There are several ways to encourage participation by poorer countries with fewer financial and other resources at their disposal, including technology sharing, which was incorporated into both the Helsinki and Oslo Protocols, but more extensively in the second (Churchill et al. 1995; Lidskog and Sundkvist 2002, 92-93). Imposing differentiated obligations on states can be another technique to overcome capacity barriers, through making realistic demands about states' ability to make changes, given their resources (French 2000). As noted above, though, the differentiated obligations of the Oslo Protocol were

not designed primarily to address capacity differences. Thus, we might expect that if there are capacity differences among these countries, the differentiated obligations would not increase the effectiveness of the treaty as much as if the countries had relatively uniform capacities.

There are several other mechanisms which have been identified as possible ways in which the Helsinki and Oslo Protocols could have influenced member emissions: through increasing the availability of scientific information, through exerting normative pressure on states, through increased availability of technology, or through the negotiating process itself (Jacobson and Brown Weiss 1998, Wettestad 2001, 198).

Non-Treaty Variables

Factors unrelated to the treaty itself could also affect the amount of sulfur emissions. These could include economic factors, geopolitics, domestic politics, policies, and environmental knowledge, as well as the larger effects of LRTAP (Levy 1993; Churchill et al. 1995).

As sulfur emissions occur largely as a byproduct of burning oil and coal, any factor that affected the amounts of these fuels used, or the mechanism by which they were combusted, would affect sulfur emissions (Levy 1993, 78; Churchill et al. 1995, 172). Economic changes would affect the amount of sulfur emissions through at least two mechanisms. First, changes in the GDP of a state would change the overall demand for energy and thus affect sulfur emissions. Second, changes in industrial output, through a transition to or from a service based economy, for example, would also affect demand for energy and thus the amount of sulfur emitted. Structural changes within a country could also affect its sulfur emissions through changing the amount of coal use. A country that restructured to generate its electricity through nuclear or natural gas instead of coal would report reduced sulfur emissions (Levy 1993, 119). These emissions reductions, though, could occur largely independently of a sulfur agreement, instead

reflecting an effort to capitalize on domestic resources or concerns about the other hazards of coal, such as local air pollution (Levy 1993, 119).

Additionally, it is important to recognize that environmental knowledge of the consequences of sulfur emissions could play a role in emissions reductions, even in the absence of a treaty (Levy 1993, 122). Because a significant amount of the acid rain damage within a nation is the result of international rather than domestic emissions, considering this variable an independent one is problematic. Nevertheless, environmental knowledge could influence sulfur emissions of individual countries, even in the absence of an international treaty.

Between-Country Differences

There are many differences between countries that might affect the influence of these mechanisms of treaty effectiveness. In order to establish whether the existence of differentiated goals increases treaty effectiveness, and whether this effect is influenced by country wealth, this paper will attempt to rule out other mechanisms of treaty influence, and account for differences between countries that might influence treaty effectiveness.

Differences between countries could explain why a treaty could have an effect on emissions in one country but not another. Theses between-country variables could include wealth and/or capacity, existing environmental knowledge of the problem, and ecological vulnerability. Another important between-country variable to consider is the amount the country contributes to the problem. As noted earlier, because of the ambient weather patterns, countries in the south and did not contribute as much transboundary sulfur pollution as countries in other areas. Countries that are not as involved in the problem might not be subjected to as much normative pressure as countries who contribute more (Levy 1993, 127). We might expect that this would interact with the capacity problem: poor countries who experienced enhanced

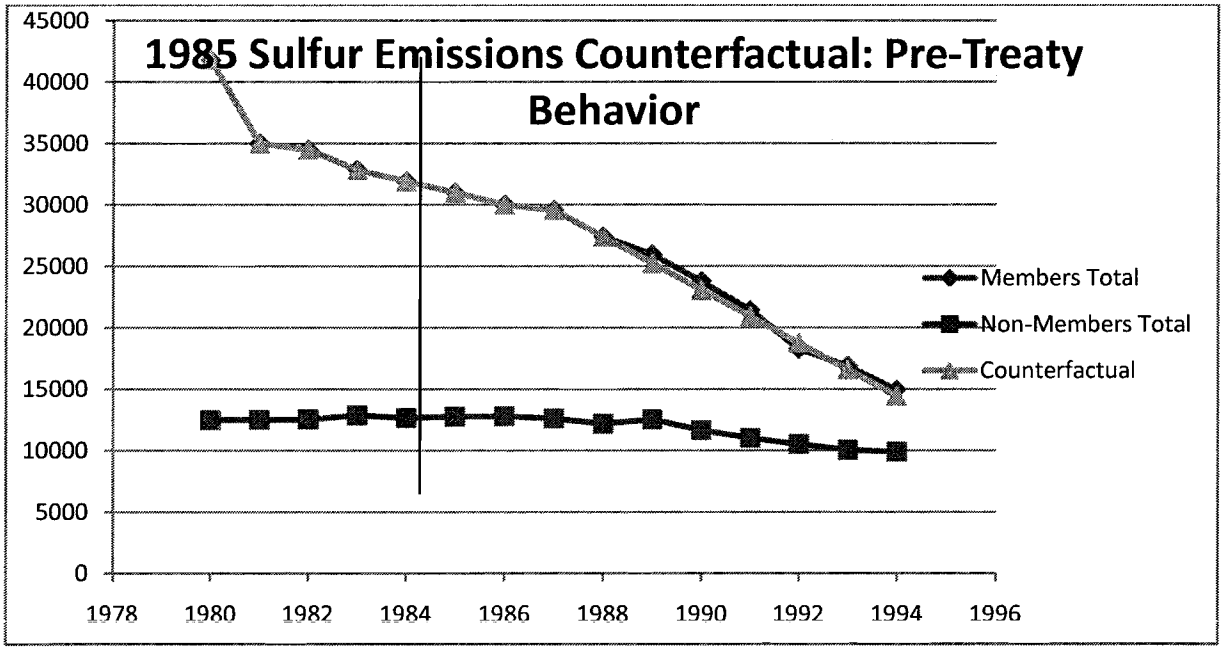
pressure from outside states might be more effectively influenced by the treaty than poor countries who did not experience as much external pressure (Levy 1993).

Hypothesis

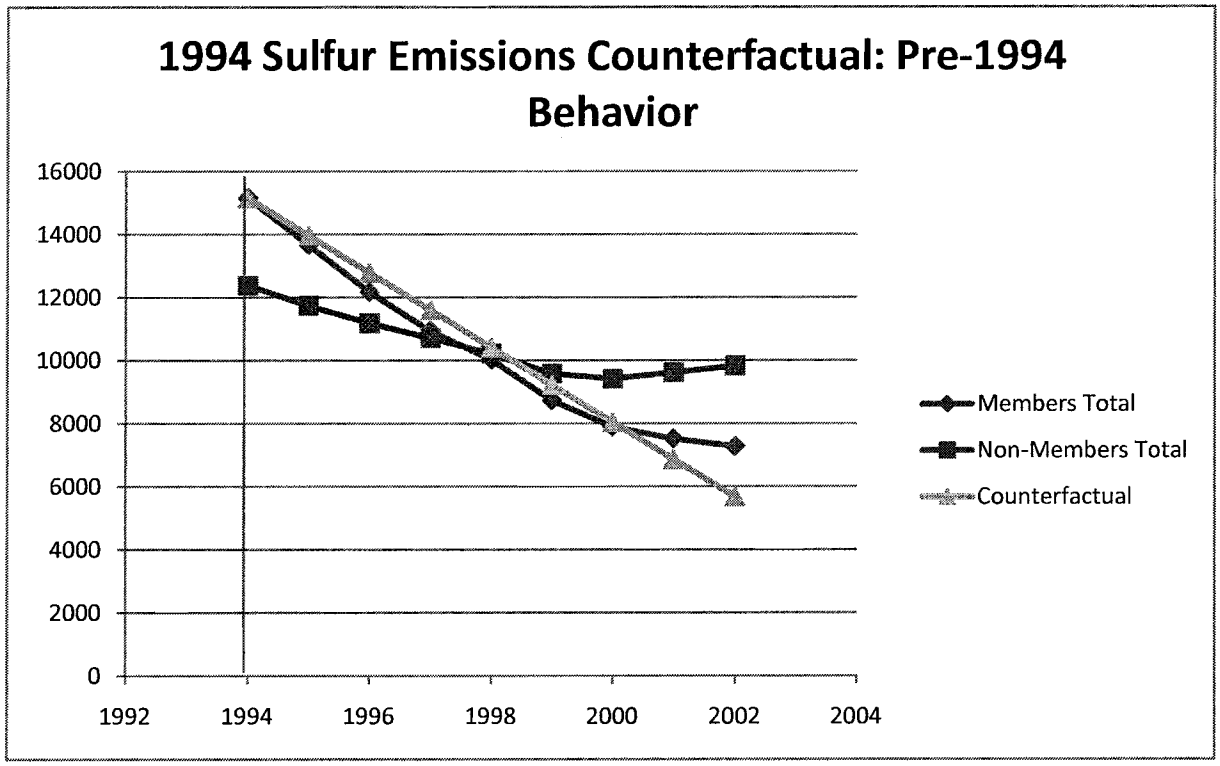
I will argue that in the case of the sulfur protocols, differentiated obligations did not cause increased treaty effectiveness, largely because they did not fully incorporate scientific emissions targets into the negotiation process. Both the Helsinki and the Oslo protocol had a modest influence on a few countries, but most of the observed emissions reductions were caused by non-treaty factors.

Sulfur Emissions Behavior

Graph 1:



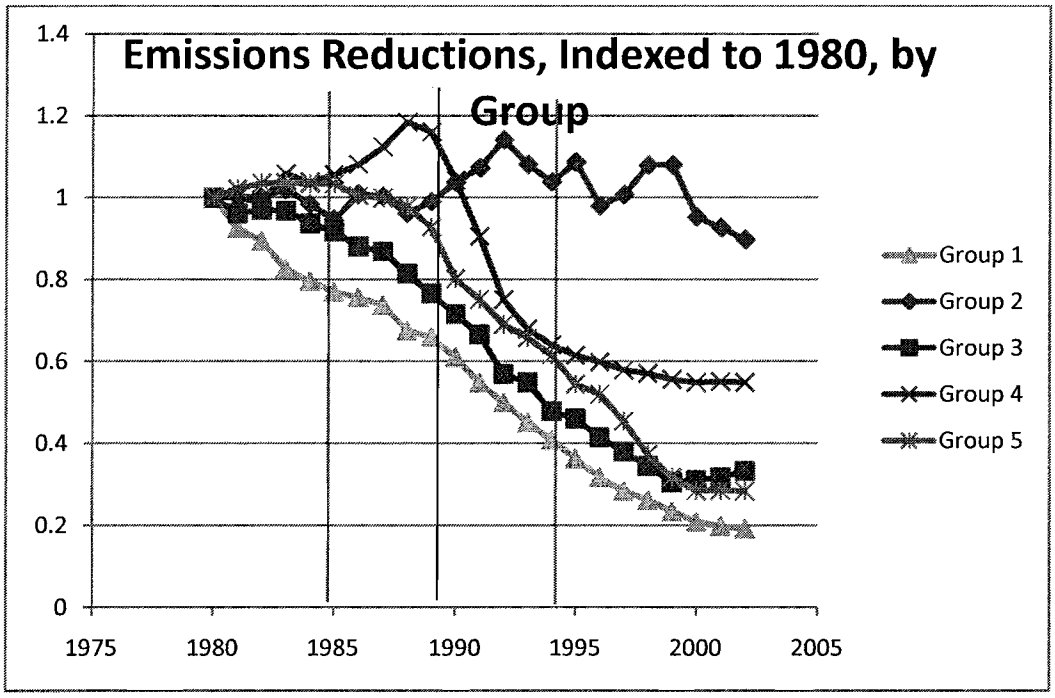
Graph 2:



Emissions for all countries fell between 1980 and 2002. From graphs 1 and 2, it is apparent that members and non-members had different rates of emissions reductions during both treaties (Vestreng et al. 2004; UNECE 1985; UNECE 1994). Over both treaty periods, though, the rate of emissions is relatively close to linear for members. That is, pre-treaty behavior does not seem very different from post-treaty behavior: members' rate of emissions reductions before the 1985 Helsinki Protocol and in the 4 years before the 1994 Oslo Protocol was the same as their rate of emissions reductions after the Protocols took effect. Thus, if we take members' pre-treaty emissions behavior as a counterfactual, the treaties do not appear to have caused them to behave differently than they otherwise would have. This suggests that there are categorical differences between the member states and non-member states that make the non-member behavior a poor counterfactual for member behavior without a treaty.

Organizing the countries into groups reflecting differences in geographical location, GDP, and political affiliation reveals important trends in sulfur emissions that are not shown by a simple comparison of members and non-members.

Graph 3: (red line indicates breakup of Soviet Union)



Graph 3 shows the countries organized into 5 groups. The group membership can be broken down as follows:

Table 1:

Group 1		Group 2	Group 3	Group 4	Group 5
Germany	Spain	Ireland	USSR/Russia	Romania	Poland
Norway	UK	Greece	Ukraine	Belarus	Slovenia
Sweden	Hungary	Portugal	Bulgaria	Armenia	Czech Republic
Austria					
Finland					
Netherlands					
Switzerland					
Denmark					
Italy					
France					

Group 1 is made up of compliers: Mainly Western European countries who signed, and

complied with, both the Helsinki and Oslo Protocols. The exceptions to this rule are in the second column of group 1. Although they ultimately complied with both Protocols, the UK and Spain signed the Oslo but not the Helsinki Protocol. Hungary signed and complied with both Protocols, but is not a Western European state. In fact, with the exception of the USSR, group 1 is a combination of all the states in Levy's columns 2-5: states that, for various reasons, reduced emissions in compliance with the Helsinki Protocol (Levy 1993, 119). Group 2 is made up of the less wealthy Western European states. Along with Spain, these were the only states that in 1980 had a per capita GDP of less than 10,000 dollars (Vestreng et al. 2004).[1]

Groups 3, 4 and 5 are all Eastern European former Soviet states. Group 3 is made up of states who signed both the Helsinki and Oslo Protocols (Vestreng et al. 2004; UNECE 1985). These states are also notable because their GDPs decreased between 1990 and 2002. Group 4 is made up of states who did not sign either Protocol. These states' GDP all decreased between 1990 and 2002, as well. Group 5 is made up of states who signed the Oslo Protocol but not the Helsinki Protocol. These states' GDP increased between 1990 and 2002.

Ignoring for the time being the mechanisms through which group membership is related to emissions reductions outcome, we can see several differences in emissions behavior between groups. Group 1 reduced emissions at a relatively constant rate, beginning when sulfur emissions were first recorded in 1980. Unlike all the other groups, group 2's emissions fluctuated over the two decades, but never went significantly under 90% of 1980 emissions. One could argue that this group's emissions peaked in about 1991, then gradually decreased until 2002, but there is a lot of year to year variation. Group 3 reduced emissions at a slow rate between 1980 and 1989, then had a greater rate of emissions reductions between 1989 and 1999, before emissions leveled off (or increased slightly) after 2000. Relative to 1980 levels, Group

[1] Expressed in 1990 International Geary-Khamis dollars.

4's emissions increased from 1980 to 1989, but then declined rapidly until 1993, when the rate of emissions reductions began to decrease. Emissions had leveled off by the year 2000. Finally, Group 5's emissions remained relatively constant until 1989. Between 1989 and 2000, this group's emissions fell at a constant rate until 2000, when they leveled off. There are several specific between-group differences to note. First, the rate of emissions reductions for groups 1, 3, and 5 is relatively uniform between 1989 and 1999, but the rates differ across groups both before and after this decade. Second, neither group 4 nor 5 reduced emissions appreciably before 1989, and in 1993 their total percent emissions reductions was almost equal. After 1993, though, group 4's emissions reductions began to slow, while group 5's emissions continued to decrease.

In general, there are differences between these groups, as well as within them, over time.

Goal Attainment

10 countries had already exceeded emissions goals by 1985, and 13 by the time Helsinki entered into force in 1987 (Churchill et al. 1995, 177). From graphs 1 and 2, it is apparent that collectively, member states met the goals of both the Helsinki and Oslo Protocols. Furthermore, from graph 3, it is visible that as a whole, group 1 appears to have met the 30% reduction goal of the Helsinki Protocol by 1987. By 1993, groups 3, 4, and 5 appear to have met the 30% goal, as well. Attainment of the differentiated goals of Oslo is more difficult to determine from this graph. Groups 1, 3, and 5 reduced their overall emissions by much larger percentage than groups 2 and 4 during this period, though.

Explaining Treaty Behavior

External Factors Affecting Emissions

Although a great deal of sulfur emissions reductions occurred during the period from 1980 to 2002, relatively little is causally attributable to either the Helsinki or Oslo Protocols. There were several major factors that caused emissions reductions independent of the treaties.

Differences Between States

The variables below explain some of the causes of states' emissions reductions over time. Additionally, it should be noted that these variables also explain differences in emissions reductions across states. Unlike Levy's state groupings, which reflect the mechanism through which LRTAP affected emissions, the state groups used here primarily reflect differences between states in GDP, geographic location, and political affiliation. These underlying differences were not caused by the treaties, but rather affect how each Protocol affected the countries. As mentioned above, these differences also describe the membership of states in the Protocols, and differences in emissions reductions. While discussing the external variables that affect emissions, I will also attempt to explain how these variables affected different groups of states in different ways.

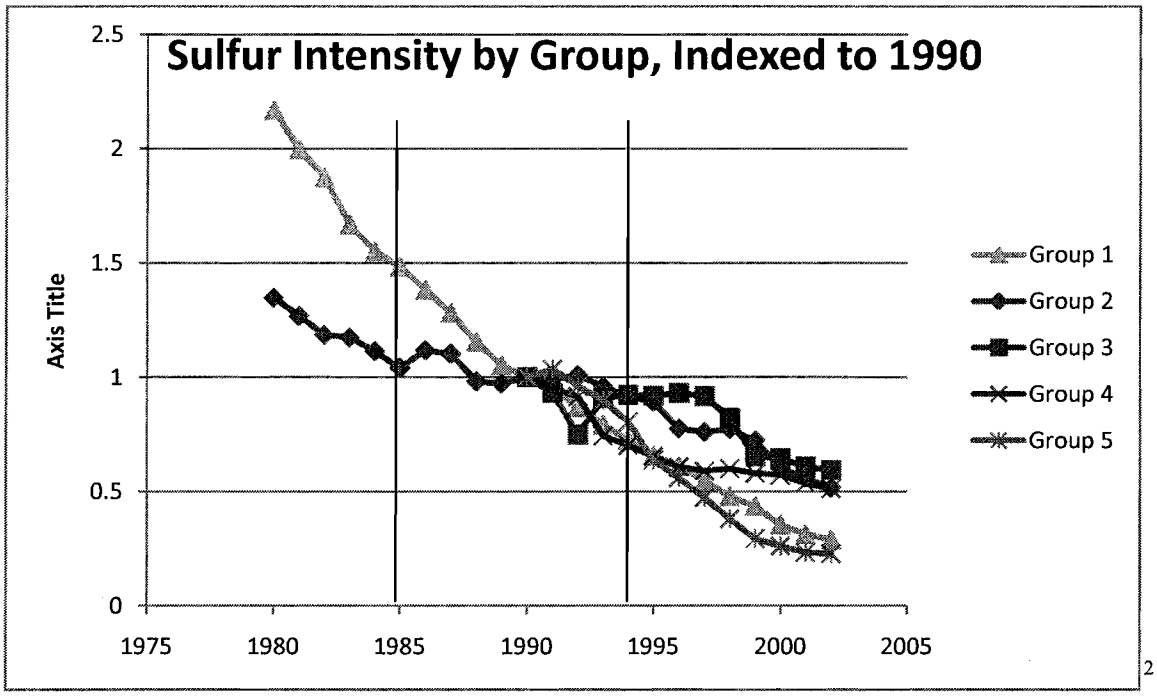
Geopolitical Factors

During the period the Helsinki and Oslo Protocols were in effect, the Soviet Union collapsed. The political restructuring that occurred during this period corresponded with dramatic reductions in industrial output across Europe, and reductions in GDP in much of Eastern Europe. As a result of these changes, many countries' sulfur emissions decreased substantially during this period. Country groups 3, 4, and 5 are all Eastern European former

Soviet states. As visible in graph 3, the rate of sulfur emissions reductions for these three groups increased after 1989. Because this decrease occurred 4 years after Helsinki was signed, it is likely that at least a large portion of the emissions reductions of these countries during this period are due to decreased industrial output in the politically unstable years after the dissolution of the USSR.

This geopolitical change may also have contributed to an "industrial recession" in Britain which led it to meet the Helsinki emissions mandate, even though Britain's internal emissions forecasts before 1989 predicted reductions less than 30% by 1993 (Churchill et al. 1995, 180).

Economic Factors



[2]

[2] As GDP data is not available for former Soviet States before 1990, no emissions intensity data is available before 1990 for groups 3, 4, or 5. Groups 1 and 2 are provided for scale.

Graph 4, above:

As sulfur emissions are highly correlated with coal use, electricity generation, and industrial output, decreases in GDP or shifts in economic production can have a profound effect on emissions (Levy 1993, 89; Churchill et al. 1995; Wettestad 2000). Emissions reductions that were due to decreases in GDP are arguably not caused by a treaty. Neither Helsinki nor Oslo *caused* decreases in GDP; external geopolitical factors arguably caused such decreases. Further, countries would not attempt to meet treaty obligations through purposefully reducing GDP.

As seen in graph 4, controlling for GDP by plotting emissions intensity explains a lot of the changes in rates of emissions decrease across all groups, especially for group 3. While graph 3 shows group 3 reducing emissions by over 20% between 1990 and 1997, graph 4 shows that, with the exception of 1992, emissions intensity over this period decreased by less than 10%. That is, for every dollar, these states still produced roughly the same amount of sulfur pollution. Their apparent reduction in sulfur emissions is due to the fact that they were producing less electricity overall. It is for this reason that Russia is not in group 1: while the emissions intensities of Western Helsinki signatories (group 1) continued to decline throughout this period, the emissions intensity of Russia remained relatively constant. This difference points to the fact that at least a significant part of Russia's emissions reductions under the Helsinki Protocol was due to economic rather than political factors.

Some of the economic factors affecting states' sulfur emissions are a result of the end of the Soviet Union, as discussed above. Other economic factors affected Western countries, as well. While group 2's overall sulfur emissions remained relatively constant, on average, between 1980 and 2002 (graph 3), their emissions intensity decreased during this period (graph 4). Their economies were growing, causing them to produce proportionally less sulfur per

dollar, even though their overall sulfur emissions did not decrease. Spain's compliance with the 30% goal is also likely due to economic factors of some kind: its emissions reductions in 1992 were 29%: it reached 33% in 1993, but its GDP also decreased between those years, suggesting that its compliance might be due in part to economic factors (Vestreng et al. 2004).

Domestic Political and Structural Changes

Structural changes within a country could also affect its sulfur emissions through changing its amount of coal use. Several countries in group 1, including France, Italy, Belgium, Hungary, Luxembourg, and the UK, restructured to generate their electricity through nuclear or natural gas instead of coal, or switched to low-sulfur fuel (Levy 1993, 119; Churchill et al. 1995, 179), reporting reduced sulfur emissions. While these structural adjustments could have been domestic policy attempts to meet the reductions goals of the Protocols, the causal pathway leading to these structural changes appears relatively independent of the Protocols. The reductions in sulfur emissions in these countries appear to be an incidental byproduct of changes in electricity generation infrastructure in response to domestic needs. France had decided to generate its power domestically as early as 1974, in response to the first oil supply shortage. This decision to pursue nuclear power not only appears to be not so much an issue of environmental quality as national security, but it predated even LRTAP by 5 years, meaning that LRTAP did not influence France's decision to decrease its reliance on fossil-fuel based electricity (World Nuclear Association 2010; Levy 1993, 119). Thus, France had nothing to lose in signing the Helsinki and the Oslo Protocols, as they reflected domestic policy changes it was already in the progress of making independently.

Similarly, Italy switched to low sulfur fuel largely in response to domestic, urban air pollution concerns: if this switch had been in response to the Helsinki Protocol, Italy would

likely have at least calculated the effect of this fuel switch on projected sulfur emissions, which they did not (Levy 1993, 119). Hungary and Belgium also switched fuel sources, largely without environmental motivation. Although the UK did not sign the Helsinki Protocol, it reduced its emissions through a switch to gas-fired power plants after 1989, which were less expensive (Churchill et al. 1995, 179). These countries signed the Helsinki Protocol, and likely the Oslo Protocol, because it reflected actions they would have taken in the absence of the treaties.

Domestic Environmental Knowledge

Germany, Norway, and Sweden all signed the Helsinki and Oslo Protocols, but their desire to reduce their emissions came primarily from domestic knowledge of environmental vulnerabilities to sulfur depositions that they had developed independently of LRTAP. Norway and Sweden had been "pushers" on the issue of sulfur emissions reductions since the 1960s and 1970s, and Germany had been a pusher since 1982 when it discovered extensive damage to its forests (Wettestad 2001, 200-210; Wettestad 1997, 241). Although these countries may have played a role in exerting normative pressure on other states through the Helsinki and Oslo Protocols, they would have pursued emissions reductions even in the absence of a treaty (Levy 1993, 120). Their emissions reductions were caused by their independently developed knowledge of the effects of sulfur emissions, not by the Helsinki and Oslo Protocols.

We would expect that these countries would continue to reduce their emissions under the Oslo Protocol, and that their motivations would not change. Note that even though sulfur emissions were reduced during the 1980s, the environmental effects of sulfur emissions continued to grow worse in many places through the mid 1990s, due to the complicated biological and physical mechanisms causing environmental harm from acid rain, as well as the other chemicals that contribute to acid rain (Wettestad 2001, 205). Given that the environmental

effects of acid rain that initially caused these countries to reduce emissions were still present when the Oslo Protocol went into effect, these countries had no reason to stop continuing to reduce their emissions. In fact, reinforcing this causal interpretation, Germany and Sweden were two of the authors of the first draft of the Oslo Protocol, indicating a desire to continue to reduce emissions (Churchill et al. 1995, 181).

Effects of Protocols on Emissions

Helsinki

All the signatories of Helsinki reduced emissions by at least 30% by 1993, thus complying with the Protocol (Vestreng et al. 2004). Not all of these countries' reductions can be causally attributed to the influence of the Protocol, though (Levy 1993, 120). The following section will examine individually the possible mechanisms of influence of Helsinki and attempt to discern which states' reductions were at least partially caused by the Protocol, and which were independent of it.

One mechanism through which the Helsinki Protocol could have caused a change in behavior is through increasing the availability of scientific information about the problem. Clearly, scientific information about the effects of sulfur emissions on environmental quality increased between 1979 and 1985, and this may have played a role in states' willingness to participate in a binding environmental treaty (Levy 1993). In 1979 only Norway and Sweden believed acid rain was a serious issue requiring attention, and LRTAP only became possible when these countries agreed to drop their demand for the inclusion of binding sulfur reductions (Levy 1993, 82-84). By late 1984, though, 21 countries had agreed to 30% emissions reductions. A portion of this change is certainly attributable to increased understanding of the effects of acid rain. This increase in scientific knowledge, though, is due to LRTAP, not Helsinki: it is due to

the organization of EMEP and the research efforts coordinated by LRTAP (Churchill et al. 1995, 177). Levy cites 4 countries: Austria, Finland, the Netherlands, and Switzerland, which would not have recognized domestic environmental damage from sulfur emissions in the absence of LRTAP. While this is likely true, this knowledge creation occurred before Helsinki was implemented in 1985 and thus there no mechanism through which Helsinki could have generated this knowledge (Levy 1993, 110). In fact, Levy even states that "EMEP eventually convinced all of them [the skeptical European countries] that long-range transport did indeed occur; by the early 1980s that debate was over (Levy 1993, 80-81). In other words, given the new scientific about domestic damages from acid rain, these four states likely would have undertaken emissions reductions even in the absence of a treaty. And, as they all substantially exceeded the 30% target, the influence of the Protocol on the amount of their emissions reductions seems minimal: they likely would have reduced their emissions by a similar amount even in the absence of a treaty. Interestingly, increases in scientific knowledge, whether caused by Helsinki or not, mostly affected group 1 states, because these states were the ones with the most domestic sulfur vulnerability: Eastern and Southern European countries were less vulnerable to acid depositions (Levy 1993).

Another way that Helsinki could have caused emissions reductions is through exerting normative pressure over states. Given that scientific information existed due to LRTAP, Helsinki negotiations could have allowed "pusher" states to exert pressure over other states, possibly causing more states to reduce their emissions than would have in the absence of a treaty (Wettestad 2001, 200-210). Normative pressure could induce states to reduce their emissions either through causing states that would not otherwise have signed the treaty to reconsider their position, or through convincing non-compliant signatories to increase compliance. These might

be countries whose domestic risk was not great, but who agreed during negotiations to sign, where they had not agreed in the years previously.

More broadly, normative pressures appear to have exerted pressure on states to join Helsinki. Between 1984 when the "thirty per cent club" was started with only 10 states, and the 1985 Helsinki signing, an additional 11 states had agreed to join (Churchill et al. 1995, 176). While some of this change can be attributed directly to increased environmental knowledge due to LRTAP, the normative pressures exerted by the negotiation of Helsinki cannot be [ignored] as a possible cause of at least some of this change. Denmark, for example, was an original member of the "thirty percent club" largely due to normative pressure; the USSR and other group 3 states agreed to the target after 1984, also because of normative pressure (Churchill et al. 1995,176).

Denmark had been resisting Norwegian and Swedish pressure to reduce sulfur emissions since the 1960s, but did not commit itself to reduce emissions until 1982, when the sulfur protocol was being negotiated (Levy 1993, 122). Denmark, despite being a group 1 country, has very little domestic vulnerability to acid rain. Therefore, its change in position is likely due to normative pressure exerted by states, rather than scientific knowledge gained during this period.

Another country that appears to have been influenced by the normative pressures of the Helsinki Protocol is the UK. The UK was not a member of the Helsinki protocol, but nevertheless reduced its emissions by 37% (Vestreng et al. 2004). Britain's change in policy occurred after the negotiating process had ended. The UK was unwilling to change its views based on the scientific findings of LRTAP. It only began to reduce its emissions in response to a domestic scientific report released in 1986, which independently substantiated the claims made by EMEP in the previous years (Churchill et al. 1995, 170; Underdal and Hanf 2000, 41). Unlike Austria, Finland, the Netherlands, or Switzerland, this domestic report did not reveal

extensive domestic vulnerabilities to acid rain, but that UK emissions contributed substantially to other countries' acid deposition problems, which it had previously equivocated (Levy 1993, 124; Churchill et al. 1995, 170-171). It was only after this domestic scientific information that the UK changed its domestic reductions policies, not as a result of the scientific information available through LRTAP or Helsinki. The UK's decision to act on this domestic information, though, was likely due to normative pressures exerted through Helsinki. Levy comments that "it is highly unlikely that the sulfur reduction measures adopted by the British government would have been adopted in the absence of the sulfur protocol" (124). The hesitancy of the UK to sign the Helsinki protocol subjected it to external pressure from other nations, but also to internal pressure from political factions within the country. Evidence that Helsinki was responsible for these pressures comes from the fact that sulfur emissions reductions within the UK were treated as a foreign policy concern during this period (Levy 1993, 124). Nevertheless, British compliance with Helsinki was somewhat coincidental, as pre-1989 their internal policies were not projected to meet the 30% target; likely, the economic forces affecting Europe as a whole in the early 1990s was responsible for the additional emissions reductions (Levy 1993, 125). Churchill et al. claim that the UK refused to join Helsinki not because of uncertainties in scientific knowledge but because the arbitrary base year selection ignored its previous emissions reductions (Churchill et al. 1995, 179). Nevertheless, Churchill et al. do not attribute the UK's emissions to the influence of Helsinki, but to other mechanisms (see above.)

In a way, the USSR was also motivated to join Helsinki through normative pressure. LRTAP had originally been suggested as a mechanism through which to promote East-West détente in Europe (Churchill et al. 1995, 174). The USSR was motivated to join LRTAP largely out of a desire to maintain positive relations with the West. Evidence of this motivation is

contained in the fact that the USSR argued for regulation of transboundary emissions rather than overall emissions, even though it had domestic acid deposition vulnerabilities: its goal was not ecological, but a desire to comply with a Western treaty. Additionally, while many other countries exceeded the emissions goal, the USSR's domestic policy was designed to just reach the 30% target in the regulated, western part of the state (Levy 1993, 123). As its motivations were political, the USSR would likely not have undertaken emissions reductions in the absence of the Helsinki Protocol framework. Although there is little direct evidence available to support it, this logic probably also applies to the other countries in group 3, who were also Soviet states at the time.

Between Group Differences: Members vs Non-Members

Were some states affected more by Helsinki than others? Not all LRTAP countries joined the Helsinki Protocol. Of the Western European nations, only group 1 signed and/or complied with the Protocol. Furthermore, only a subset of group 1 countries' emissions reductions can be causally attributed to the Protocol itself. The group 2 countries, including Greece, Portugal, and Ireland all did not sign Helsinki, and do not appear to have been affected by it. In fact, in some respects Spain belongs in this category, as well. These four countries had separately negotiated the rights to increase sulfur emissions from large power plants through the EC, pursuant to economic development (Churchill et al. 1995, 179). These were the only four states with per capita GDP below 10,000 as of 1980 (Vestreng et al. 2004). The hesitancy of these members to contribute to an agreement to reduce emissions continued through the negotiation of the Oslo Protocol, where economic concerns about the costs of emissions reductions and a general lack of domestic acid vulnerability made them "draggers" once again (Churchill et al. 1995, 182). In fact, Portugal never signed the Oslo Protocol, and Greece was given the right to index its

reductions to its 2000 emissions (Churchill et al. 1995, 183). As mentioned above, Spain was the only one of the three countries to meet the Helsinki emissions reduction mandate, although given its failure to sign, its lack of environmental vulnerability, and its late reductions, its apparent compliance is likely due to non-treaty factors (Levy 1993, 119). Would these countries' emissions have been higher in the absence of a

Of the Eastern European countries, Significant Eastern European emitters Poland, Romania, and Yugoslavia (essentially groups 4 and 5) did not join the Helsinki Protocol because they lacked the technology or the cost was too high (Churchill et al. 1995, 179). Interestingly, though, the countries of group 5 joined Oslo, while the countries of group 4 did not.

Effectiveness

The Helsinki Protocol affected a few countries through exerting normative pressure, making them sign the protocol and reduce emissions when they otherwise might not have. Generally, though, countries signed the Helsinki Protocol only if they had been planning to pursue policies that would have reduced sulfur emissions, anyway (Underdal and Hanf, 2000, 37; Murdoch and Sandler 1997). The Helsinki protocol had particularly little effect on Eastern and Southern European countries. Some of this can be attributed to the fact that these states' involvement in LRTAP monitoring in general was lower than the involvement of the Western States (VanDeVeer 2006).

Countries who signed the Helsinki Protocol but whose GDPs subsequently decreased are interesting. These states are represented by group 3 in graph 3, and include many former Soviet states, including Russia, Ukraine, and Bulgaria. Did these states sign the Oslo Protocol because their GDPs were already decreasing, and they were going to meet their emissions targets without any further work?

Oslo

Unlike the Helsinki treaty, where the negotiation process was characterized by a fairly high level of uncertainty, during the negotiation process of the Oslo Protocol, the scientific effects of sulfur emissions were relatively uncontested (Churchill et al. 1995). The Helsinki Protocol's emissions goal had been politically motivated, and scientists had realized relatively soon after its enactment that it was insufficient to reduce acid-related environmental problems, justifying another treaty (Churchill et al. 1995, 181).

Did normative pressure motivate states to sign the Oslo Protocol? Somewhat. While in Helsinki the prospect of détente had motivated group 3 Eastern European states to participate in emissions reductions, this dynamic was no longer as present in the Oslo negotiations. Group 5 Eastern European states, however, were motivated to sign the Oslo Protocol to gain favor with Western states (Churchill et al. 1995, 174). Did their signatures result in sulfur reductions that would not have occurred otherwise? Possibly, due to the technology sharing mechanisms, discussed below. Why then did other newly independent Eastern European states (group 4) fail to sign the Oslo Protocol?

A rival explanation for the group 5 states' membership in Oslo relies on changes in GDP. One difference between the post-Soviet states in groups 4 and 5 is that while the countries in group 5 enjoyed net economic growth during the period of 1990 to 2002 (as measured by GDP), the economies of the countries in group 4 shrank during this period. A growing economy would mean more demand for new sources of electricity, and it would be easier to implement sulfur reduction strategies in new infrastructure rather than through retrofitting existing power plants. This expansion in itself would not explain a reduction in sulfur emissions, but combined with a desire for acceptance from Western European countries, and facilitated through a mechanism of

technology transfer, it could explain why group 5 countries opted to join Oslo. A shrinking economy, on the other hand, would mean any reduction in emissions intensity would have to come from retrofitting existing technology. More importantly, though, a shrinking economy would put different priorities on governments: there would likely be better domestic uses for resources than reducing sulfur emissions. As it happens, these countries are also not major sulfur emitters, so external pressure to join was low (Levy 1993, 127). This interpretation is reinforced by the fact that Romania was not even listed as an eligible Annex II country in the final version of Oslo (Churchill et al. 1995, 192). It is not completely possible to separate out the causal effect of these two explanations on group 4's failure to join Oslo during this period.

In response to the ongoing capacity problems of Southern and Eastern European states, there was more of an attempt to share technology in the Oslo Protocol (Churchill et al. 1995, 182). It seems likely that this increased attempt to share technology resulted in more emissions reductions in group 5 countries than would have occurred otherwise. The group 4 countries almost serve as a counterfactual: in graph 3, the emissions reductions of groups 4 and 5 were essentially equal in 1994, but by 2002 group 5 had reduced substantially more than group 4, the non-members. It is not possible to completely deduce whether it was the Oslo protocol which caused this change, or whether it was differences in GDP growth which caused the countries to select different outcomes. Nevertheless, it is not possible to rule out the possibility that the Oslo Protocol caused a reduction in emissions for group 5 states.

There was also more of a mechanism to address non-compliance in the Oslo protocol, another possible way in which Oslo could have influenced member behavior. However, compliance was perfect in the Helsinki Protocol, and nearly perfect in the Oslo Protocol, and the compliance mechanisms went unused (Churchill et al. 1995, 194). Thus, we cannot say with any

confidence that enhanced compliance mechanisms resulted in any more emissions reductions than would have occurred without them.

Common versus Differentiated Goals

How did the differentiated goals influence the effectiveness of the Oslo Protocol? Here, counterfactual selection is important. It is difficult to examine the effects of common obligations on the effectiveness of the Helsinki Protocol. Given that the scientific capacity to set critical loads or differentiated obligations did not exist until 1988, asking whether a critical loads approach would have increased the effectiveness of the Protocol is not useful (Churchill et al. 1995, 173). Similarly, considering whether Oslo was more effective than Helsinki because of critical loads incorporation is difficult.

There are two mechanisms by which the differentiated goals could influence the effectiveness of the Oslo Protocol. First, incorporation of differentiated goals could lead to more states signing the treaty than would have otherwise. Unless we consider treaty membership an indicator of treaty effectiveness, though, increased membership is only an indicator of treaty success if these members emitted less sulfur than they would have otherwise. Second, differentiated goals could increase treaty effectiveness if they led members to reduce their emissions by more than they would have otherwise (either in the absence of a treaty, or with a common goals treaty.)

Several scholars have stated that the Oslo Protocol would not have existed if it had been negotiated through common reductions goals rather than differentiated goals (Churchill et al. 1995; Kolari 2007, 31). This observation points to the fact that the differentiated goals played an important role in the effect of the Oslo Protocol, but only if the Oslo Protocol caused emissions reductions that would not have occurred without it.

Examining the negotiation process of the Oslo Protocol reveals that while the emissions reductions were based on a consideration of critical loads, the actual adoption of critical load emissions standards was quickly rejected as not feasible (Churchill et al. 1995, 185). A 60% percent closing of the gap between current emissions and critical loads was adopted as a political compromise – this number was chosen based on what countries thought was feasible rather than what was scientifically necessary. Furthermore, during negotiations countries actually specified their own emissions targets (Churchill et al. 1995, 185). To a certain extent, these targets were based on critical loads, but in other ways the critical loads models were manipulated to fit these specifications. This points to the fact that the inclusion of critical loads really did not reframe the discussion – the negotiation was still very political in character (Gough 1997, 23). In fact, Churchill et al. (1995) comment that, "taken overall, the projected reductions remained in line with official energy use projections and did not constitute 'real' reductions" (186).

Even though the negotiations were political in character, did countries sign who would not have otherwise?

Given the relatively constant rate of emissions reductions by group 1 countries and their perfect level of compliance, it is difficult to determine whether these countries would have reduced emissions less in the absence of the Oslo Protocol. If these countries had been influenced by the Oslo Protocol, it would have been through the mechanism of critical loads, which might have led to the adoption of more stringent reductions standards. Given that the differentiated goals were ultimately political rather than scientific, and according to some scholars, represented estimates of existing emissions projections, it is unlikely that the differentiated emissions standards affected the Helsinki-signers in the group 1 countries (Churchill et al. 1995, 182).

Of the countries who signed the Oslo Protocol but not the Helsinki Protocol, only Spain, Greece, Ireland, and the UK appear to have been motivated to sign specifically by the differentiated goals approach. In the early 1990s, The UK did announce its intentions to comply with the critical load standards, in principle. This change in policy is probably partly a result of the normative pressures of Helsinki, but also a result of external factors, like pressures and regulations within the EC, separate from LRTAP (Levy 1993, 124). Nevertheless, the UK was still a "dragger" in the Oslo negotiations, likely due to its low domestic vulnerability and large contribution to the problem (Churchill et al. 1995, 182). Even though these four countries likely would not have signed the Oslo Protocol if it had not included differentiated loads, this is because the differentiated loads approach allowed all countries to tailor goals that they would have achieved even in the absence of a treaty: Greece was even allowed to index its emissions reductions to 2000 levels, as a concession to ongoing development (Churchill et al. 1995, 186). Thus, the differentiated loads approach did not lead these countries reduce their emissions more than they would have otherwise.

This same logic holds true for group 4 countries: even if the differentiated goals had been a causal factor in their willingness to sign, it allowed them to set goals reflecting emissions reductions that occurred otherwise.

Conclusion

The Helsinki and Oslo Protocols occurred during a momentous time in history. Teasing out the causal connections of behavior to assess the effect of the treaty on emissions reductions is a complicated task. Based on an analysis of non-treaty and treaty-related factors influencing emissions, we can begin to come to several conclusions. First, generally, non-treaty factors do

not appear to explain all of the between and within country variance in sulfur emissions over this period. Although some scholars have hypothesized that the emission changes observed can be explained solely through domestic interests, from this analysis it appears that the treaty caused some of the emissions reductions observed. Second, the treaties' effectiveness varied across countries. Between-country differences in GDP, location, and political affiliation appear to have affected how the treaties influenced behavior. Third, while the treaties mostly both affected countries through exerting normative pressure, to some extent the two treaties were effective via different mechanisms.

The five groups of countries analyzed throughout this paper illustrate these last two points. While the Helsinki Protocol appeared to influence some Western countries within groups 1 and 3 through exerting normative pressure both during and after treaty negotiation, it does not appear to have caused any emissions reductions in some of the richer countries in group 1, or in any of the poorer countries in groups 2, 4, or 5, regardless of political affiliation. The Oslo Protocol, on the other hand, appeared to influence group 5 countries (poor Eastern European countries with increasing GDPs) to decrease their emissions through normative pressures, but also through technology sharing. Interestingly, while the Helsinki Protocol appears to have reduced the emissions of both relatively rich and relatively poor states, the Oslo Protocol appears to have influenced mainly poorer states. More broadly, though, the characteristics of the states themselves appear to have influenced the ways in which they were affected by the treaty.

The final conclusion we can reach is that while the differentiated goals may have caused more countries to sign the protocol than otherwise would have, differentiated goals do not appear to have caused more emissions reductions than would have occurred otherwise. Thus the Oslo Protocol was at least partially responsible for the reduction of emissions in some Eastern

European states, but through normative pressure and increasing the availability of technology, not through differentiated emissions goals. Ultimately, differentiated goals did not lead to more emission reductions than would have occurred otherwise.

If accepted, this last conclusion could have interesting ramifications for future policies. The differentiated goals appear to have failed to change emissions behavior because they were not truly reflective of critical loads, but were politically motivated, facilitating countries' choice of goals that they were already planning to meet. Even if these goals had been based in scientific emissions targets, one wonders whether they would have caused emissions reductions in poorer states, given that the differentiated goals model is optimizing environmental goals, rather than equity. It will be interesting to observe how future Protocols negotiated under LRTAP incorporate differentiated goals, as well as how they accommodate capacity problems within the member nations.

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