PATHWAYS OF COOPERATION: INTEGRATED AND UN-INTEGRATED
INTERNATIONAL ENVIRONMENTAL GOVERNANCE

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Abstract

Governments have incentives to form integrated rules and institutions when they pursue international environmental cooperation. Under what conditions do they form environmental cooperation consisting of un-integrated rules and institutions? I argue that governments form integrated cooperation when they share convergent preferences over cooperation. They form un-integrated cooperation when they have divergent preferences. Preferences diverge under one of two conditions: (i) economic actors (“stakeholders”) responsible for the environmental problem operate in diffuse markets, or (ii) states have an asymmetrically interdependent relationship in managing the environmental issue. When neither condition holds, governments share convergent preferences over environmental cooperation. I evaluate the importance of stakeholder concentrations by studying patterns of cooperation on global environmental issues such as climate change, ozone layer depletion, biodiversity loss, and mercury pollution. I evaluate the importance of interdependence structures by studying patterns of cooperation on regional rivers, lakes, and seas. The analysis employs original data stemming from agreement texts, field surveys, primary-source interviews, field observations, primary texts, quantitative data, as well as secondary sources. Governments create integrated global environmental cooperation when stakeholders are economically concentrated. They create un-integrated cooperation when stakeholders are economically diffuse. On regional water bodies, governments form integrated cooperation when states share symmetrical exposure to pollution and other externalities. They form un-integrated cooperation when states have asymmetrical exposure. Neither the number of states with control over an environmental issue nor the wealth and geopolitical relations among states better explain patterns of cooperation on global environmental issues or regional water bodies.
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADP</td>
<td>Ad Hoc Working Group on the Durban Platform for Enhanced Action</td>
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<tr>
<td>AGBM</td>
<td>Ad Hoc Group on the Berlin Mandate</td>
</tr>
<tr>
<td>APP</td>
<td>Asia-Pacific Partnership on Clean Energy and Climate</td>
</tr>
<tr>
<td>ASGM</td>
<td>artisanal and small-scale gold mining</td>
</tr>
<tr>
<td>BALTHAZAR</td>
<td>Baltic Hazardous and Agricultural Releases Reduction</td>
</tr>
<tr>
<td>BASE</td>
<td>Baltic Sea Action Plan Implementation in Russia</td>
</tr>
<tr>
<td>BRICS</td>
<td>Brazil, Russia, India, China, South Africa</td>
</tr>
<tr>
<td>CBD</td>
<td>Convention on Biological Diversity</td>
</tr>
<tr>
<td>CCAC</td>
<td>Climate and Clean Air Coalition on Short-Lived Climate Pollutants</td>
</tr>
<tr>
<td>CDM</td>
<td>Clean Development Mechanism of the Kyoto Protocol</td>
</tr>
<tr>
<td>CEM</td>
<td>Clean Energy Ministerial</td>
</tr>
<tr>
<td>CFCs</td>
<td>chlorofluorocarbons</td>
</tr>
<tr>
<td>CITES</td>
<td>Convention on International Trade in Endangered Species</td>
</tr>
<tr>
<td>CLRTAP</td>
<td>Convention on Long-Range Transboundary Air Pollution</td>
</tr>
<tr>
<td>COP</td>
<td>Conference of the Parties to the United Nations Framework Convention on Climate Change</td>
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<tr>
<td>CPR</td>
<td>common-pool resource</td>
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<tr>
<td>ODS</td>
<td>ozone-depleting substances</td>
</tr>
<tr>
<td>EPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>G8</td>
<td>Group of Eight</td>
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<tr>
<td>G20</td>
<td>Group of Twenty</td>
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<tr>
<td>G77</td>
<td>Group of 77</td>
</tr>
<tr>
<td>GATT</td>
<td>General Agreement on Tariffs and Trade</td>
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GDP           gross domestic product
GEF           Global Environmental Facility
GHG           greenhouse gas
GWP           global-warming potential
HCFCs         hydrochlorofluorocarbons
HFCs          hydrofluorocarbons
HELCOM        Helsinki Commission
ICAO          International Civil Aviation Organization
ICPDR         International Commission for the Protection of the Danube River
ICPR          International Commission for Protection of the Rhine
IEA           International Energy Agency
IMO           International Maritime Organization
IMO-MEPC      Marine Environment Protection Committee, International Maritime Organization
INC           Intergovernmental Negotiating Committee on a legally binding instrument on mercury
IPBES         Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services
IPCC          Intergovernmental Panel on Climate Change
IPEEC         International Partnership for Energy Efficiency Cooperation
IREA          International Renewable Energy Agency
ITTO          International Tropical Timber Organization
KP            Kyoto Protocol to the United Nations Framework Convention on Climate Change
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>LCA</td>
<td>Ad Hoc Working Group on Long-Term Cooperative Action under the Convention</td>
</tr>
<tr>
<td>LOPs</td>
<td>Lists of Participants</td>
</tr>
<tr>
<td>MARPOL</td>
<td>International Convention for the Prevention of Pollution from Ships</td>
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<tr>
<td>MEF</td>
<td>Major Economies Forum</td>
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<tr>
<td>MLF</td>
<td>Multilateral Fund for the Implementation of the Montreal Protocol</td>
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<tr>
<td>NGO</td>
<td>non-governmental organization</td>
</tr>
<tr>
<td>ODP</td>
<td>ozone-depleting potential</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>RD&amp;D</td>
<td>research, development, and deployment</td>
</tr>
<tr>
<td>REDD+</td>
<td>Reducing Emissions from Deforestation and Forest Degradation</td>
</tr>
<tr>
<td>TEAP</td>
<td>Technical and Economic Assessments Panel of the Montreal Protocol</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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</tbody>
</table>
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This dissertation has complicated origins – too complicated for an acknowledgements section. It is as much a reflection of me as it is a reflection of the support I have received. I could not have done it without the steadfast encouragement of many. Robert O. Keohane has had an indelible mark on my analytical vision and approach to social science. His impact has been so immense that I do not know the full extent of it. I don’t know when I will know the full extent. Christina L. Davis has been instrumental in so many aspects of my dissertation. Her careful advice and encouraging words have kept me going. I have learned so much from her. Helen V. Milner has provided so many encouraging words to keep going and strive for impactful contributions. She has helped me make this possible. Andy Moravcsik invited me to Princeton University in March 2007, after I was accepted into the PhD program. He introduced me to the program – and it is fitting that he participates in my doctoral defense. I feel as though it means the process has come full circle. This dissertation could not have been possible without the encouragement of my friends and colleagues. So many of my fellow PhD students in the Politics Department and the STEP Program, past and present, have helped me learn about politics and the environment. They have lifted my spirits when times were difficult and provided sage advice. I am equally indebted to Michael Oppenheimer for his input and to Ron Mitchell for assisting me with his data. I would be remiss not to mention the institutions that have funded my research. The Bobst Center for Peace and Justice, the Niehaus Center for Globalization and Governance, the Woodrow Wilson School, and the Princeton Institute for International and Regional Studies have enabled me to make this possible. Most of all, my family and Christy have been there, whenever and wherever. Completing this dissertation has required that I learn the art of soul-searching. They have provided the light for that search. I can’t thank them enough. This is for them.
CHAPTER ONE

Introduction: Forms of International Environmental Cooperation

1.1 Settling for Complexity

When governments create international cooperation on an environmental issue, they prefer to have an efficient set of tools for managing the issue. This often means that governments would prefer to have cooperation that consists of rules and institutions that build on each other to help manage the environmental issue. They would prefer to avoid investing in institutions and rules that perform superfluous functions. Governments would prefer rules and institutions that are efficient to create and maintain and that provide them with cost-effective means of managing the environmental issue.

In the course of cooperation, governments sometimes find that their initial international institutions or rules are not able to provide the benefits they had sought. Governments sometimes find they are not adequate in meeting new challenges or in meeting the original goals for which the rules or institutions were created. Governments then decide individually and sometimes collectively whether to continue cooperation with the current set of rules and institutions or create new ones. Creating new ones is costly. Governments would need to invest in negotiating the new rules and institutions. They often would need to finance their maintenance and any further actions they imply, such as implementation.

In a world without politics, governments could facilitate cooperation with cost-effective and efficient tools. They could use the existing rules and institutions as a platform for creating new ones. This would enable governments to economize on the costs of negotiating and
maintaining the cooperation they had established. In social science terminology, they could economize on “transaction costs” – the costs of joint action for joint gain. Cooperation brings greater net benefits when governments can economize on transaction costs.

In a world with politics, however, they are not always able to economize on transaction costs because of constraints. They sometimes cannot create efficient systems for managing the environmental issue. This may not be obvious at the outset. Governments may not anticipate that they will encounter specific constraints in the course of cooperation. Governments are forward-looking in designing cooperation – but they cannot anticipate all the constraints to cooperation they will encounter. In some cases, they may prefer to simply deal with those constraints as they arise in the future rather than invest in dealing with them before they become limitations.

Environmental cooperation can sometimes become less efficient with new challenges and obstacles. Governments sometimes find that they cannot economize on the transaction costs of cooperation to the extent they had wanted. Under this circumstance, they are more likely to select less efficient systems for managing the environmental issue than had previously existed. By adapting or adjusting to constraints, governments find it more useful to create rules and institutions that do not clearly economize on transaction costs. In pursuit of mutual and individual benefits from collective action, they create institutions and rules that are independent of preexisting ones and do not build on them. They settle for complexity.

In this dissertation, I explain when and why this occurs in the field of international environmental cooperation. I show that one constraint to building on prior rules and institutions comes from the individuals, communities, or businesses that generate the environmental problem – the “stakeholders.” When stakeholders are in concentrated economic markets, governments have more opportunity to economize on international regulation after it begins. Although
stakeholders in concentrated markets have stronger lobbying power, they make it simpler for governments to create relatively efficient forms of international environmental cooperation. However, when the stakeholders are in diffuse economic markets, governments have less opportunity to economize on international regulation after it begins. They may have ambitious goals at the beginning. Yet the diffuseness of stakeholders makes it infeasible from a political standpoint and impractical from a regulatory standpoint to create international regulation with as much efficiency as when the stakeholders are in concentrated markets.

In addition to the importance of stakeholders, the distribution of interdependence between states can either encourage or discourage governments to economize on the transaction costs of international environmental cooperation. Interdependence reflects the relative control of each state over the environmental conditions of other states. When interdependence is relatively symmetrical between those states, they find more common ground and view the environmental problem as an issue of mutual concern. They become more inclined to create new rules and institutions that are built into the existing framework of rules and institutions. However, when interdependence is relatively asymmetrical between states, they find less common ground and tend not to view the environmental problem as an issue of mutual concern. In the event they create new rules and institutions, they make them independent of the preexisting framework for cooperation on the issue.

The economic concentration of stakeholders and the symmetrical structure of interdependence encourage governments to pursue international environmental cooperation involving integrated rules and institutions. The economic diffuseness of stakeholders and the asymmetrical structure of interdependence encourage governments to pursue a different strategy: they become more inclined to pursue cooperation that economizes less on transaction costs and
consists of un-integrated rules and institutions. Stakeholders and interdependence can make efficient international cooperation likely. They can also make it unlikely.

Interdependence and stakeholders encourage or discourage economizing on transaction costs by shaping the preferences of national governments over international environmental cooperation. By affecting the costs of mitigating the environmental problem, stakeholders encourage a convergence or divergence of national preferences over cooperation. By affecting the feasibility of cost-effective international cooperation, stakeholders encourage governments to prefer either an integrated approach to cooperation or settle for an un-integrated one. And by shaping whether different states have a common interest in cooperation, interdependence structures encourage a convergence or divergence of national preferences over cooperation. Whether governments economize on transaction costs by building new international rules and institutions into earlier ones depends on how stakeholder concentrations and interdependence structures shape national preferences over international environmental cooperation.

1.2 Global Governance of the Atmosphere

On 16 September 1987, twenty-four wealthy countries completed a treaty to fulfill the mandate of the Vienna Convention on the Protection of the Ozone Layer. They adopted a protocol to place legal limitations on the production and consumption of ozone-depleting substances (ODS). The United States and European governments had recently learned that a hole in the stratospheric ozone layer had become wider than previously believed when they adopted the Vienna Convention in 1985. Scientific assessments had shown that an ozone hole had emerged over Antarctica and that it was growing (Parson 2003, 150). Instead of negotiating a
new convention to protect stratospheric ozone, governments negotiated the Montreal Protocol on Substances that Deplete the Ozone Layer. They amended the Vienna Convention by adopting a protocol under the existing legal framework. The Montreal Protocol was designed to achieve the objectives of the Vienna Convention, which had served as a framework convention because it did not specify limitations on ODS.

Legally, the Montreal Protocol is not an independent agreement because it relies on the definitions and provisions set forth in the Vienna Convention. For example, the procedure for submitting amendments to the Protocol depends on Article 9 of the Vienna Convention. Rules under the Protocol must fall within the legal purview of the Vienna Convention. Institutionally, the Montreal Protocol relies on the secretariat originally established to service the Vienna Convention. The informational functions of the Montreal Protocol were integrated within the existing informational provisions of the Vienna Convention. Both legally and institutionally, the Montreal Protocol is integrated into the framework established by the Vienna Convention, even as more attention has gone towards the Protocol.

Over time, parties have added to requirements under the Protocol by amending and adjusting it. Between 1990 and 2007, parties to the Protocol modified legal obligations by placing new restrictions on a growing number and variety of ODS. Much like they did in 1987, parties chose to use the existing rules and institutions established under the United Nations (UN) ozone regime instead of making independent agreements. The success of the UN ozone regime has become noteworthy. Many call the Montreal Protocol the most successful environmental treaty in history because of its impact on the production and consumption of chemicals harmful to the ozone layer (Molina et al. 2009). Current estimates indicate that the ozone layer will return to its pre-1979 state by 2050 – a major policy goal of parties under the Protocol (EPA 2011).
Other analyses show that the Montreal Protocol has also become the most successful climate protection treaty ever because of its impact on the emission of ODS with warming effects on Earth’s climate (Velders et al. 2007). Since 1985, the UN ozone regime has been successful as an integrated set of rules and institutions to protect the health of the atmosphere.

That experience had proven so successful that parties to the Montreal Protocol tried to recreate their success in protecting the climate (Victor 2011). On 7 April 1995, parties to the United Nations Framework Convention on Climate Change (UNFCCC) formally decided to negotiate a treaty to fulfill the Framework Convention’s mandate of “preventing dangerous anthropogenic interference in the climate system” (Article 2, UNFCCC). They agreed to what became known as the Berlin Mandate, which established the mandate for negotiations on a follow-up agreement to reduce greenhouse gas (GHG) emissions. The mandate called for “the adoption of a protocol or another legal instrument” (FCCC/CP/1995/7/Add.1). Thus, parties had decided to amend the Framework Convention with another agreement to fulfill its objective. They agreed to adopt a protocol or other legal instrument that would build on the provisions established under the Framework Convention.

On 11 December 1997, parties to the UNFCCC adopted the Kyoto Protocol. The Kyoto Protocol obligated so-called Annex I parties to the Framework Convention to stabilize or reduce GHG emissions relative to 1990 baseline levels. Annex B of the Protocol sets forth an emissions target for each of the Annex I parties under the Framework Convention. Critically, the United States, the European Union, Japan, Australia, New Zealand, and other wealthy parties to the Framework Convention accepted emissions obligations under the Kyoto Protocol. This treaty fulfilled the Berlin Mandate negotiated two years earlier.
The Kyoto Protocol was *legally integrated* into the UNFCCC insofar as it relied on the legal provisions of the Framework Convention. For example, Annex I parties are defined in the Framework Convention and not in the Kyoto Protocol, which references that legal category for several of its provisions. In addition to the legal integration of the Kyoto Protocol into the UNFCCC, it was *institutionally integrated* into the UNFCCC as well. The Kyoto Protocol’s bureaucratic and administrative institutions were partly housed within the newly established Climate Change Convention Secretariat in Bonn, Germany. The Kyoto Protocol’s meetings were expected to take place alongside the Framework Convention meetings. Parties and observers expected that several other institutional characteristics of the Framework Convention would service the Kyoto Protocol.

Despite these efforts to create an international regime for climate change whose legal and institutional elements were integrated, governments have not continued the early effort to make an integrated regime for climate change. They have instead created new international institutions and have used existing institutions to address climate change issues formally under the mandate of the UNFCCC and its Kyoto Protocol. They have used the UNFCCC/Kyoto system to integrate cooperation on some climate change issues but not all (Ovodenko 2013). They have created what some researchers have called a “regime complex for climate change” (Keohane and Victor 2011). In other words, governments have formed a non-hierarchical network of international institutions addressing varying issues on the climate change agenda. In contrast to the earlier trend of creating an integrated regime consisting of rules and institutions to manage climate change, they have created an *un-integrated* regime in recent years.

Figure 1.1 below elaborates the rules and institutions in international climate change governance. Governments increasingly used non-UNFCCC institutions following the entry into
force of the Kyoto Protocol in February 2005. In particular, they have used the Montreal Protocol and the International Maritime Organization (IMO) to achieve mitigation objectives and have created small “clubs” to coordinate on technology promotion and energy policies. They have used existing institutions such as the World Bank to channel multilateral aid on climate change projects. These non-UNFCCC institutions have contributed to climate change governance on a variety of issues, such as clean energy development and project financing. Some have been legally binding such as the IMO amendment adopted in July 2011 to reduce GHG emissions from commercial tankers. Others have been non-binding voluntary measures, such as declarations by the Group of Eight and similar high-level forums. International climate change governance has become an un-integrated network of rules, institutions, and agreements that share overlapping policy goals but non-hierarchical relationships.

1.3 Puzzle

Why have parties to the UNFCCC not continued to make an integrated international regime for climate change? Why did they begin to replicate the experience of the UN ozone regime and then decide to make an un-integrated network of international climate change institutions? This dissertation generalizes beyond these well-known cases of global environmental governance to a wider range of international environmental issues. It studies variation in the form of international environmental cooperation on regional water bodies and global environmental issues. It focuses on when governments create integrated international cooperation, in the form of the ozone regime, and when they create un-integrated international
Fig. 1.1 Functional and Legal Contributions of Multilateral Institutions in Climate Change Governance. The horizontal space indicates the legal force of the contributions to climate change governance. The vertical space indicates the substantive area of the contribution. Some institutions make contributions across these areas. Their positioning in the figure reflects the area of their largest contribution to the governance of climate change, roughly assessed. The UNFCCC is positioned at the center to reflect its central place in the climate change regime and the mix of contributions it makes, functionally and legally.
cooperation, in the form of the climate change regime. *What explains variation in the form of international environmental cooperation?*

Un-integrated international cooperation is puzzling. It implies that governments choose not to deploy existing rules and institutions to achieve the objectives for which they were created. Integrated international cooperation is an attractive option for governments. It enables them to harness the rules and institutions they created to manage a natural resource. In political science terminology, existing institutions lower *transaction costs* and generate *increasing returns* (Keohane 1984, Pierson 2004). They lower the costs of coordinating policies and dis-incentivize the use of alternative institutions. International environmental cooperation that consists of un-integrated rules and institutions does not fully harness these advantages. It requires additional negotiations and perhaps additional rules and institutions to achieve policy goals.

Consider the paradigmatic case of global trade cooperation in the post-War era. Governments originally negotiated the General Agreement on Tariffs and Trade (GATT) as an interim agreement after the US Senate refused to accept the International Trade Organization. GATT was not expected to become the foundation for trade between non-communist governments (Barton et al. 2005). It only assumed that role after it had proven its usefulness (Kim 2010). Governments invested in successive negotiating rounds to add tariff limitations and limitations on non-tariff trade barriers. Cooperation under GATT was integrated: governments used existing rules and institutions as a baseline for adding new rules to open markets even further. This enabled parties to avoid the costs of reconstructing a new trade regime after the existing rules were deemed inadequate.

Variation in the form of international environmental cooperation implies that governments sometimes choose not to pursue integrated cooperation as they did in building the
UN ozone regime. It implies they do not harness the rules and institutions in place to achieve more cooperation. To the extent those rules and institutions help governments economize on the transaction costs of cooperation, not using them as a baseline for building new rules or institutions is a cost-intensive course of action. It may require more investments in new rules and institutions to facilitate cooperation on an environmental issue already under regulation.

Governments are generally reluctant to increase the costs of cooperation. The point of cooperation is to reduce negative externalities – the social costs of individual actions. By increasing (or not lowering) the costs of cooperation, the net marginal benefit of cooperation would decline. The costs would increase relative to the benefits. Since governments prefer to economize on the costs of achieving international policy goals, they would tend to avoid duplicating rules and institutions that do not enable them to achieve their goals cost-effectively. Governments would prefer to harness existing tools of cooperation that enable them to economize on the costs of further cooperation. This generally means forming integrated rules and institutions on an issue or linked issues.

1.4 Integrated and Un-integrated International Environmental Cooperation

Integrated international environmental cooperation has two defining characteristics. First, it implies that the international rules or institutions that governments establish to manage an environmental issue build on earlier rules or institutions they had created to manage the issue. They are not legally or institutionally independent of the earlier rules and institutions. This implies some measure of dependence on the international rules and institutions already in place. In the examples cited above, the Kyoto Protocol and the Montreal Protocol rely on the
institutions established under the framework conventions on climate change and ozone protection, respectively. They also rely on the legal status of those conventions. This is the *dependence* condition: integrated cooperation implies that new rules or institutions depend on earlier ones for their operation or implementation.

Second, integrated cooperation implies that governments continue managing an environmental issue but with new rules or institutions. International environmental cooperation would not be integrated if governments did not make new rules or institutions on an issue for which they had an earlier set of rules or institutions. In other words, it implies that governments make new rules and institutions that share the subject matter of earlier rules and institutions. Although this may seem obvious, it is critical to distinguishing integrated international cooperation from situations in which governments never seek new rules or institutions on the issue that originally motivated cooperation. By negotiating the Kyoto Protocol and Montreal Protocol, governments added rules and institutions to those in place on climate change and ozone protection, respectively. This is the *additionality* condition: integrated cooperation implies that governments add rules or institutions to those already in place.

The difference between integrated and un-integrated international cooperation is the dependence condition; additionality is present in both forms of cooperation. When governments add international rules or institutions that depend on earlier ones, they form integrated international cooperation. Un-integrated international cooperation implies the absence of dependence on earlier rules and institutions but the addition of *independent* rules and institutions on the same issue – or part of it – as governed by the earlier rules or institutions. The new rules or institutions share an overlapping subject with earlier ones that governments had established. The advent of new rules or institutions adds to the ones in place to govern the issue. However,
the new rules or institutions do not depend on the earlier ones for their implementation or operation. They are independent but additional. Table 1.1 summarizes the distinction between integrated and un-integrated international environmental cooperation.

Table 1.1 Dependent Variable Characteristics

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<thead>
<tr>
<th>Form</th>
<th>Dependence</th>
<th>Additionality</th>
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<tbody>
<tr>
<td>Integrated</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Un-integrated</td>
<td>No</td>
<td>Yes</td>
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Note: “Dependence” refers to the relationship between new rules and institutions and older rules and institutions established to manage an issue. “Additionality” refers to whether the rules and institutions add to the corpus of rules and institutions that manage the issue.

To illustrate the distinction, consider again the international regimes for ozone layer protection and climate change. Figure 1.2 highlights the difference between the integrated cooperation on ozone projects and the un-integrated cooperation on climate change projects. Financing of ozone projects is nearly entirely integrated within the Montreal Protocol. Financing of climate change projects is shared between different international organizations. Ozone financing is integrated in the UN ozone regime; climate financing is spread across different independent international organizations.
The Montreal Protocol parties adopted an amendment in 1990 to establish the Multilateral Fund (MLF) as the financial mechanism of the Protocol. They created a financial mechanism within the legal and institutional framework of the Montreal Protocol with an amendment. The only other international institution providing financing for ozone projects has been the Global Environmental Facility (GEF), which has limited ozone-project financing to the
former Soviet republics and no other countries. However, the MLF has dominated the financing role in the ozone layer regime. The rules and institutions for financing the vast share of ozone projects have been integrated within the provisions and institutions of the Montreal Protocol.

This has not characterized international financing for climate change projects. Governments made the GEF a financial mechanism of the Framework Convention on Climate Change. Over time, however, the World Bank has added numerous programs to finance climate change projects related to development assistance. Those programs under the World Bank contributed to un-integrated international financial cooperation on climate change because they were independent of the UNFCCC but dealt with climate change aid. Historically, the GEF and the World Bank have each made important contributions to financing climate change projects. However, the GEF is a financial mechanism of the UNFCCC, not the World Bank. The rules and institutions for financing climate change projects are spread independently across different international organizations. They are un-integrated.

1.5 The Arguments

In an ideal world without politics, governments would make integrated international cooperation on specific environmental issues because it enables them to harness the efficiency gains of rules and institutions that complement each other. They would rely on existing rules and institutions established under an agreement or international organization to help secure joint gains in protecting the environment. Transaction costs and increasing returns would drive their choices and they would take advantage of synergies between rules and institutions by making integrated cooperation.
In a world with politics, governments do not always create integrated cooperation because political and regulatory conditions shape the extent to which their preferences over international cooperation converge or diverge. The more their preferences over cooperation diverge, the more they disagree over the rules or institutions to facilitate cooperation, the more likely they are to find integrated cooperation unrealistic or impractical. Ultimately, the distribution of preferences among national governments affects the form of international environmental cooperation. Integrated cooperation emerges when national preferences converge; un-integrated cooperation emerges when national preferences diverge.

The distribution of national preferences over the rules and institutions of international environmental cooperation depends on stakeholder concentrations. Stakeholders are individuals, communities, and businesses whose economic activities are responsible for the environmental externalities. Their actions would need to change to mitigate the externalities. Stakeholders are concentrated when they operate in markets involving relatively few suppliers and producers, with consumers operating in small heterogeneous markets. Stakeholders are diffuse when they operate in markets involving many suppliers and producers, with consumers operating in large homogenized markets. Diffuse stakeholders contribute to preference divergence among national governments. Concentrated stakeholders enable national preferences to converge.

Stakeholders shape the form of international environmental cooperation because of the markets in which they operate, not only through their lobbying efforts. Stakeholders in concentrated markets enable governments to form integrated regimes; stakeholders in diffuse markets force governments to settle for un-integrated regimes. A long history of research has argued that group concentration is critical to whether individuals are able to overcome barriers to collective action and influence policymakers (Olson 1965). Concentrated stakeholders should be
able to narrow the scope of regulation or weaken provisions more effectively than diffuse stakeholders. However, stakeholder concentration also promotes integrated regimes after the initial terms of cooperation are established. Stakeholder concentration sets a condition for cost-effectively mitigating an environmental problem. Diffuse stakeholders may not have the lobbying capacity of concentrated stakeholders but they also do not enable governments to make new regulations that cost-effectively mitigate the environmental problem.

Similarly, the distribution of national preferences over the rules and institutions of international environmental cooperation depends on interdependence structures. Interdependence refers to the mutual dependence of states in maintaining their environmental conditions. Interdependence structure refers to the relative dependence among states. Interdependence is asymmetric when some states have more control over the exposure of other states to environmental externalities from their nationals. Interdependence is symmetric when states share similar control over the exposure of other states to environmental externalities from their nationals. When states share symmetrical interdependence in managing the environmental issue, preferences over cooperation converge and governments form integrated cooperation. By contrast, when states have asymmetrical interdependence in managing the environmental issue, preferences over cooperation diverge and governments form un-integrated cooperation.

These arguments seek to explain the form of international environmental cooperation by specifying when governments have divergent preferences over rules and institutions. They specify two conditions preventing “harmony” (Keohane 1984). Both stakeholder concentrations and interdependence structures affect the form of international environmental cooperation by shaping the distribution of preferences among national governments. Stakeholder concentrations
and interdependence structures affect national preferences and national preferences shape the form of international environmental cooperation.

1.6 Research Design

I evaluate these explanations by analyzing the development of international environmental cooperation on regional water bodies and global environmental issues. Regional water bodies entail strongly varying interdependence structures among states bordering the water. Global environmental issues have widely varying stakeholder concentrations. I evaluate the explanations in these empirical settings because they each feature wide variation in one explanatory variable but not the other. Table 1.2 summarizes my empirical strategy.

Table 1.2 Summary of Empirical Settings, Dependent Variables, and Explanatory Variables

<table>
<thead>
<tr>
<th>Empirical Settings</th>
<th>Dependent Variables</th>
<th>Explanatory Variables</th>
</tr>
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<tbody>
<tr>
<td>Global environmental issues</td>
<td>Integrated and un-integrated agreements</td>
<td>Stakeholders in concentrated or diffuse markets</td>
</tr>
<tr>
<td>Regional water bodies</td>
<td>Integrated and un-integrated agreements</td>
<td>Symmetric or asymmetric interdependence among countries</td>
</tr>
<tr>
<td></td>
<td>Agreements with broad participation and narrow participation</td>
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Regional water bodies have differing interdependence structures. Lakes and seas have properties of common-pool resources because states expose each other to pollution and other environmental problems. Elinor Ostrom has shown that common-pool resources provide communities with a common stake in cooperation (Ostrom 1990). By contrast, rivers
neighboring several states have asymmetric properties, particularly along upstream-downstream rivers. Studies have shown that international rivers encourage preference divergence over water management (Priscoli and Wolf 2009). Regional water bodies present a useful domain for analyzing how the form of international environmental cooperation varies with interdependence structures among states.

Similarly, global environmental issues have differing stakeholders. Some problems such as climate change and biodiversity loss stem from the actions of diffuse actors ranging across markets and sectors (Zaccai and Adams 2012). Other global issues have more economically concentrated stakeholders who contribute to the problem and whose actions could mitigate it. Global environmental issues offer a domain for analyzing how the form of international environmental cooperation varies with stakeholder concentrations.

Evaluating the explanations separately within these empirical settings provides control over the variables. It minimizes variation in one explanatory variable while maximizing variation in the other explanatory variable. Interdependence structures vary considerably across different categories of regional water bodies but the stakeholders are often the same because similar economic activities contribute to environmental problems across different categories of water bodies. Similarly, stakeholder concentrations vary considerably across different global environmental issues but the interdependence structures are often similar because local economic actions have global consequences that are spread across geographic regions. Within each empirical domain, one explanatory variable features much greater variation than the other, justifying separate analyses of interdependence structures and stakeholder concentrations.

1.7 The Evidence
Chapters Three through Five document how governments have chosen to manage global issues. The evidence indicates that stakeholder distributions affect how governments manage different global environmental issues. On issues such as climate change and biodiversity loss, governments have political disagreements over the distribution of mitigation costs, particularly between wealthy and lower-income countries, and face governance challenges in managing diffuse markets. They form un-integrated cooperation on these issues. However, on issues such as ozone layer depletion or mercury pollution, governments can rely on concentrated industries with technical knowledge and capital resources to diffuse technologies that lower mitigation costs. National preferences converge on international cooperation and governments create integrated rules and institutions. These patterns reflect a convergence of interests in managing global environmental issues involving concentrated stakeholders and a divergence of interests in managing global environmental issues involving diffuse stakeholders.

Chapters Six and Seven document how governments have managed regional water bodies. The evidence shows that interdependence structures affect the form of regional water cooperation. Governments are more likely to form integrated international cooperation on lakes and seas than on rivers. However, governments are more likely to form un-integrated cooperation on rivers than on lakes and seas. These patterns reflect a convergence of interests in managing water bodies featuring symmetrical interdependence and a divergence of interests in managing water bodies featuring asymmetrical interdependence. The structure of interdependence does not consistently shape the breadth of regional water cooperation. Lakes and seas are not more prone to broader cooperation than rivers. Interdependence structures shape the form of regional water cooperation more than the breadth of cooperation.
GLOBAL ENVIRONMENTAL TREATY PROCESSES. Chapter Three demonstrates that governments make integrated cooperation on global environmental problems stemming from sectors with concentrated stakeholders and make un-integrated cooperation on problems stemming from sectors with diffuse stakeholders. National preferences converge on cooperation when the environmental problem stems from stakeholders in economically concentrated markets. Preferences diverge when the environmental problem stems from markets with economically diffuse stakeholders. Consequently, governments use independent agreements in regulating sectors with diffuse economic actors and but use integrated agreements in regulating sectors involving concentrated economic actors. Statistical analysis of 18 global environmental treaty processes demonstrates that governments form un-integrated regimes on agriculture and land use but form integrated regimes on industrial pollutants. Qualitative data from a focused comparison of climate change governance and ozone layer governance show how stakeholder concentrations shaped national preferences over the rules and institutions on these two atmospheric issues. Overall, governments tailor the form of global environmental cooperation to the concentration of the regulated sectors.

MERCURY POLLUTION AND BIODIVERSITY LOSS. Chapter Four explains when governments expect to use multiple independent treaties to regulate a global environmental problem instead of an integrated set of treaties. With original data from field surveys at two recent global environmental negotiations, it outlines the relationships between stakeholders, technology, disagreement among governments, and forms of international cooperation. The survey evidence and supporting data show that individual participants in these two global environmental meetings were less likely to expect integrated agreements on biodiversity and ecosystems (i.e., diffuse problems) than on mercury pollution (i.e., a concentrated problem).
They were more skeptical of technological solutions to mitigating the diffuse problem than the concentrated problem. Their beliefs about technology and stakeholders were related to the perceived disagreement among governments over the main issues in the negotiations on mercury and biodiversity. Most importantly, negotiators and non-government stakeholders converged on more precise goals and international instruments on mercury than on biodiversity. With stakeholders in concentrated markets, policy goals and international instruments become more precise for negotiators and stakeholders to envision and develop.

CLIMATE CHANGE. Chapter Five analyzes the form of un-integrated cooperation on climate change. The earlier chapters explain the importance of stakeholder concentrations in whether governments create integrated or un-integrated cooperation on global environmental issues. They do not explain when governments create de novo rules and institutions in pursuing un-integrated cooperation. I analyze the conditions under which governments created de novo institutions and rules on climate change instead of using other international bodies to take on climate change issues. Qualitative evidence shows that governments selected international bodies that had previously not handled climate change issues, at least not directly, because of their stakeholder characteristics. The United States formed de novo institutions in the absence of an international body with concentrated stakeholders that could make progress on a particular issue in climate change mitigation. Governments economized on transaction costs and start-up costs by creating flexible and informal small “clubs.” They sought to achieve legal agreements on climate change mitigation by selecting non-UNFCCC treaty regimes with concentrated stakeholders.

FORMS OF REGIONAL WATER COOPERATION. Chapter Six analyzes how interdependence structures among countries affect the form of international cooperation on
regional water bodies. I argue that lakes and seas tend to involve relatively symmetrical interdependence, encouraging states to share similar preferences over managing the water body. Rivers tend to involve asymmetrical interdependence, encouraging more un-integrated cooperation consisting of independent agreements. Panel data on the agreement histories of 76 rivers, lakes, and seas show that cooperation on lakes and seas becomes integrated while cooperation on rivers becomes un-integrated. Qualitative data from interviews and other sources elaborate how varying interdependence relationships have shaped the course of international cooperation on the Danube River, the Rhine River, and the Baltic Sea. They also qualify the importance of political relations and economic wealth in shaping the form of cooperation that has emerged on these European water bodies. The findings indicate that interdependence structures shape national preferences over regional water management, affecting the form of international cooperation that governments create.

**BREADTH OF REGIONAL WATER COOPERATION.** Chapter Seven studies the breadth of regional water cooperation. The breadth of cooperation is not a dimension related to the form of cooperation (i.e., integrated or un-integrated). However, the breadth of cooperation is a dimension of cooperation that may reflect interdependence structures. It is another dimension of cooperation that may depend on the interests stemming from different interdependence structures. Statistical analysis of panel data on 76 rivers, lakes, and seas shows that states are not more inclined to form broad cooperation on lakes and seas than on rivers. There is stronger evidence that states form narrow cooperation on rivers. Qualitative evidence from a focused comparison of the breadth of international cooperation on the Danube River and the Baltic Sea area provides strong support for the interdependence structures argument. Governments along the Baltic Sea have consistently made broader cooperation than Danube states have made over
30 years. Symmetrical interdependence has informed the decisions of Baltic countries to form broad cooperation. Asymmetrical interdependence along the Danube River and more symmetrical relationships along specific stretches of the river have influenced the decisions of Danube Basin countries to form multi-layered cooperation at bilateral, sub-basin, and basin-wide levels.

1.8 Evidence on Alternative Explanations

This dissertation applies concepts and theories of international cooperation in political science to the study of environmental management. It extends general explanations for cooperation that are not confined to specific issues in environmental protection or other fields such as political economy. For example, the interdependence structures explanation for variation in the form of international environmental cooperation is an extension of research in political science on international institutions with a long intellectual history (Keohane and Nye 2012). The stakeholder concentrations argument is more novel in relation to existing explanations for international cooperation. This dissertation has relevance to the study of environmental management and more general relevance to the study of international organization.

BREADTH AND DEPTH. As alternatives to the primary explanations for the form of international environmental cooperation, I apply two other explanations rooted in different research traditions on international institutions. One alternative explanation suggests that the form of international environmental cooperation will reflect a strong trade-off between breadth and depth. Integrated cooperation is tantamount to deeper cooperation, in this view, and deeper cooperation is unlikely when more states are involved. Each state possesses different preferences
over cooperation and policy adjustments than other states. Aggregating state preferences can complicate efforts to produce deep cooperation through integrated rules and institutions. When more states have control over an environmental issue, integrated cooperation becomes unlikely and governments settle for un-integrated cooperation. They become more inclined to create institutions and rules with narrow participation. But these institutions and rules are unlikely to be integrated with others because of greater preference divergence in large groups of states. This explanation for variation in the form of international environmental cooperation is a strict application of the view that broad and deep cooperation are incompatible. Governments must settle for one or the other.

I find very limited evidence for this explanation in the pattern of global environmental governance but more support in the pattern of regional water cooperation. In governing global environmental issues, the evidence shows that having more inclusive treaty regimes is conducive to integrated cooperation, contrary to the expectation that deep and broad cooperation are incompatible. Having more states included in global governance can facilitate more preference convergence than forming narrow international institutions with fewer parties. In governing global issues, having more states involved in treaty regimes is preferable. There is more evidence for the tradeoff argument in the management of regional water bodies. However, the evidence is no greater on balance than evidence for the importance of interdependence structures. Having more states included in regional water management provides greater added value in cooperation than limiting cooperation to a subset of states. Applying a strict interpretation of the breadth-depth tradeoff perspective on international cooperation may have caustic consequences for cooperation and regulatory effectiveness.
WEALTH AND GEOPOLITICS. International cooperation on environmental issues may also merely reflect broader transformations in international politics and national economies. In this view, the form of cooperation will tend to reflect not specific characteristics of an environmental issue such as stakeholder concentrations or interdependence structures but geopolitical relationships and national wealth. The capacity to manage an environmental problem will depend on economic wealth. The desire to manage the problem will depend on both political relations between governments and the cost-effectiveness of management opportunities. Nothing specific to the environmental issue will determine the course of cooperation. Geopolitical relations between governments and their national wealth will shape the course of cooperation. Friendly governments that are wealthy will tend to create integrated institutions and rules; rivals with lower economic wealth will tend to create un-integrated cooperation, if any at all.

Evidence from the analysis of global environmental governance does not support this explanation. Governments have created integrated regimes on several global environmental issues even as the global economy has changed and more wealth has moved to the developing world. More un-integrated cooperation has emerged after 1992, when governments convened the UN Conference on Environment and Development in Rio de Janeiro, Brazil. However, there is more evidence supporting the importance of stakeholder concentrations than supporting the importance of these transformative changes in the global economy and the political implications they have brought. In managing water bodies, friendly geopolitical relations and more wealth may contribute to more integrated cooperation. However, they do not diminish the propensity to form un-integrated cooperation on rivers entailing asymmetric interdependence between riparian states. Overall, geopolitical conditions and greater wealth can enhance the prospect of integrated cooperation on regional water bodies, but they do not diminish the importance of
interdependence structures. Changes in the global economy can shift influence from the developed countries to the developing countries by some margin, but they do not make all global environmental regimes prone to inducing un-integrated cooperation.

1.9 Significance for Policy

Governments cooperate on international environmental issues because un-coordinated actions by individuals, communities, and businesses create negative environmental externalities – the social costs of their actions on natural resources. Cooperation is intended to mitigate these externalities. Governments make rules and institutions to encourage mutual policy changes that lower the externalities. To the extent that governments can cooperate on mitigating externalities, they can preserve a natural resource such as the global atmosphere or regional water quality. Cooperation enables governments to encourage the sustainable consumption of natural resources so that they do not expose populations to externalities and do not succumb to the tragedy of the commons.

The form of cooperation is significant because it is linked to the extent of environmental protection. Examples of integrated global cooperation on atmospheric issues or the marine environment illustrate that integrated international rules and institutions are generally more effective in mitigating externalities than un-integrated global cooperation. At local levels, integrated cooperation on water basins is often associated with more rules and institutions covering a larger portion of the water basin. The effectiveness of international environmental cooperation implies a counterfactual: how environmental conditions would have been different in the absence of rules or institutions in place to manage the problem (Ringquist and
Kostadinova 2005). However, it is widely believed that the form of cooperation and the extent to which governments mitigate the problem and protect the environment are correlated. Namely, *integrated cooperation is associated with deeper cooperation and more environmental protection than un-integrated cooperation.*

Underlying this dissertation is the notion that un-integrated cooperation reflects barriers to integrated cooperation. It is a response to those barriers. As the history of international climate change governance illustrates, some governments would prefer integrated cooperation because it is widely viewed as more effective than un-integrated cooperation involving rules and institutions of varying (and possibly questionable) effectiveness. Un-integrated cooperation reflects government efforts to make rules or institutions when barriers to integrated cooperation make that approach to international cooperation politically infeasible or ineffective from a regulatory standpoint. Un-integrated cooperation is a response to those constraints. Without efforts to form un-integrated cooperation in the face of political obstacles or governance limitations, the landscape of cooperation would have fewer rules and institutions.

Un-integrated cooperation represents the addition of rules or institutions that would probably not exist – least not with the same impact – if governments only ever sought to pursue integrated cooperation no matter the obstacles. In climate change governance, attempting to make rules and institutions outside the UNFCCC has enabled governments to make legal agreements and non-binding voluntary measures that obstacles inside the UNFCCC have long blocked (Keohane and Victor 2011, Victor 2011). In managing the Danube River Basin, making bilateral or sub-basin commissions has enabled governments to make projects or settle disputes that lacked basin-wide relevance. In these and similar cases, pursuing integrated cooperation on the whole issue would not have been feasible and would not have proven productive.
Recognizing the value of un-integrated cooperation, governments have made integrated rules and institutions where feasible but have settled for un-integrated rules and institutions where realistic. A long history of research shows that the prospect of joint gains gives governments an incentive to make rules and institutions (Simmons and Martin 1998). This dissertation seeks to explain the barriers to integrating those rules or institutions on the environment and how governments craft international responses to those barriers.

Moreover, international cooperation on global environmental issues is tailored to stakeholder concentrations. The capacity of stakeholders to create new technologies and diffuse them affects to extent to which national preferences converge over the terms of cooperation. More technological innovation and more diffusion of technologies lower the burden on governments to pay the costs of mitigation. When stakeholders have the capacity and incentives to innovate, they encourage integrated cooperation. Governments find this particularly important from a political standpoint. It enables them to rely on businesses to effectively solve the pollution problem without investing significantly with public resources in the solutions. These desirable conditions are common when stakeholders operate in economic markets involving concentrated suppliers and producers, with consumers operating in diverse and narrow markets. They are not common in other market conditions, particularly when the upstream producer markets are diffuse.

Stakeholder concentrations shape the investments needed from governments to reduce environmental externalities because they make more regulation necessary in some circumstances but not others. When stakeholders are economically concentrated, providing markets for innovation to capital-intensive producers with high information and technical capacities make intrusive and costly policies unnecessary. When stakeholders do not possess these characteristics
and policies cannot generate reliable markets for innovation, costly policies and greater
regulation are essential for making progress in mitigating the environmental problem.

*Stakeholder concentrations affect how much governments must invest in mitigation and how
much they can rely on businesses to make those investments for them.*

To the extent that diffuse stakeholders make cost-effective and integrated cooperation
unlikely, this places greater burden on national governments to craft tailored international
policies. Since relying on stakeholders to solve the environmental problem by creating
appropriate incentives is costlier when the stakeholders are diffuse, governments shoulder a
comparatively higher burden in tackling these problems. And since governments are reluctant to
waste public resources on ineffective international regulation, the diffuseness of stakeholders
places a higher burden to tailor international policies and institutions to the information,
technical capacities, and economic opportunities of stakeholders. Governments should not seek
to apply pre-established templates when stakeholders are diffuse, as they can more safely do
when stakeholders are concentrated.

Finally, applying the view that broad cooperation is incompatible with deep cooperation
can be self-defeating in international environmental cooperation. Economic actors are reluctant
to accept new regulations if their competitors overseas do not accept similar regulations. Only
when they know foreign competitors will face similar standards can these competitiveness
concerns dissipate. If governments apply the view that deeper cooperation requires narrower
membership in cooperation, this may undo efforts at deeper cooperation by raising
competitiveness concerns in domestic industries. Far from preferring narrower membership,
domestic industries prefer broader membership to harmonize regulations and standards across all
markets in which they operate (DeSombre 2000b). Pursuing narrow cooperation to ensure its
depth can generate incentives for states to do exactly the opposite: they would have incentives to refuse or abrogate responsibilities because of competiveness imbalances created by narrow participation.

Applying the view that broad cooperation is incompatible with deep cooperation can be self-defeating not only because of domestic pressures to harmonize standards across competitors but also because it limits the environmental effectiveness of response measures. Limiting involvement in cooperation to a narrow group constrains the environmental effectiveness of any responses measures the narrow membership establishes. It not only raises competitiveness concerns but also caps the environmental effectiveness of collective efforts to mitigate the problem. To the extent that narrowing the breadth of cooperation is a strategy for pursuing deeper cooperation, it may prove ineffective. It may reduce the capacity of states to reduce the environmental externalities by narrowing the breadth of participants while leaving some that contribute to the externalities out of participation. This in turn can reduce the inclination of governments to undertake costly measures – not only because that would expose domestic industries to competitive disadvantages but also because it would have limited effectiveness, calling into question the environmental value of narrow cooperation.

1.10 Significance for Theory

This dissertation makes a contribution to research on international organization by analyzing the development of integrated and un-integrated international environmental cooperation. A growing number of studies on international relations focus on the emergence and dynamics of “regime complexes,” “polycentric governance,” “overlapping institutions,”
“fragmented governance,” or related terms (Raustiala and Victor 2004, Alter and Meunier 2009, Beirmann et al. 2009, Ostrom 2010, Keohane and Victor 2011, Abbott 2013). I avoid using these terms to define the problem motivating this dissertation because they are subject to conceptual stretching and may complicate more than clarify analytical efforts from time to time.

The proliferation of terms to characterize un-integrated international cooperation highlights the growing interest in this form of cooperation. Perhaps not ironically, concept proliferation in the literature matches institutional proliferation in the empirical domain of that literature. More research has begun to explore the evolution of international environmental cooperation, addressing questions of integrated and un-integrated development in a variety of regimes (Young 2010, Johnson and Urpelainen 2012). Despite these advances, several questions remain on the differential pathways of international environmental cooperation. This dissertation contributes to the growing literature by clarifying when governments make varying forms of international cooperation, focusing on the natural environment.

In particular, the un-integrated development of international environmental cooperation raises a puzzle. Why do governments make integrated international cooperation on some environmental issues but make un-integrated cooperation on other environmental issues? Why don’t they harness the efficiency potential of integrated cooperation across all environmental issues? This puzzle parallels debates on emerging patterns in the global trade regime (Mansfield and Reinhardt 2003), the nuclear non-proliferation regime (Verdier 2008), and international law (Koskenniemi and Leino 2002). Focusing specifically on international environmental affairs, this dissertation engages this general puzzle.

Efficient international cooperation requires favorable conditions. In international environmental affairs, efficient cooperation entails relying on rules and institutions as a platform
for furthering cooperation. On issues such as climate change and biodiversity, integrated cooperation cannot lower transaction costs. Stakeholders are too economically diffuse to enable governments to harness a single international regime to govern these issues. Stakeholder diffuseness is a constraint on lower transaction costs and efficiency gains within a single international environmental regime. On issues with strong upstream-downstream properties, integrated cooperation is also unlikely. Asymmetrical interdependence is a constraint on having integrated rules and institutions for managing these issues. This dissertation explains the conditions favorable and unfavorable to lowering transaction costs and harnessing the efficiency potential of international environmental rules and institutions.
CHAPTER TWO

Explaining the Form of International Environmental Cooperation

2.1 Introduction

Governments cooperate on the natural environment because economic activities by nationals of one country limit or degrade a natural resource for nationals of another country. Their “externalities” are borne in other parts of the world. By producing externalities, individuals, communities, and businesses create an incentive for coordinated action by national governments. In the absence of scientific evidence for transboundary externalities, governments are reluctant to invest in international environmental cooperation (Dimitrov 2006). They have an interest in cooperation when their populations are vulnerable to externalities (Sprinz and Vaahtoranta 1994). The goal of environmental cooperation is to promote mutual adjustments that preserve or sustain a natural resource. Cooperation enables governments to avoid the “tragedy of the commons,” illustrated by the history of harvesting North Pacific Fur Seals (Barrett 2003).

International environmental cooperation occurs with rules and institutions that provide information-rich contracting environments for national governments (Haas, Keohane, and Levy 1993). Institutions and rules reduce uncertainty over current and future national policies and policy outputs. By reducing uncertainties, institutions and rules lower the transaction costs associated with adopting costly policies. National governments make international agreements to create this contracting environment. International environmental agreements have varying degrees of legalization and institutionalization. Governments cannot rely on third parties to enforce environmental agreements, requiring that they become self-enforcing (Barrett 1994).
In this chapter, I theorize when governments tend to make integrated and un-integrated international cooperation. First, I elaborate why and how states cooperate on the natural environment. What are their incentives and when do those incentives prompt new international rules and institutions? Second, I outline the consequences of variation in national preferences over international environmental cooperation. National preferences are critical in the form of cooperation that emerges. I argue that convergent preferences encourage integrated cooperation; divergent preferences encourage un-integrated cooperation. Third, I explain the sources of convergent and divergent preferences. By elaborating why preferences converge or diverge over cooperation, my arguments avoid taking preferences as given in hypothesizing on patterns of international cooperation (Moravcsik 1997).

Explaining preference convergence and divergence is the analytical core of my arguments. I outline the antecedent sources of national interests over international cooperation across environmental issues. The distribution of preferences is understood as a critical source of variation in the form of international cooperation in a diverse range of policy fields (Kranser 1991, Moravcsik 1998, Ikenberry 2001). I elaborate why preferences diverge or converge across environment issues to explain international cooperation patterns. My explanations focus on sub-national actors – what I call “stakeholders” – and national-level characteristics. In that respect, they specify national and sub-national sources of variation in national preferences.

I elaborate the importance of stakeholder concentrations in the distribution of national preferences over cooperation. This is the primary theoretical contribution of the dissertation. It specifies how stakeholders affect the course of international environmental cooperation beyond their lobbying efforts. Stakeholder concentrations matter.
By stakeholders, I refer to the individuals, communities, and businesses whose economic activities contribute externalities. *Stakeholder concentrations* refer to the markets in which stakeholders operate. Concentrated stakeholders operate in markets with relatively few suppliers or producers at upstream portions of the supply chain. They may also have heterogeneous and narrow consumer bases at downstream portions of the supply chain. By contrast, diffuse stakeholders operate in markets with homogeneous and large consumer bases. They may also have relatively many producers and suppliers at upstream portions of the supply chain.

When stakeholders operate in concentrated markets, governments are more likely to find opportunities to form integrated cooperation that lowers transaction costs and the economic costs of regulation. Their preferences on the rules and institutions of cooperation converge. Top-down strategies of regulation can succeed in achieving policy goals. Governments form integrated cooperation. When stakeholders operate in diffuse markets, governments are less likely to find opportunities to form integrated cooperation that lowers transaction costs and the economic costs of regulation. Their preferences on the rules and institutions of cooperation diverge. Top-down strategies of regulation cannot succeed in achieving policy goals. Governments pursue un-integrated cooperation.

I also elaborate the importance of interdependence structures in the distribution of national preferences. This explanation extends theories of international organization to the field of international environmental affairs (e.g., Mitchell and Keilbach 2001). It represents an application of core theory to the environmental field.

Interdependence refers to the mutual exposure of nationals from one country to the externalities of nationals in another country. By interdependence structure, I refer to the distribution of this exposure between different countries. An asymmetric structure implies that
some countries are not as exposed to externalities as they expose others. A symmetric structure implies that countries expose each other to externalities to relatively similar extents. When interdependence structures are symmetric, governments find a common interest in cooperation and they tend to form integrated cooperation. When interdependence structures are asymmetric, they do not share a common stake in cooperation. They are more likely to form un-integrated cooperation.

Figure 2.1 summarizes my explanations for variation in the form of international environmental cooperation. Integrated cooperation occurs when national preferences over cooperation converge because countries are symmetrically interdependent in managing the environmental issue or stakeholders operate in concentrated markets. Un-integrated cooperation occurs when national preferences diverge because countries are asymmetrically interdependent in managing the environmental issue or stakeholders operate in diffuse markets. Stakeholder concentrations and interdependence structures are treated as independent explanatory variables, not co-dependent variables, in the explanations.

![Diagram of Concentrated and Diffuse Stakeholders and Interdependence Structures]

**Fig. 2.1 Summary of Explanations for the Form of International Environmental Cooperation**

**2.2 Why and How Do States Cooperate on the Environment?**
International environmental cooperation is costly. Governments must invest in cooperation with national resources. Maintaining international institutions requires financing that comes from public budgets. They also require bureaucratic resources: individuals from national governments include those rules and institutions in their policy portfolios. Maintaining institutions may also demand political investments to the extent that environmental regulation is a political issue in domestic and international politics. Financially, bureaucratically, and politically, international environmental cooperation is an investment by multiple national governments that have limited budgets and resources in all three dimensions.

Governments are willing to make investments in international environmental cooperation only if they mutually recognize individual gains that outweigh individual investments (Barrett 2003). Ordinarily, they would prefer to handle environmental externalities with domestic policies and regulations because domestic adjustments do not require negotiations and investments in international cooperation. International cooperation entails a category of investments that domestic regulation does not entail.

However, for transboundary environmental externalities, governments are unable to simply rely on domestic regulation. They must coordinate or cooperate with other national governments representing individuals, communities, or businesses that generate externalities. Governments invest in international institutions and rules for environmental cooperation because unilateral adjustments are not sufficient for environmental recovery. Governments must make mutual adjustments credible and sustainable to secure individual improvements and avoid socially undesirable outcomes.
International rules and institutions are the tools by which governments make commitments on cooperation credible and sustained (Keohane 1984). International rules and institutions on the natural environment are often established under international agreements that codify terms and establish property rights (Barrett 2003). International environmental agreements are mechanisms of collective action on environmental regulation because they reduce uncertainty and lower the transaction costs of adopting and implementing costly regulations (Haas, Keohane, and Levy 1993). The decision to make an international environmental agreement is an investment by national governments. The growth of these agreements corresponds to the growth of international environmental cooperation, representing sustained investments in joint gains (Mitchell 2002-2013).

2.3 International Consequences of Variation in National Preferences

The distribution of national preferences over international environmental cooperation matters: it shapes the prospects of cooperation. The more governments have divergent preferences, the less they prefer rules and institutions in common. In general, when states discount future gains from cooperation at varying rates, those who discount the most are inclined to translate the asymmetry of preferences into bargaining leverage. This can contribute to delayed settlements (Fearon 1998). However, when a natural resource can be depleted over time, too much patience may detract from bargaining leverage. It may mean that the party will have less to gain in future negotiations after the resource is depleted (Barkin 2004). When some states have substitutable natural resources, their access to substitutable resources is a source of
bargaining leverage (Barkin and DeSombre 2000). They would lose less if the resource were depleted. Substitutability can affect the prospects of cooperation, just as lower discount rates.

The distribution of national preferences over international environmental cooperation also shapes the terms of cooperation. States with a lower discount rate are inclined to secure an opt-out clause in case their preferences change and they no longer want to follow the agreement. A state with a lower discount rate than others would have credibility in using an opt-out clause (Barkin 2004). The lower discount rate is tantamount to a credible “outside option” relative to the agreement in place (Voeten 2001, Slapin 2009, Stone 2011). These preference distributions can lead to a favorable allocation of property rights (Asgeirsdottir 2007). The weakness of agreements may also reflect the preferences of powerful states that seek to avoid binding constraints on their consumption of a natural resource.

When preferences converge, environmental cooperation often assumes a symmetrical form. In her analysis of local common-pool resources (CPRs), Elinor Ostrom found that when individuals in a community shared similar long-term perspectives on a CPR, they would make self-enforcing rules and institutions common to those who exploit the resource for personal use or profit (Ostrom 1990). The limitations on consumption or degradation applied to all on similar terms with similar “contractual” or regulatory application. The monitoring and enforcement institutions applied to all users and on similar terms.

At the international level, convergent preferences over resource consumption also encourage cooperation involving symmetrical distributive terms. Along rivers that separate two states, cooperation involves reciprocity (Dinar 2008). States that have a shared interest in cooperation do not possess differential bargaining leverage. They do not possess differential incentives. Their common stake in cooperation gives them each similar incentives. In the event
they decide to cooperate, they can achieve deeper cooperation more efficiently and cost-effectively by creating integrated rules and institutions.

When preferences diverge, environmental cooperation is not in the common interest of parties affecting the environmental conditions. Some governments may prefer deeper cooperation with more costly regulations than other governments. They possess different incentives: some seek environmental regulations binding states under a common set of rules but others prefer to avoid accepting such rules. Governments are unable to accept a common set of rules and institutions to add further regulations on an environmental issue. Some may prefer deeper cooperation and different policies than their counterparts, prompting un-integrated cooperation. Preference disparities have prompted un-integrated global energy governance over 40 years (Colgan, Keohane, and Van de Graaf 2012). Instead of forming integrated institutions and rules, governments make un-integrated ones that have differential implications and involve differential obligations on parties.

2.4 Source of Preference Variation: Stakeholder Concentrations

Stakeholders are important sources of national preferences over international environmental cooperation in part because they influence governments in selecting policies (DeSombre 2000, Falkner 2008). Environmental regulation imposes costs on businesses that, to varying extents, shape the positions of national governments in international negotiations (Meckling 2011). This is true of global issues such as climate change (Newell 2000) and local issues such as fisheries (Asgeirsdottir 2007). The political economy of environmental policy is often analyzed much like the political economy of trade or financial regulation. Studies in each
domain focus on competing interests seeking to influence policy decisions (Grossman and Helpman 2001, Falkner 2008). Direct efforts to influence policy choices are clearly an important mechanism by which stakeholders affect international environmental cooperation.

I advance a different explanation of how stakeholders affect international environmental cooperation. Stakeholders are critically important to the negotiation of international environmental cooperation because governments must alter stakeholder behavior to mitigate the externalities. Stakeholders are the subject of international rules and institutions because governments seek to alter their incentives. To the extent that stakeholders possess characteristics that make it costly for governments to implement regulations to mitigate the externalities, they influence the form of international environmental cooperation by creating constraints on what governments can achieve cost-effectively. Stakeholders not only seek to directly influence the outcomes of negotiated settlements, but they also impose constraints on the costliness and feasibility of integrated international environmental cooperation. Those constraints vary across environmental issues and they shape the international regulatory choices of national governments.

STAKEHOLDER CONCENTRATIONS. Stakeholders in concentrated markets have several characteristics that distinguish them from stakeholders in diffuse markets. The main difference is in upstream portions of the supply chain. In concentrated markets, there are relatively few producers and suppliers. In economic terminology, they operate in an oligopolistic market. Individually, their actions have consequences in the market. Withholding supply has downstream consequences. Expanding supply has downstream consequences. In diffuse markets, by contrast, there are many producers and suppliers. In economic terminology, they operate in markets of perfect competition. Individually, their actions have minimal consequences in the
market. Withholding supply has minimal downstream consequences. Expanding supply has minimal downstream consequences.

A secondary difference between stakeholders in concentrated markets and those in diffuse markets is in the downstream consumer base. At downstream portions of concentrated markets, the consumer base operates in heterogeneous markets of narrow size. They have different preferences over products. Products are not readily substitutable. Prices are not marked down to the costs of supply. By contrast, at downstream portions of diffuse markets, the consumer base operates in homogeneous markets of large size. They have similar preferences over products. Products are readily substitutable. Prices are marked down to near the costs of supply.

MITIGATION COSTS. Concentrated stakeholders are able to lower the costs of reducing environmental externalities without confronting prohibitively high economic losses. In concentrated producer markets, the producers and suppliers possess financial and human capital enabling technical innovations. If downstream consumer markets are diversified, upstream producers can differentiate products and sell to narrow markets consisting of consumers with differentiated preferences. Environmental regulations in place to reduce pollution in these circumstances induce technological innovations: upstream producers have the capacity to innovate and downstream consumers provide them an incentive to innovate and diffuse innovations. The conditions are ripe for innovation. *The economic costs of mitigation decline over time.*

Diffuse stakeholders are not able to lower the costs of reducing environmental externalities because they confront prohibitively high economic losses. In diffuse producer markets, producers and suppliers are similar and have limited resources or capacities that
differentiate them from competitors. There are many producers and the barriers to entry are few because the capital resources needed for entry are minor compared to concentrated producer markets. Their capacity to innovate and diffuse innovations is limited. If downstream consumer markets are homogeneous and large, the consumer base can readily substitute without much value loss if prices rise. Consumers are price sensitive: they are willing to source from another supplier if the price changes. This gives upstream producers reason not to increase prices – even if for the purposes of financing innovations or their diffusion. Innovation is stagnant. The economic costs of mitigation do not decline over time.

Concentrated stakeholders are able to localize the economic costs of mitigation to specific consumer bases with the capacity or willingness to absorb price increases. Heterogeneous markets with narrow consumer bases give producers and suppliers the opportunity to target innovations that may be costly but that certain downstream markets are willing to accept in meeting environmental regulations or because they have heterogeneous consumer preferences over product characteristics. The costs of meeting environmental regulations can be localized to these markets, which may even be confined to specific portions of a wider consumer base.

Diffuse stakeholders are not able to localize the economic costs of mitigation. The costs of mitigation are generalized because products are similar and consumers are price sensitive. Regulations that require environmental externalities to decline generate pressure on upstream suppliers and producers to meet new standards. Since they are either unable to innovate or unwilling to innovate because of downstream market conditions, the regulations are costly to implement. The consumer base is diffuse and the inability to innovate while lowering the costs of mitigation means prices rise across a diffuse consumer base. Consumers cannot turn to
alternatives since the regulations imply new standards across the suppliers and producers and those upstream actors cannot readily reduce the costs of innovations to meet new environmental standards. The costs of meeting new standards are passed along to wide consumer bases and the mitigation costs are not localized to narrow markets.

Table 2.1 summarizes the hypothesized relationship between stakeholders, innovation and diffusion prospects, and mitigation costs. When stakeholders are in concentrated markets, mitigation costs either decline with innovations or remain localized to narrow markets. When stakeholders are in diffuse markets, mitigation costs persist and have diffuse properties.

**Table 2.1 Stakeholders, Innovation and Diffusion Prospects, and Mitigation Costs**

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Innovation and Diffusion Prospects</th>
<th>Mitigation Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated markets</td>
<td>Potential for innovation and diffusion</td>
<td>Mitigation costs decline or remain localized</td>
</tr>
<tr>
<td>Diffuse markets</td>
<td>Obstacles to innovation and diffusion</td>
<td>Mitigation costs persist and are diffuse</td>
</tr>
</tbody>
</table>

REGULATORY CHALLENGES. Concentrated stakeholders present a different set of regulatory challenges than diffuse stakeholders. When markets are concentrated and stakeholders have human and financial capital resources, they require relatively similar adjustments to meet new environmental standards. Regulations can create similar incentives across stakeholders in either the upstream or downstream segments of concentrated markets. Once regulations are in place, producers and suppliers can innovate and diffuse technologies in markets where demand for innovations has risen following the adoption of regulations. Since the upstream producers possess financial and human capital resources for producing innovations and diffusing them, new international regulations can galvanize them to diffuse innovations, to the extent the regulations
provide new markets for these producers. This diffusion process reduces environmental externalities as the innovations spread through downstream consumer markets.

The regulations need not be tailored to meet particular circumstances because the upstream producers will tailor innovations on their own to meet downstream market demand. The regulations need only provide for those markets. Rather than scaling up regulations, governments can create general standards for these markets that stakeholders adapt to through innovation and diffusion. In other words, general standards can achieve policy goals of reducing environmental externalities when stakeholders are in concentrated markets. Governments can set general standards from the “top-down” – that is, they can set international regulations that encourage concentrated producers at the top to innovate and diffuse innovations downward. This enables governments to secure policy goals of reducing the environmental externalities without needing to tailor policy instruments to specific circumstances. By giving capable producers and suppliers the markets they need, governments can rely on the private sector and stakeholders to do the mitigation work with investments and technical adaptations.

When stakeholders are in diffuse markets, governments cannot rely on “top-down” strategies of policy implementation. They cannot rely on upstream producers and suppliers to meet market demand for innovations because diffuse upstream suppliers may lack the human or financial capital resources necessary to innovate. They cannot rely on new regulations to create sufficiently large and reliable demand for innovations downstream, which dis-incentivizes innovation upstream in the supply chain. Governments face a complicated challenge because a coherent singular set of international policies cannot induce stakeholders to do the mitigation work. Mitigating the environmental externalities requires more policies tailored to specific groups of stakeholders.
In particular, diffuse stakeholders may possess specific characteristics that differentiate them from others, which means top-down strategies cannot be tailored enough to alter their incentives and actions. Instead, strategies for altering incentives and capacities in markets with diffuse stakeholders are more likely to be effective in reducing environmental externalities when they meet the demands of specific economic actors at local levels. General regulations that can incentivize mitigation when stakeholders are concentrated cannot achieve similar success when stakeholders are diffuse. Strategies that focus on local scales and scale-up based on experiences in specific portions of the diffuse stakeholders are more likely to reduce environmental externalities. In the absence of viable top-down strategies, bottom-up strategies become comparatively attractive approaches to reducing environmental externalities when stakeholders are in diffuse markets. But bottom-up strategies are costlier to implement than top-down ones. The improvements are marginal and context-specific.

Table 2.2 summarizes the hypothesized relationship between stakeholders, regulatory challenges, and the relative effectiveness of regulations. When stakeholders are in concentrated markets, governments can create general regulations that incentivize stakeholders to mitigate externalities. Top-down strategies are viable and effective. General regulations can incentivize innovations at the top, which then diffuse downward. When stakeholders are in diffuse markets, however, governments must harmonize practices or technologies across local actors with different information and limited capacities or incentives to make adjustments. They also need additional support or incentives to make adjustments. Top-down strategies are comparatively ineffective because of incapacities and dis-incentives among stakeholders. Bottom-up strategies tailored to specific economic actors are more viable in reducing environmental externalities, even though governments would prefer a top-down strategy.
Table 2.2 Stakeholders, Regulatory Challenges, and the Relative Effectiveness of Strategies

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Regulatory Challenges</th>
<th>Relative Effectiveness of Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated markets</td>
<td>Innovating and diffusing new practices, procedures, or technologies among international and national actors</td>
<td>Top-down regulatory strategies can achieve policy objectives at declining or localized costs</td>
</tr>
<tr>
<td>Diffuse markets</td>
<td>Harmonizing practices or technologies across local actors with narrow information, capacities, and incentives</td>
<td>Top-down regulatory strategies are ineffective; only bottom-up strategies can feasibly reduce externalities</td>
</tr>
</tbody>
</table>

NATIONAL PREFERENCES. Stakeholder conditions affect government preferences over international environmental cooperation because they affect the costs of reducing environmental externalities to the public and to governments themselves. Fundamentally, when stakeholders are in concentrated markets, government preferences will converge over international environmental cooperation because they will be able to lower mitigation costs and develop efficient top-down strategies. When stakeholders are in diffuse markets, however, government preferences will diverge over international environmental cooperation because they will not be able to lower mitigation costs and will need to develop costly bottom-up strategies. Concentrated stakeholders will enable governments to agree more on international rules and institutions to reduce environmental externalities than when stakeholders are diffuse. Stakeholder characteristics will filter into the politics of international environmental cooperation.

By enabling mitigation costs to decline or remain localized, concentrated stakeholders encourage preferences to converge over environmental cooperation because governments can rely on stakeholders to assume a share of the implementation costs by providing markets for innovation and incentivizing adjustment to new practices and technologies. Governments see
their own costs of implementing the regulations decline. Governments need not finance implementation entirely; the stakeholders share much of the financing burden because regulations incentivize the creation of markets for upstream producers and suppliers and adjustments for downstream consumers. In negotiating settlements, governments need not negotiate over sums of money as high as they otherwise would be if stakeholders were diffuse because mitigation costs decline or remain localized and because stakeholders assume a share of the cost. Financing implementation is a source of disagreement between national governments. Governments generally prefer to give less rather than more money for other countries to implement policies. Governments essentially have a smaller sum of money to disagree over when stakeholders are concentrated, reducing the financial costs of environmental cooperation for governments. They have less public money at stake, which translates into a more manageable distributive problem than when more public money is needed for reducing externalities.

Concentrated stakeholders minimize the financial burden of cooperation on governments in part because top-down strategies of reducing environmental externalities are less expensive to implement than bottom-up strategies. Setting general regulations that apply to all stakeholders to reduce environmental externalities entails less of a burden on national governments to create rules and institutions tailored to specific groups of stakeholders. Top-down strategies better enable governments to economize on the transaction costs and implementation costs of reducing environmental externalities by enabling them to create an integrated set of rules and institutions for all stakeholders contributing to a specific environmental problem. This further makes preference convergence more likely by reducing the burden on national governments to create tailored rules and institutions on specific portions of the stakeholders contributing environmental
externalities. Instead, governments can settle the main issues needed to reduce externalities through generalized top-down strategies.

However, when stakeholders are in diffuse markets, mitigation costs remain high, persist over time, and have diffuse properties. This means governments cannot shift much of the mitigation cost burden onto stakeholders because they lack the capacities or incentives to innovate on a large scale, diffuse innovations cost-effectively, and require more tailored incentives and opportunities. This means governments cannot reliably shift a large share of the implementation cost burden on stakeholders to make investments that reduce environmental externalities. Governments shoulder some of the financial burden. And since diffuse stakeholders are unable to cost-effectively reduce mitigation costs, the financial burden on governments remains high and persists over time. This gives governments more to disagree over in the course of negotiating the terms of cooperation. Financing implementation of new environmental regulations entails a higher share of the burden on governments themselves and a higher total cost for implementing changes and reforms to reduce externalities. Consequently, the sum of financing needed to reduce externalities is greater when stakeholders are diffuse and governments find they are unable to shift the financing burden to stakeholders, pitting them in distributive problems. The financial stakes of cooperation are higher for the governments themselves. This generates a more intense distributive problem. National preferences diverge.

Moreover, the ineffectiveness of forming cost-effective general regulations when stakeholders are diffuse requires governments to have more negotiations and more policy instruments targeting specific economic actors to reduce environmental externalities. The regulatory challenge is not only expensive for governments but also requires more attention to tailored policies and bottom-up approaches to reducing externalities. Top-down strategies that
economize on transaction costs enable governments to form efficient international cooperation. Diffuse stakeholders make this option infeasible and impractical, requiring more negotiations, more tailored policies, and more diplomatic engagement on the issue. The opportunities for disagreement grow and governments must work hard to avoid zero-sum disputes over implementation costs, financing, and obligations in tailoring specific regulations.

FORMS OF COOPERATION. Varying forms of cooperation follow from these national preference distributions. Governments are inclined to make integrated rules and institutions when stakeholders are concentrated; they are inclined to make un-integrated rules and institutions when stakeholders are diffuse. Preference convergence will enable governments to economize on the transaction costs of international environmental cooperation when stakeholders can lower mitigation costs, diffuse technologies, encourage general top-down strategies, and assume some of the implementation costs. These conditions favorable to integrated cooperation are more likely when stakeholders operate in concentrated markets than when they operate in diffuse markets.

Integrated cooperation enables governments to create a corpus of rules and institutions that harness the capacities of stakeholders and provide them with incentives to reduce environmental externalities. Un-integrated cooperation represents a reaction to obstacles inhibiting governments from relying on stakeholders to reduce externalities because of dis-incentives to innovate, diffuse innovations, and make adjustments in practices or procedures. Integrated cooperation follows from the convergence that emerges when stakeholders have the capacity to reduce environmental externalities but require the right incentives to do so. Un-integrated cooperation follows from the divergence that occurs when governments struggle with financing much of the implementation and cannot establish rules and institutions that economize
on transaction costs. Integrated cooperation relies on stakeholders; un-integrated cooperation reacts to stakeholders.

INITIAL SETTLEMENT, SUBSEQUENT IMPLEMENTATION. This argument may seem counter-intuitive. A long history of research in political science shows that concentrated groups are better able to lobby and secure preferable settlements than diffuse groups. Concentrated groups can pool resources and expose diffuse groups to the negative consequences of policy choices (Lowi 1964). Diffuse groups suffer from free-rider problems and cannot prevent these negative consequences by counter-balancing the political efforts of concentrated groups (Olson 1965). Yet the stakeholder concentrations argument suggests that concentrated stakeholders are associated with integrated cooperation, which generally involves deeper rules and institutions on a specific environmental issue. Diffuse stakeholders may seem to enjoy the benefits of their diffuseness by encouraging un-integrated cooperation, which sometimes entails weaker provisions and regulations and more opportunities to shirk responsibilities. How does the stakeholder concentrations argument reconcile with this irony?

Indeed, concentrated stakeholders should be able to lobby more effectively and should mount greater political pressure than diffuse stakeholders. This should prompt governments to scale down the requirements imposed on those stakeholders. In that respect, the stakeholder concentrations argument is consistent with the literature on concentrated groups in American politics. However, once these groups are able to narrow the scope of regulations they face, governments can harness the concentration of stakeholders in the course of international environmental cooperation. After cooperation begins, although it may have narrowed in scope because of lobbying efforts, the concentration of stakeholders enables governments to implement regulations and provide the conditions that favor integrated cooperation. In that respect,
concentration enables stakeholders to narrow regulations but also enables them to cost-effectively implement regulations that survive the lobbying process. Diffuseness may leave stakeholders unable to lobby effectively but it also means that general obligations adopted by national governments cannot be implemented cost-effectively. Consequently, the concentration of stakeholders leads to narrow obligations that can be cost-effectively implemented through integrated cooperation, while the diffuseness of stakeholders leads to broad obligations that cannot be cost-effectively implemented and prompt un-integrated cooperation.

HYPOTHESIS. This explanation of how stakeholder concentrations affect national preferences, thereby affecting the form of international environmental cooperation, suggests a hypothesis.

*Stakeholder Concentrations Hypothesis*: When stakeholders are in concentrated markets, governments form integrated international environmental cooperation. When stakeholders are in diffuse markets, governments form un-integrated international environmental cooperation.

2.5 Source of Preference Variation: Interdependence Structures

Natural resources have two characteristics that make individuals, communities, and countries interdependent. First, they cannot privatize the resource by restricting access; others can also access the resource. And second, use or exploitation of the resource brings depletion; the status of the resource changes after use. These characteristics make parties who use the resource interdependent because they rely on each other for sustaining and preserving their own access to the resource in a particular state. Interdependence in managing the resource is why individuals, communities, and governments make rules and institutions for collective
management. The rules and institutions are intended to create a system for managing interdependence to sustain the resource (Ostrom 1990).

Although interdependence implies they share a natural resource, individuals, communities, or countries may have symmetrical or asymmetrical interdependence relationships in managing the resource. They may each rely on each other to relatively similar extents in managing a resource. In other words, they may share *symmetrical interdependence* over the resource. Alternatively, some actors may rely on their counterparts to a greater extent than the counterparts rely on them in managing the resource. That is, they may have *asymmetrical interdependence* over the resource.

The structure of interdependence in managing a natural resource strongly shapes the preferences of individual parties over cooperating on sustainable management. Privileged access means that privileged parties have relatively little to lose from other’s consumption of the resource; others have much more to lose from consumption by the privileged parties. For these privileged parties, collective management is relatively unimportant for sustaining their own access to the resource in a desired state. When actors do not have privileged access – when they share similar access – they each lose evenly from others’ consumption of the resource. For these evenly situated actors, collective management is relatively important for sustaining their individual access to the resource in a desired state.

At the international level, interdependence structures are country-level characteristics of an environmental issue. Symmetrical interdependence has similar properties at the international level as it has at individual or community levels, although the level of aggregation is higher. The nationals of one country rely on the nationals of another country for access to an environmental condition or natural resource to a relatively similar extent as the nationals of the other country
rely on them. Asymmetrical interdependence also has similar properties at the international level as it has at the individual or community level, albeit it a higher level of aggregation. The nationals of one country enjoy privileged access and other nationals from a different country rely on them for their access to the resource in a desired state.

Interdependence structures encourage varying national preferences over international environmental cooperation. By giving governments a common stake in collective resource management, symmetrical interdependence between countries encourages similar preferences over cooperation. By giving some governments a greater or different stake in collective management than other governments, asymmetrical interdependence between countries encourages some to prefer cooperation to a greater extent than others. International cooperation patterns follow from the incentives generated by varying interdependence structures.

Interdependence structures have long been a subject of theoretical and empirical research on international cooperation (Keohane and Nye 2012). Interdependence structures are not strictly limited to environmental issues. They are general conditions in international relations that span multiple policy spaces. Interdependence structures are critical in several areas of international political economy (e.g., Conybeare 1987, Martin 1992, Andrews 2006). They are also critical in international security strategy (e.g., Schelling 1960, Ikenberry 2001). Transboundary environmental issues are one of the many policy spaces where interdependence structures are critical sources of variation in international cooperation (Barkin and Shambaugh 1999).

I apply interdependence theory to explain when governments tend to make integrated and un-integrated international environment cooperation. Specifically, I argue that interdependence structures explain two specific dimensions of international environmental cooperation: (i) the
form of cooperation and (ii) the breadth of cooperation. Applying interdependence theories to the study of international environmental cooperation is an extension of existing ideas to explain a puzzle in specific policy areas. My interdependence structures explanation for the form of international environmental cooperation takes countries as the unit of analysis, not sub-national actors, as in the stakeholder concentrations explanation. In that respect, it differs from the stakeholder concentrations explanation.

INTERDEPENDENCE STRUCTURES AND PREFERENCES. Interdependence shapes preferences over cooperation by giving states with control over an environmental issue a stake in mutual adjustment. The structure of interdependence shapes the relative significance of that stake across states. Symmetrical interdependence gives states a similar stake in cooperation because that would encourage reciprocal resource management to sustain the resource for each state’s nationals. Their nationals are exposed to the externalities of other countries’ nationals – and this characterizes the exposure of all states with control over the natural resource. Asymmetrical interdependence does not provide incentives for cooperation across states to the same extent. Some states have a lower stake in cooperation: their nationals are not nearly as exposed to the externalities from other countries’ nationals as those nationals are exposed to their externalities. These unexposed states are reluctant to make adjustments that entail changing practices or new investments. Other states, by contrast, would seek to have them adopt new practices and reduce their externalities.

The link between exposure to negative externalities and preferences over international cooperation has been elaborated in the literature on problem structures. Ronald Mitchell and Patricia Keilbach write,
“With symmetric externalities, actors differ in their preferences for alternative institutions, but all prefer some institution to none. With asymmetric externalities, perpetrating actors prefer no institution because, absent compensation, they would bear the institutional costs but receive no institutional benefits. Such distributional asymmetries can arise from material conditions or from states having different values, with some preferring that all undertake externality-mitigating acts and others preferring the status quo” (Mitchell and Keilbach 2001, 895).

Fundamentally, the structure of interdependence shapes the relative gains from cooperation. When interdependence is symmetric across countries with a stake in the natural resource, they have comparable gains from cooperation. When interdependence is asymmetric, states have incomparable gains from cooperation. Some may not have direct gains from mutual adjustments at all, depending on the extent of asymmetry with other states. Under these circumstances, side payments that offset the costs of making adjustments are often needed to incentivize cooperation from the less exposed states (Barrett 2001, Dinar 2006). Side payments are not essential for incentivizing cooperation under symmetrical interdependence because the environmental benefits of cooperation provide their own incentive under these circumstances (Dinar 2008).

FORMS OF COOPERATION. Symmetrical interdependence encourages integrated cooperation because governments share convergent preferences over international cooperation and prefer to economize on transaction costs. Integrated cooperation enables states sharing co-equal access to a natural resource and exposed to mutual externalities to avoid making investments in superfluous rules or institutions. They can harness the benefits of existing rules and institutions and add to them under a common framework by making integrated rules and institutions to mitigate the externalities. When cooperation exists, governments can achieve better regulatory results at the same investment level than under un-integrated cooperation,
which would require more investment and have higher transaction costs to achieve the same regulatory results. Thus, if countries manage to overcome the obstacles to initiating cooperation, they make integrated rules and institutions for international cooperation. Integrated cooperation reflects the desire of countries sharing symmetrical interdependence to economize on transaction costs and governance costs in pursuit of mutual environmental improvements.

When national governments have asymmetrical interdependence, however, they are more likely to form un-integrated cooperation. Asymmetrical interdependence encourages un-integrated cooperation because different rules and institutions would attract different parties to cooperate and that makes un-integrated cooperation relatively appealing. Privileged parties are less inclined to practice restraint for purely environmental reasons. Un-integrated cooperation enables governments to separate rules and institutions, thereby separating property rights and obligations. It better enables them to tailor rules and institutions according to the political interests of specific parties. Governments focus on making tailored and differentiated rules and institutions. Un-integrated international cooperation reflects an awareness of political differences under asymmetrical interdependence.

HYPOTHESIS. This explanation of how interdependence structures affect the form of international cooperation suggests a hypothesis.

Interdependence Structures Hypothesis (Integration): When governments share symmetrical interdependence over a natural resource, they form integrated international cooperation on the resource. When governments have asymmetrical interdependence over a natural resource, they form un-integrated international cooperation on the resource.

BREADTH OF COOPERATION. Interdependence structures shape not only the form of international environmental cooperation but also the breadth of cooperation. Symmetric
interdependence encourages broad participation in cooperation by states with a stake in reducing environmental externalities. It encourages broader international cooperation consisting of countries whose nationals individually contribute to the environmental problem. By contrast, asymmetric interdependence encourages narrow participation in cooperation by states contributing to the environmental externalities. It encourages narrower cooperation consisting of only a fraction of countries whose nationals contribute to the environmental problem.

When states share symmetrical interdependence in managing a natural resource, they share a common stake in cooperation. Each state gains from the participation of another state contributing negative externalities. Non-participation by a state contributing environmental externalities reduces the effectiveness of cooperation because it means some nationals are not covered under the rules and institutions. This limits the potential environmental effectiveness of international cooperation. Since states under symmetric interdependence have a mutual stake in reducing externalities, non-participation by some states limits the capacity of participating states to reduce externalities. Narrow cooperation limits the environmental effectiveness of cooperation.

Non-participation by some states contributing externalities exposes those individuals, communities, and businesses subject to international rules to competitive disadvantages. States adhering to the rules and institutions subject domestic constituencies to regulations to which other states do not subject their domestic constituencies by not participating in cooperation. Competitive disadvantages created by the non-participation of some states in cooperation can render cooperation questionable on environmental effectiveness grounds. Governments who would otherwise participate in cooperation become reluctant to participate because of free-rider concerns and the competitiveness distortions that would induce.
Narrow cooperation that does not include all states contributing externalities can hamper efforts to have cooperation in the first place. It may render cooperation unlikely, leaving states exposed to externalities as before. Since they each have a stake in mutual adjustments, however, they are reluctant to hamper the prospects of cooperation through non-participation. Although states each have an incentive to avoid making costly domestic adjustments, they also have a stake in establishing and maintaining cooperation.

Under asymmetric interdependence, some states do not have a stake in cooperation comparable to that of other states. This means that other states cannot expect cooperation without crafting independent incentives for the unexposed states to participate in cooperation. Although competitiveness imbalances can also arise under asymmetric interdependence, exposed states are inclined to pursue narrow cooperation on issues involving mutual gains that do not require participation from the unexposed states. They view asymmetric interdependence as a reason for narrow cooperation on specific issues, rather than a reason to avoid all cooperation because broad cooperation is unlikely. These exposed states are inclined to limit the competitive imbalances from narrow cooperation. In that respect, narrow cooperation offers limited potential benefits for the participating arties but also entails limited adjustments and minimal costs for domestic constituencies. Asymmetric interdependence encourages narrow cooperation among the exposed states – it does not necessarily discourage cooperation altogether. Rather, it encourages piece-meal rules and institutions rather than the broad rules and institutions that states are inclined to make under symmetrical interdependence.

HYPOTHESIS. Interdependence structures should not only encourage international environmental cooperation of varying forms but also of varying breadth. In particular, interdependence structures that encourage integrated cooperation should also encourage broad
cooperation. Interdependence structures that encourage un-integrated cooperation should also encourage narrow cooperation. This argument suggests a hypothesis on how the breadth of cooperation varies with interdependence structures.

*Interdependence Structures Hypothesis (Breadth):* When governments share symmetric interdependence over a natural resource, they form broad cooperation on the natural resource. When governments have asymmetric interdependence over a natural resource, they form narrow cooperation on the natural resource.

### 2.6 Research Design

My research design characterizes the consequences of stakeholder concentrations and interdependence structures in situations where those variables vary the most. I analyze the pattern of integrated and un-integrated international environmental cooperation where stakeholder concentrations vary widely. Likewise, I analyze the pattern of integrated and un-integrated cooperation (and the breadth of cooperation) where interdependence structures vary widely. This empirical strategy identifies the policy settings where variation in the explanatory variables is greatest and analyzes the consequences of that variation within those settings.

I focus on two distinct empirical settings: *global environmental issues* and *regional water bodies*. In global environmental issues, the scale and timespan of externalities vary with stakeholder attributes. Where stakeholders are diffuse, the externalities stem from diffuse markets and persist longer with more diffuse scope. Where stakeholders are concentrated, the externalities stem from concentrated sources and decline or have localized scope. Along regional water bodies, the structure of interdependence varies according to whether the water body exposes states in common to each other’s externalities or exposes some states systematically to
more externalities than others. When states are exposed in common, they share symmetrical interdependence in managing the water body. When some states are systematically exposed to more externalities than others, they have asymmetrical interdependence in managing the water body.

I focus on global environmental issues and regional water bodies because they each have wide variation in one explanatory variable but not the other. This limits the extent to which one explanatory variable can confound inferences on the importance of the other explanatory variable. Variation in stakeholder concentrations is far greater in global environmental issues than in regional water management. Variation in interdependence structures is far greater along regional water bodies than in global environmental issues. Thus, my research design limits the analysis of stakeholder concentration effects to global environmental issues and limits the analysis of interdependence structure effects to regional water bodies.

Regional water bodies have similar stakeholders: farmers, fisherman, commercial shipping, and local power consumers, among others. However, they involve drastically different interdependence structures. Rivers with three or more states involve asymmetrical interdependence because of upstream-downstream properties along the river. Lakes and seas involve symmetrical interdependence because of mutual exposure to externalities along the water. Regional water bodies provide a useful empirical setting for analyzing the consequences of interdependence structures without confounding the analysis with significant differences in stakeholder concentrations.

Global environmental issues often, albeit not always, have similar interdependence structures because many of them are CPRs and those that are not CPRs do not feature the asymmetric properties of rivers. However, global environmental issues have drastically different
stakeholder concentrations. Climate change stems from human economic activities across several sectors, some of which entail diffuse markets: industry, energy, land use, and agriculture. Ozone depletion stems from chemicals manufactured by multinational corporations in large production facilities for discrete markets. Global environmental issues provide a useful empirical setting for analyzing the consequences of stakeholder concentrations without confounding the analysis with significant differences in interdependence structures.

Table 2.3 summarizes the empirical settings in which I evaluate the explanations and the corresponding variation in the explanatory variables. I use the same empirical settings to evaluate the alternative explanations outlined below.

Table 2.3 Summary of Variation In Explanatory Variables Across Empirical Settings

<table>
<thead>
<tr>
<th>Empirical Setting</th>
<th>Variation in Stakeholder Concentrations</th>
<th>Variation in Interdependence Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global environmental issues</td>
<td>Significant</td>
<td>Minor/moderate</td>
</tr>
<tr>
<td>Regional water bodies</td>
<td>Minor/moderate</td>
<td>Significant</td>
</tr>
</tbody>
</table>

2.7 Applying the Explanations

GLOBAL ENVIRONMENTAL ISSUES. I expect that on global environmental issues, when stakeholders are in concentrated markets, governments will tend to make integrated institutions and rules. Externalities will change over time based on adjustments in concentrated markets. In particular, externalities will remain localized or decline over time with technical innovations. Governments will harness the capacities of concentrated stakeholders by making institutions and rules that incentivize stakeholders to mitigate externalities by creating markets for innovation. Governments will economize on transaction costs and governance costs by
forming integrated global regimes that engage stakeholders in concentrated markets to reduce negative externalities. They will be more willing to internalize the mitigation costs when stakeholders are concentrated because financing the implementation costs will be relatively low compared to when stakeholders are diffuse. However, they will also have the stakeholders assume some of the mitigation costs by creating incentives for adjustments and innovation. They will pursue top-down strategies that economize on transaction costs and establish general standards for the concentrated stakeholders.

When stakeholders are in diffuse markets, governments will tend to make un-integrated rules and institutions. They will have more difficulty economizing on transaction costs because integrated rules and institutions will not generate incentives for innovation and adjustment. Governments will find that the costs of mitigation are comparatively higher than when stakeholders are in concentrated markets. They will also have greater difficulty in incentivizing stakeholders to assume some of the mitigation costs because creating markets for innovation and incentivizing adjustments will require more investment and more tailored policies. This will prevent governments from shifting the mitigation costs to stakeholders – and since the costs will be comparatively higher when stakeholders are diffuse – governments will shoulder a significant cost burden. This will tend to generate distributive disputes between the wealthy countries and the developing countries because the developing countries will demand financing for implementation of reforms and the wealthy countries will be relatively more reluctant to provide financing because the aggregate sum of financing will be higher. Governments will tend to form un-integrated international institutions and rules. They will pursue bottom-up strategies that are tailored to specific stakeholders in diffuse markets and invest limited resources in environmental improvements at local levels.
REGIONAL WATER BODIES. I expect that in managing regional water bodies, governments will tend to form international cooperation consisting of un-integrated rules and institutions when they are asymmetrically exposed to externalities. They will also tend to form narrower cooperation consisting of only a fraction of states contributing environmental externalities. However, governments will tend to form international cooperation consisting of integrated rules and institutions when they are mutually exposed to externalities. They will also tend to form broad cooperation consisting of all states contributing environmental externalities.

More specifically, governments will tend to form integrated international cooperation on regional lakes and seas because these water bodies involve mutual exposure to externalities. Pollution from some states along a sea or lake exposes other states bordering the water body to pollution. Similarly, environmental improvements that reduce pollution will generate positive externalities for other states bordering the sea or lake. Mutual exposure to externalities and a desire to economize on transaction costs will tend to encourage governments to form integrated cooperation. It will also encourage broad cooperation involving states bordering the lake or sea because of a mutual interest in cooperation and a reluctance to hamper cooperation through non-participation. Symmetrical interdependence in managing lakes and seas will encourage integrated cooperation and broad cooperation.

By contrast, governments will tend to form un-integrated international cooperation on regional rivers because these water bodies involve asymmetrical interdependence between upstream and downstream states along the river and because of more symmetrical interdependence between neighboring riparian states. Pollution from upstream states will tend to have consequences downstream but pollution downstream will be discharged further downstream and reach the lake or sea into which the river flows. Upstream states will not be exposed to those
externalities. However, governments sharing specific spans of the river will share symmetrical interdependence in managing those river stretches and engage in more reciprocal cooperation. Consequently, international cooperation on regional rivers will be narrower than along regional lakes and seas. It will also tend to be more un-integrated than cooperation on regional lakes and seas because differential incentives for cooperation will encourage rules and institutions tailored to specific states or groups of states, unlike those created for lakes and seas, which will have application to all states bordering those water bodies.

SUMMARY OF EXPECTATIONS. Table 2.4 summarizes the explanatory variables and observable expectations corresponding to each explanation within its corresponding empirical setting.

<table>
<thead>
<tr>
<th>Empirical Setting</th>
<th>Observable Expectations</th>
<th>Explanatory Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global environmental issues</td>
<td>(1) Governments will make integrated agreements on global issues involving stakeholders in concentrated markets. (2) Governments will make un-integrated agreements on global issues involving stakeholders in diffuse markets.</td>
<td>Stakeholders in concentrated and diffuse markets.</td>
</tr>
<tr>
<td>Regional water bodies</td>
<td>(1) Governments will make integrated agreements on regional lakes and seas. (2) Governments will make agreements on regional lakes and seas with broad membership. (3) Governments will make un-integrated agreements on regional rivers. (4) Governments will make agreements on regional rivers with narrow membership.</td>
<td>Symmetric and asymmetric interdependence among countries.</td>
</tr>
</tbody>
</table>
2.8 Alternative Explanations

Stakeholder concentrations and interdependence structures are different types of variables. Stakeholders operate in markets; they are a sub-national variable. The importance of stakeholder concentrations reflects the critical role of individuals, communities, and businesses that produce externalities in environmental regulation. Interdependence is between countries; it is country-level variable. The importance of interdependence structures reflects the critical role of influence and power over natural resources. In explanations of the form of international environmental cooperation, these variables emphasize different constraints on national governments. However, they both shape national preferences over international environmental cooperation, making some forms consistent with national interests more than others.

The political science literature has studied other variables affecting the prospects of international cooperation. I explain the relevance of some of those other variables to outline alternative explanations for patterns of integrated and un-integrated cooperation. Specifically, (i) the number of states with control over the environmental issue and (ii) the economic wealth and geopolitical relations among countries are other variables that may explain patterns of cooperation. I evaluate the importance of these other variables as alternatives to the stakeholder concentrations and interdependence structures explanations that are of primary interest in this dissertation. In particular, I evaluate the importance of these alternative variables in studying the impact of stakeholder concentrations in global environmental governance. I do the same in evaluating the importance of interdependence structures in patterns of regional water cooperation.
2.8.1 Number of States

Research has shown that the number of states with control over a natural resource can affect the prospects of cooperation and different dimensions of cooperation, such as the depth of policy changes and the success of environmental measures adopted (Barrett 1994, Barrett 2003). The relationship between “breadth and depth” has long been a critical topic in International Relations because of its implications for the negotiation and design of international institutions (Kahler 1992, Downs, Rocke, and Barsoom 1998, Gilligan 2004). The relationship between the number of relevant actors in managing a natural resource and the heterogeneity of their preferences towards management has been the subject of studies on local and global CPRs (Keohane and Ostrom 1995). A recent study has tested whether there is a tradeoff between the depth of cooperation and the breadth of cooperation in global environmental governance (Bernauer et al. 2013). These and other inquiries have analyzed the extent to which there is a strict tradeoff between deep cooperation and broad cooperation.

The form of international environmental cooperation may reflect the number of relevant parties in managing a natural resource. In this view, as the number of parties with a stake in the natural resource and with control over its management increases, the depth of cooperation will tend to decrease because each party adds to the heterogeneity of preferences over environmental regulation. A recent study qualifies this expectation by demonstrating that institutional design characteristics can mitigate the tradeoff (Bernauer et al. 2013). Presumably, in the absence of incentives to join cooperation, there would be a greater tradeoff between the breadth of participation and the depth of cooperation. I evaluate the extent of this tradeoff.
Following the tradeoff perspective, whether countries make integrated or un-integrated international environmental cooperation would depend on the number of states with control over the natural resource. Since the integration of cooperation (or lack thereof) depends on the convergence or divergence of national preferences over cooperation, having more relevant states would affect the form of cooperation. Under a tradeoff perspective, more states with control over the resource would add to preference divergence, making un-integrated cooperation more likely. Fewer states with control over the resource would limit preference divergence, making integrated cooperation more likely.

*Number of States Hypothesis (Integration):* As the number of states with control over an environmental issue increases, states become more likely to form un-integrated cooperation on the environmental issue.

The tradeoff perspective would suggest that the number of states affects the breadth of international environmental cooperation, not only the form of cooperation. Since environmental cooperation implies accepting *some* responsibilities or allocating property rights among states, a greater number of states with control over the environmental issue would raise the probability that some states do not participate in cooperation. Only states sharing some stake in cooperation would participate in the rules and institutions established to facilitate mutual adjustments. The preference heterogeneity that follows from an increase in the number of states with control over the environmental issue would translate into narrow participation in international cooperation. When fewer states have control over the issue, the extent of preference heterogeneity remains limited, making broad cooperation more likely.
Number of States Hypothesis (Breadth): As the number of states with control over an environmental issue increases, they become more likely to form narrow international cooperation that does not include some relevant states.

2.8.2 Wealth and Geopolitics

A key omission of the number of states explanation is that it does not explain variation in preference convergence and divergence. It presumes that preferences will become heterogeneous as the actors with control over the natural resource increase in number. This distinguishes the number of states explanation from the interdependence structures and stakeholder concentrations explanations, both of which aim to explain preference convergence and divergence over international environmental cooperation.

Economic and political variables, by contrast, provide a potential explanation for preference convergence and divergence. Economic wealth affects the cost-effectiveness and technical capabilities of societies to reduce environmental pollution (Grossman and Krueger 1995). These cost and technical conditions affect the willingness of individuals, communities, and businesses to invest in pollution abatement (Jaffe, Newell, and Stavins 2002). Wealthier societies have more cost-effective means of reducing environmental externalities than low-income societies. Wealthier societies are more willing to invest in conservation programs and environmentally friendly technologies than low-income societies. The wealth of countries should affect the mitigation costs and public preferences in societies towards lowering transboundary environmental externalities.

To the extent that integrated cooperation entails greater costs and more economic adjustments, low-income countries would not prefer additional rules and institutions that place new obligations on their businesses or communities or that commit them to taking environmental
action in the future. Wealthy countries would prefer more cooperation and to the extent that integrated cooperation facilitates that at lower transaction costs, they would prefer that form of cooperation. The wealth of countries, therefore, should affect the distribution of preferences over the form of international environmental cooperation. When countries are wealthy, they should prefer more cooperation at lower transaction costs (integrated cooperation). When countries have low incomes, they should prefer less cooperation. And when they are economically heterogeneous, countries should have divergent preferences over international environmental cooperation.

The wealth of countries should account for variation in patterns of integrated and un-integrated international environmental cooperation. Economically heterogeneous countries are not likely to make integrated rules and institutions on environmental protection because they have divergent preferences over environmental policy. The rules and institutions they make are likely to have legally and institutionally independent relationships. Integrated cooperation is more likely to occur among the wealthiest countries, which may have some cooperative arrangements with lower-income countries that are independent from their robust rules and institutions. A hypothesis summarizes the expected relationship between wealth and the form of cooperation.

*Wealth Hypothesis*: When countries are wealthier, they form integrated international environmental cooperation. When they are less wealthy or economically heterogeneous, they form un-integrated international environmental cooperation, if any at all.

Similarly, preferences over environmental cooperation may simply stem from political relations among countries. In this explanation, international environmental cooperation is a product of political relations among countries and not insulated from geopolitical conditions.
Geopolitical conditions shape the form of international environmental cooperation as a function of overall political relations. Politically close relations may prompt integrated cooperation: environmental cooperation might represent one of several policy fields in which politically close governments find common ground. Political tension may detract from the prospects of cooperation, making un-integrated cooperation more likely because governments make few if any rules and institutions with rival governments. Integrated cooperation stems from closer political relations among governments; un-integrated cooperation stems from a checkered political history among governments. I evaluate this explanation with a hypothesis.

*Geopolitics Hypothesis:* When countries share close political relations, they form integrated international environmental cooperation. When they are political rivals, they form un-integrated international environmental cooperation, if any at all.

The wealth and geopolitics explanation stems from a fundamentally different perspective than the stakeholder concentrations argument or the interdependence argument. In particular, the wealth and geopolitics explanation suggests that variation in the form of international environmental cooperation has little to do with the environment. It has little to do with the distribution of interdependence or the markets in which stakeholders operate. Instead, the form of environmental cooperation is a product not of the specific characteristics of an environmental issue but of basic differences between countries – their wealth and political relations. Regardless of how exposure to externalities is distributed or who the stakeholders are, the wealth and geopolitical relations of countries drive the choice over different forms of environmental cooperation.

2.9 Conclusion
In this chapter, I outlined two explanations for variation in the form of international environmental cooperation. I specified why integrated and un-integrated cooperation tend to reflect stakeholder concentrations and interdependence structures. Both explanations address the problem of variation in the form of cooperation by outlining when national preferences over cooperation will converge and diverge. They both specify when national governments will have convergent and divergent preferences over international environmental cooperation.

The stakeholder concentrations explanation is the innovative one studied in this dissertation. Stakeholders are critical to the form of international environmental cooperation not only because of their direct attempts to influence negotiated settlements but also because they affect the feasibility of cost-effective cooperation. Depending on the concentration (or diffuseness) of markets in which stakeholders operate, governments may have more intense distributive problems in mitigating global environmental problems. They may be unable to shift the mitigation costs onto stakeholders. They may be unable to create top-down strategies that induce stakeholders to change behaviors and adopt environmental measures. Stakeholder concentrations matter: they shape the politics and practicality of having efficient global environmental cooperation.

Unlike stakeholder concentrations, interdependence structures are a country-level variable. They reflect the distribution of exposure to the negative environmental externalities of individuals, communities, or businesses in different countries. Depending on the structure of interdependence, governments have convergent or divergent interests in cooperation. The form of cooperation and the breadth of cooperation depend on how interdependence along water
bodies is distributed among states bordering the water. Interdependence structures matter: they shape the politics of regional water cooperation.

In the next five chapters, I evaluate how well these explanations and two alternative ones account for patterns of international cooperation on global environmental issues and regional water bodies. I first analyze the impacts of stakeholder concentrations in global environmental governance because of its theoretical importance in the dissertation. I then analyze the impacts of interdependence structures as an extension of existing theories of international organization to the environmental field. The next five chapters employ a combination of data sources – agreement texts, primary interviews, primary documents, field surveys, participant observations, secondary sources, and quantitative data – to determine the extent to which patterns of cooperation are consistent with my explanations and alternative ones.
3.1 Introduction

In the early years of the United Nations Framework Convention on Climate Change (UNFCCC), many negotiators and policymakers expected to form a regime for climate change similar to the one created for ozone layer protection. The precedent for designing a global regime on atmospheric protection had been set in the decade before the first Conference of the Parties (COP) to the UNFCCC. At that meeting, delegates launched a negotiating process to adopt another legal agreement to fulfill the mandate of the Framework Convention. This decision matched the earlier sequence for ozone protection: governments had used the protocol to set specific restrictions on ozone-depleting substances (ODS).

In the years since the Kyoto Protocol was negotiated as a subsidiary instrument to the UNFCCC, the UN regimes for climate change and stratospheric ozone have taken divergent paths. The UNFCCC and the Kyoto Protocol remain the two central instruments on climate change. However, they have come to share climate protection responsibilities with other institutions (Keohane and Victor 2011, Victor 2011). The legal status of these institutions varies and their memberships range from fewer than ten parties to more than the UNFCCC. By contrast, the Montreal Protocol internalized nearly all the major initiatives on ozone layer protection over the 1990s and 2000s. It has received some contributions from conventions adopted under other international organizations. Nonetheless, the Montreal Protocol has increasingly consolidated its role in controlling ODS.
The divergent pathways of these regimes resemble the historical development of other UN and non-UN regimes for the global environment. Despite its goal of managing biogenetic resources, the Convention on Biological Diversity shares this responsibility with the International Treaty on Plant Genetic Resources for Food and Agriculture, completed in November 2001. A single treaty with subsidiary instruments does not govern the maintenance, distribution, and sharing of plant genetic resources. Instead, multiple independent treaties and non-binding instruments with different goals share these functions (Raustiala and Victor 2004). By contrast, international regulations on trafficking in endangered species are centralized under the 1973 Convention on International Trade in Endangered Species (CITES). Even as endangered species crises have occurred, governments have consolidated the role of CITES in preventing illicit trafficking in endangered wildlife.

In general, governments have strong incentives against using un-integrated institutions for global environmental governance. First, global institutions for the natural environment entail sunk costs. They take years to negotiate. They establish new international rules when they enter into force. They set forth new obligations on parties. They set precedents for future negotiations. These represent start-up costs that governments prefer to avoid by not duplicating efforts across multiple institutions, even when existing ones are imperfect or inefficient. Second, existing institutions lower transaction costs and generate increasing returns. These characteristics make existing institutions more appealing than alternatives when governments seek to enhance collective action (Keohane 1984, Pierson 2000). The existing institution has mechanisms that make follow-up initiatives more cost-effective than resorting to other institutions for collective action. Not using existing global treaties and institutions to mitigate the problems for which they were created means that parties do not translate their benefits to new or persistent problems.
In light of these incentives, variation in the form of global environmental governance is puzzling. Why have some UN and non-UN environmental regimes remained integrated? Why have others become un-integrated over time, despite the expectation that with new challenges, governments would turn to those treaties to make new safeguards? Governments have used un-integrated institutions to manage climate change more often than to regulate plant genetic resources. Each of these issues has prompted the use of un-integrated institutions more than ozone layer depletion. CITES remains the main mechanism for regulating international trafficking in endangered wildlife, despite repeated strains on its capacity to limit animal pouching and smuggling. However, the UNFCCC has not maintained its singular status, despite clear strains on its capacity to cope with climate change. What explains this variation?

I argue that governments prefer to create integrated regimes for global environmental governance but stakeholders impose constraints on their capacity to achieve their goals. Stakeholders create global externalities and their actions would need to change to reduce externalities. However, governments face a greater challenge in seeking to incentivize stakeholders in diffuse markets to lower their externalities through innovation and adjustments than stakeholders in concentrated markets. Stakeholders impose constraints on governments’ options. These constraints shift the burden onto governments, who then face distributive problems in reaching settlements. Regulating stakeholders in diffuse markets involves higher mitigation and implementation costs. Wealthy countries are called upon to contribute larger sums of money for developing countries to make adjustments and reforms for global environmental benefits. Regulating stakeholders in concentrated markets provides more opportunities for cost-effective regulations to open new markets and incentivize technological innovation and diffusion, with positive global benefits.
Governments form un-integrated cooperation on global issues involving stakeholders in diffuse sectors to lower their burdens in financing reforms and create incentives for stakeholder adjustments in specific areas. By contrast, governments form integrated cooperation global cooperation on issues involving stakeholders in concentrated sectors to cost-effectively manage the environmental issue and provide consistent incentives and rules for the stakeholders to make adjustments and reduce externalities. Un-integrated global environmental cooperation is a response to political obstacles and regulatory constraints; integrated global environmental cooperation is a response to transaction costs and efficiency priorities.

I evaluate this explanation with original panel data on 18 global environmental treaty regimes. I find that global environmental problems stemming from agriculture and land use are associated with repeated independent agreements. Mitigating environmental externalities from these sectors takes longer and governments make independent agreements to regulate them. By contrast, environmental problems stemming from industry are associated with repeated integrated agreements. These involve capital-intensive industries that are concentrated and dominated by Northern companies, enabling innovations in the advanced economies to diffuse to developing economies, thereby lowering mitigation costs for all parties. Stakeholders operating in concentrated markets such as ship construction and chemicals encourage preferences to converge, prompting integrated global regimes. Stakeholders operating in diffuse markets such as agriculture and energy encourage preferences to diverge, prompting un-integrated global regimes.

I supplement the quantitative analysis with in-depth qualitative data from primary source interviews and field observations on the governance of climate change and ozone layer depletion. The diffuseness of stakeholders in mitigating climate change does not enable wealthy countries
and lower-income countries to converge on rules and institutions because the mitigation costs remain high and persistent. Distributive problems and the substantial financing needed to mitigate climate change have prompted governments to make independent institutions with narrow goals and mandates. The diffuseness of consumer markets has prompted them to adopt institutions to incentivize technology innovation and land use reforms. By contrast, the concentration of stakeholders in preventing ozone layer depletion has enabled technology innovation and diffusion, encouraging countries to form facilitative mechanisms for technical innovation, diffusion, and adjustment. The stakeholders have lowered the burden on wealthy countries in financing the implementation of commitments in the developing countries, prompting an integrated financial mechanism under the Montreal Protocol. Overall, diffuse stakeholders prompted governments to use independent agreements and institutions for technology promotion and project financing in climate change governance but concentrated stakeholders encourage them to make integrated technology and financing institutions in ozone layer governance.

Alternative explanations do not account for variation in the form of global environmental governance. In particular, the changing distribution of global wealth and geopolitical influence in recent decades has not been a significant factor in the development of un-integrated global environmental cooperation. However, it was more significant in diminishing integrated cooperation. In that respect, changes in global wealth and geopolitics have not contributed to un-integrated cooperation but have dampened integrated cooperation. Moreover, the number of parties in a treaty process has not been a significant source of un-integrated cooperation on global environmental issues. In fact, having more states in a treaty process has discouraged un-integrated cooperation, not encouraged it. Growth in the total number of sovereign states has
been negatively associated with integrated cooperation. Thus, having more sovereign states in the world has dampened integrated cooperation. However, it has not spurred un-integrated cooperation.

Moreover, the development of international cooperation on climate change and ozone layer depletion undermines the alternative explanations. Although both the UNFCCC and the Montreal Protocol have had overlapping timespans (1992-2012) and have included large developed and developing countries, they have followed different pathways. Financial and technological cooperation on climate change has become increasingly un-integrated but on ozone protection has become more integrated. Mitigation cost dynamics in these areas have driven these divergent forms of international cooperation, stemming from stakeholder concentration differences, not because of overall changes in global wealth or geopolitics since 1992.

3.2 Markets, Political Interests, and Forms of Global Environmental Governance

Global treaty regimes enable governments to avoid overlapping sets of bilateral or mini-lateral negotiations on a problem with global causes and consequences. They can lower the transaction costs of making adjustments and curbing externalities. However, as the obstacles to making cost-effective adjustments grow, the transaction costs of integrated cooperation increase and the prospective regulatory effectiveness of integrated cooperation declines. These obstacles reflect the markets in which the stakeholders operate. Stakeholders in diffuse markets make integrated global regimes politically infeasible and unproductive from a regulatory standpoint.

When stakeholders are in diffuse economic markets, the costs of mitigating environmental externalities are persistent and diffuse. With diffuse and persistent mitigation
costs, governments have divergent preferences over global regulation. Lower-income countries are reluctant (or simply unable) to make changes in some sectors because of economic, regulatory, and technological limitations. This places a burden on wealthy countries to provide aid and technical support to lower-income countries to implement reforms. This generates more intense political disagreement over financing by the wealthy countries in exchange for mitigation by the lower-income countries.

On issues where aid is politically necessary, governments prefer to divide management of the environmental problem across multiple independent agreements because that enables them to separate distributional issues and tailor policy interventions. Using independent agreements mitigates the political and regulatory challenges associated with stakeholder diffuseness by limiting the scope of negotiations through the strategic selection of independent institutions. Governments use un-integrated agreements and institutions to harmonize political interests and manage mitigation costs.

3.2.1 Market Concentrations and Political Interests

DIFFUSE MARKETS. The distribution of stakeholders responsible for global environmental externalities affects the economic costs of mitigating the externalities. When stakeholders supply to diffuse consumer markets, the mitigation costs tend to persist because introducing, deploying, and diffusing technical fixes or new practices takes longer. Innovating companies have a wide consumer base for new innovations, but those consumers enjoy product substitution opportunities and are price sensitive. The market for innovations is weak: it consists of many potential consumers that possess varying capacities and desires to assimilate
innovations. This tends to dis-incentivize innovations, prolonging the period of transition to more environmentally friendly technologies or practices. Consequently, the mitigation costs associated with reducing environmental externalities persist over time and the pace of innovations remains slow when downstream consumer markets are diffuse.

In these situations, upstream producers tend to target investments and only make and diffuse innovations where they find the best opportunities for recovering their investments. Diffuse sources of environmental pollution tend to experience uneven adjustments, as mitigation costs decline in some areas but remain persistent in others. This is one reason why innovations in the chemical fertilizer industry tend to lag behind those in the chemical refrigerants industry. Downstream market conditions affect the innovation and investment choices of upstream producers. *Upstream producers tailor innovations and diffuse their innovations to target concentrated consumer markets, not diffuse ones.*

When the upstream markets are diffuse, mitigation costs also tend to persist and remain high, albeit not for the same reason as when downstream markets are diffuse. Diffuse producer and supplier markets leave individual producers unable to make innovations with environmental benefits. They lack the human and financial capital resources necessary to produce innovations. Diffuse upstream markets pit companies in intense competition over consumers and this makes stakeholders in the upstream markets risk averse: they are reluctant to make investments in potentially risky alternatives and innovations. Diffuse upstream markets are unlikely to produce environmental friendly innovations because the market conditions dis-incentivize investment in innovations. They also render companies unable to make considerable investments. Diffuse upstream markets promote status quo practices and technologies. They have similar consequences for mitigation costs as diffuse downstream markets, albeit for a different reason.
POLITICAL INTERESTS UNDER DIFFUSE MARKETS. Political interests follow from these mitigation cost characteristics. Governments find it costly to adopt policies that reduce externalities because the markets do not produce innovations with positive environmental benefits. The governments shoulder a burden of financing mitigation. This promotes distributive disputes between wealthy and lower-income countries that have different preferences over regulation. The wealthy countries prefer to limit the expense of reducing environmental externalities but the lower-income countries require financial and technical assistance to implement reforms. Since the wealthy countries seek to reduce externalities from the lower-income countries, they would want to have financial assistance for the lower-income countries. But the scale of the assistance needed remains high when the mitigation costs do not decline. The distributive dispute between wealthy countries and lower-income countries becomes a highly politicized issue that reflects the dis-incentives or inabilities of diffuse markets to generate innovations that cost-effectively reduce externalities.

Moreover, wealthy countries are unable to pass along the costs of adjustment to the stakeholders because policies and regulations are unlikely to incentivize reliable markets for innovation. The wealthy countries cannot rely on the stakeholders to carry the costs of mitigation because they cannot create conditions for the stakeholders to take actions to reduce their externalities. Consequently, the wealthy countries find it politically infeasible to finance costly adjustments in the lower-income countries. They would rather the lower-income countries finance their own reforms – but that is also politically unrealistic. Thus, diffuse markets exacerbate political differences between different groups of countries in global environmental politics. They do not enable wealthy countries to lower global externalities at declining costs.
CONCENTRATED MARKETS. If stakeholders are in concentrated markets, the mitigation costs tend to decline over time or remain localized to specific niche markets. Concentrated upstream producers tend to have the financial and human capital resources to produce innovations. They have more confidence that they will recover investments in innovations with the concentrated downstream market. A concentrated downstream market for these producers enables them to dominate the market by servicing a relatively small number of consumers with heterogeneous preferences, less price sensitivity, and fewer product substitution opportunities. This contributes to incentives for steady technical innovations that lower the costs of mitigating environmental externalities. *With the right policy incentives, concentrated markets are able to make mitigation costs decline or remain localized.*

When upstream markets are concentrated, there are high barriers to entry into the producer market. The producers operate in an oligopolistic market. They have human and financial capital resources. They can target investments where they believe they will recoup those investments and shift investments as market demand changes. Unlike in diffuse producer markets, they have the capacity to innovate and diffuse innovations. They are not as risk averse as producers in diffuse markets because competition is oligopolistic, not perfectly competitive. They simply need reliable downstream consumer markets before launching innovations.

When downstream markets are concentrated, there is less price sensitivity, narrow consumer bases, and fewer product substitution opportunities – all conditions that are conducive to investments in innovations. These downstream markets are more able than the diffuse ones to assimilate innovations and implement new practices to meet environmental regulations. Consequently, they provide the producer market with more certainty in deciding on investments.
The combination of concentrated producer and consumer markets is a potent source of reducing or localizing costs in mitigating environmental externalities.

POLITICAL INTERESTS UNDER CONCENTRATED MARKETS. Political interests follow from these mitigation cost characteristics. Governments find it less costly to adopt policies that reduce externalities because the markets produce innovations with positive environmental benefits. Governments shoulder a declining burden in financing mitigation. This minimizes distributive disputes between wealthy and lower-income countries that generally have different preferences over environmental regulation. The wealthy countries prefer to limit the expense of reducing environmental externalities and the lower-income countries pursue financial and technical assistance to implement reforms. The scale of the assistance needed declines when the mitigation costs decline. The distributive dispute between wealthy countries and lower-income countries becomes less of a barrier to cooperation because of the incentives and abilities of concentrated markets to generate innovations that cost-effectively reduce externalities.

Moreover, wealthy countries are better able to pass along the costs of adjustment to the stakeholders because policies and regulations can create reliable markets for innovation. The wealthy countries can rely on the stakeholders to carry the costs of mitigation because they can create conditions for the stakeholders to take actions to reduce their externalities. Consequently, the wealthy countries find it more politically acceptable to finance adjustments in the lower-income countries. Thus, concentrated markets diminish political differences between different groups of countries in global environmental politics. They enable wealthy countries to lower global externalities at declining costs to their public budgets.

3.2.2 International Cooperation Patterns by Regulated Sectors
These arguments apply specifically to sectors because sectors have varying market concentrations. Economically concentrated stakeholders that contribute to global environmental externalities are often capital-intensive industries with technical capacities that operate in concentrated markets (e.g., chemicals, shipping). By contrast, economically diffuse stakeholders that contribute to global environmental externalities consist of disparate industries featuring different capital intensity, high price sensitivity, and considerable product substitution opportunities (e.g., energy production and consumption, agricultural production, tropical logging).

When concentrated industries such as chemicals or commercial shipping are regulated under a global treaty process, the mitigation costs tend to decline and technologies diffuse among downstream markets consisting of concentrated consumers. This facilitates convergence in government preferences over distributive issues and regulatory approaches. Governments tend to make integrated regimes on these sectors. By contrast, when a global treaty process regulates industries with diffuse markets such as small-scale farming or tropical logging, the mitigation costs persist and remain diffuse across economic actors. Government preferences tend to diverge because of the distributive implications and regulatory challenges of these problems. Governments tend to make un-integrated regimes on these sectors.

3.2.3 Hypothesis

We should expect global environmental treaty processes that regulate sectors consisting of concentrated markets to become integrated over time. By contrast, global environmental treaty
processes that regulate sectors consisting of diffuse markets will encourage governments to make un-integrated cooperation. This suggests a hypothesis.

*Stakeholder Concentrations Hypothesis:* (i) When a global treaty process regulates sectors consisting of diffuse markets, governments will tend to form un-integrated cooperation on the issues covered by that treaty process. (ii) When a global treaty process regulates sectors consisting of concentrated markets, governments will tend to form integrated cooperation on the issues covered by that treaty process.

3.3 Alternative Explanations for the Form of Global Environmental Governance

One alternative explanation for the form of global environmental governance is that the number of states in a global treaty process will tend to affect the extent of preference heterogeneity inside the process and that the number of potential contributors to a global environmental problem will also contribute to preference heterogeneity. More parties in a treaty process will make un-integrated cooperation more likely because they will be less likely to agree on the terms of cooperation. More states in the world will also make un-integrated cooperation more likely because there will be more potential contributors to the problem and they will each possess differentiated preferences over regulation. The total size of the group contributing externalities should weaken the depth of cooperation (Barrett 2003). I evaluate the following hypothesis corresponding to this explanation.

*Number of States Hypothesis:* As the number of states in a treaty process and the total number of states in the world increase, governments will become more likely to form un-integrated cooperation on the issues covered by the treaty process.
A second alternative explanation is that since global environmental governance involves wealthy and less-wealthy countries, changes in global wealth and the distribution of power among countries at a general level will affect the form of global environmental governance. The form of environmental cooperation on global issues will reflect the distribution of wealth and power in the world among states more generally. Un-integrated cooperation will stem from greater preference divergence because of changes in the distribution of wealth and influence in the world on a wider and more encompassing range of issues than environmental ones. Environmental issues will reflect these macro-scale patterns in global wealth and power. Particularly in the period after the Cold War and in the period after the 1992 United Nations Conference on Environment and Development (Rio Summit), the structure of global environmental governance will not be insulated from large-scale economic and political transformations in the world. These periods in the last twenty years will feature more un-integrated cooperation on global environmental issues than earlier periods. This alternative explanation suggests a hypothesis.

*Wealth and Geopolitics Hypothesis:* As geopolitics and the distribution of global wealth change, governments will become more likely to form un-integrated cooperation on a global environmental issue.

### 3.4 Global Treaty Processes: Quantitative Data and Measures

I evaluate these hypotheses with original panel data on global environmental treaty processes. The population of interest is the “treaty process” and the unit of observation is the “treaty process year.” A treaty process is a negotiating process operating under the mandate of a
treaty. Founding treaties initiate the process, which may lead to further treaties or non-binding instruments.

A treaty process enters the sample by meeting four criteria: (i) it was established by a founding treaty, (ii) the founding treaty is an independent agreement and not a subsidiary instrument, (iii) the founding treaty covers a global problem, and (iv) it includes or provides for meetings of parties to the treaty. Regarding the first criterion, agreements with ratifying parties and that use the word “shall” in reference to state obligations have legal force. Regarding the second criterion, amendments, protocols, or other modifications of earlier agreements are ineligible to initiate a treaty process – and neither can replacements to a founding treaty. For the third criterion, a global environmental problem is distinguished from a non-global one by the scope of the environmental issue to which the agreement applies. In general, non-global environmental agreements are explicit about the areas not subject to regulation but global environmental agreements are more open-ended and identify the problem itself, not necessarily the regional location of its occurrence. And regarding the fourth criterion, a treaty process implies that meetings occur under the auspices of the founding treaty or host organization.

The sample consists of 18 treaty processes that are measured yearly through 2012 (N = 564). The founding conventions were negotiated at different years, all after 1945, and eight treaty processes began in the last 20 years. Table 3.1 lists the treaty process subjects, founding conventions, and start dates (Appendix 3.1). Some share similar substantive areas and others do not, ensuring wide variation in the stakeholders.

3.4.1 Dependent Variables: Integrated and Independent Agreements

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INTEGRATED AGREEMENT. I measure when governments made agreements inside the legal or operational context of a global treaty process on issues handled by that process. The variable Integrated Agreement equals 1 when governments completed an agreement that depends on the founding convention or its subsidiary instruments for definition or operation; it equals 0 otherwise. For example, the Kyoto Protocol is legally and operationally dependent on the UNFCCC for its implementation and some of its definitions. More subtlety, some agreements are legally independent of a founding convention but depend on its provisions for implementation of their own provisions. They are operationally dependent. For example, The 1994 Lusaka Agreement – signed by African states – depends on the 1973 CITES agreement because parties must provide proof that re-exporting specimens was compliant with CITES rules.

I measure whether an agreement was integrated based on the two characteristics distinguishing integrated from un-integrated cooperation: additionality and dependence. First, additionality means the stated subject matter of an agreement matches the stated subject matter of the founding convention. This means that an agreement covers a subject under the purview of the treaty process, according to the preamble and objectives portions of the founding convention. For example, an agreement can add to the 1989 Basel Convention regulating the transboundary movement of hazardous waste only if it too regulates the movement of those substances. I used two data sources to determine whether a founding convention shared a subject matter with a subsequent agreement. First, I used the agreement texts from the treaty process and the text from an agreement that shares the subject matter of the treaty process. Based on the founding convention and the subsequent agreements, I determined which subsequent agreements shared the subject matter of the founding convention. Second, I used the secondary literature on each
treaty process to corroborate whether other researchers had identified a similar match in the subject matter between the founding convention and the subsequent agreement.

The second criterion is that the subsequent agreement must be legally or operationally dependent on the founding convention. That is, the agreement is additional and dependent. I used the same two data sources to determine whether the subsequent agreement was legally or operationally dependent on the treaty process as I did to determine whether they share the same subject matter. First, any protocol, amendment, annex, or adjustment was ruled as both legally and operationally dependent, since they are subsidiary instruments. Second, for all agreements that shared a similar subject matter but were not legally dependent on the founding convention, I used portions of the texts to determine the operational dependence of those agreements. Specifically, I used textual indicators of operational dependence if and when the subsequent agreement references the founding convention or its subsidiary instrument (Appendix 3.2). I used secondary literature on each of the 18 treaty processes to cross-validate the textual evidence by identifying relationships between the treaty process and the agreement.

Some of the integrated agreements are treaties and others are non-binding instruments. I include non-binding instruments because they have made important contributions to global environmental governance (Victor, Raustiala, and Skolinkoff 1998). The total number of years with an integrated agreement is 153. In testing the hypotheses, more years with a new integrated agreement reflect more integrated cooperation under a treaty process.

INDEPENDENT AGREEMENT. I also measure when governments made agreements outside the legal and operational context of the global treaty process on issues handled by that process. The variable Independent Agreement equals 1 when governments completed an agreement independent of the founding convention or its subsidiary instruments; it equals 0
otherwise. For example, efforts to reduce tropical deforestation have prompted governments to issue multiple political declarations on tropical forestry, including the 1985 Tropical Forestry Action Plan. These outcome documents were issued outside the purview of the International Tropical Timber Organization (ITTO) and did not reflect regulations under the ITTO, which was established to manage the international trade in tropical timber.

As with integrated agreements, I measure whether an agreement qualifies as independent based on the two characteristics distinguishing integrated from un-integrated cooperation: additionality and dependence. First, the stated subject matter of an agreement matches the stated subject matter of the founding convention. This means that an agreement covers a subject under the purview of the treaty process, according to the preamble and objectives portions of the founding convention. It is additional to the treaty process agreements. I went through the same procedure to determine whether a subsequent agreement shared a subject matter with the treaty process as I did in measuring integrated agreements. In particular, I employed the agreement texts as a primary source on additionality and secondary sources from the corresponding literatures to corroborate the coding.

The second criterion is that the subsequent agreement must be legally and operationally independent of the founding convention. That is, the agreement is additional but not dependent. I used the same two data sources to determine whether the subsequent agreement was legally and operationally independent of the treaty process as I did to determine whether they share the same subject matter. First, any protocol, amendment, annex, or adjustment was immediately ruled out as both legally and operationally dependent, since they are subsidiary instruments. Second, for all agreements that shared a similar subject matter and were legally independent of the founding convention, I used portions of the texts to determine the operational independence of those
agreements. No reference to the treaty process was the clearest indication of independence.

Otherwise, I used textual indicators of operational independence if and when the subsequent agreement references the founding convention or its subsidiary instrument (Appendix 3.2). I used secondary literature on each of the 18 treaty processes to cross-validate the textual evidence by identifying relationships between the treaty process and the agreement.

Some of the independent agreements are treaties and others are non-binding instruments. The total number of years with an independent agreement is 56. In testing the hypotheses, more years with an independent agreement reflect more un-integrated cooperation on the issues covered by the treaty process.

3.4.2 Treatment Variables: Regulated Sectors

I coded the treaty processes based on the sectors they regulate. This is consistent with the sectoral focus of my theoretical expectations on the form of global environmental governance. In particular, I use binary variables that differentiate treaty processes based on the sectors they regulate because different sectors involve stakeholders in markets of varying concentration and diffuseness. These are not direct measures of stakeholder concentration. Nonetheless, I use them to estimate how regulating a given sector affects the likelihood of integrated or independent agreements relative to regulating another sector, with the estimated differences reflecting upon the different markets and stakeholders in those sectors.

I constructed four binary variables. The variable Industry indicates whether a treaty process regulates national industries. The variable Agriculture and Land Use indicates whether a treaty process regulates national agriculture and land use. The variable Both Sectors indicates
whether a treaty process regulates both industry and agriculture/land use on a national scale. And the variable _Neither Sector_ indicates whether a treaty process regulates neither industry nor agriculture and land use on a national scale.

Table 3.2 indicates which treaty process subjects correspond to which regulated sectors.

**Table 3.2 Treaty Process Subjects by Regulated Sector**

<table>
<thead>
<tr>
<th>Neither Sector</th>
<th>Industry</th>
<th>Agriculture and Land Use</th>
<th>Both Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Trafficking in Endangered Species</td>
<td>18. Biodiversity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To measure this for each treaty process, I relied on original records of participants in the official meetings of the treaty processes. Lists of Participants (LOPs) indicate the attendees, their institutional affiliation, and the type of affiliated institution (e.g., industry, business, local or indigenous group, non-government organization, international organization, UN agency, etc.). They also sometimes indicate the responsibilities or expertise of the attendees. Low barriers to participation in these meetings make this a fairly accurate measure of the sectors regulated by a treaty process. It provides an independent measure of the regulated sectors.

With the LOPs, I coded the treaty processes based on whether the participants work in industry, agriculture and land use, both sectors, or neither sector (see Appendix 3.2 for details). A treaty process was coded as regulating industry if government and non-government
representatives were from industry or worked on industrial issues. A treaty process was coded as regulating agriculture and land use if government and non-government representatives were from agriculture or land use or worked on those issues. It was coded as regulating both sectors if there were government and non-government representatives from industry and from agriculture or land use or they worked on those issues. And it was coded as regulating neither sector if representatives were neither from agriculture or land use nor from industry and did not work on those issues. I used secondary sources on the 18 treaty processes to cross-validate the LOP-based codings.

3.4.3 Covariates: Alternative Explanations

NUMBER OF STATES. The Number of States Hypothesis suggests that more states contributing to a global environmental problem will possess greater preference heterogeneity and this will contribute to independent agreements. I use two variables to test this argument. First, I use a count variable (Number of Parties) indicating the number of parties to the founding convention or a replacement treaty. Second, I use a count variable for the total number of sovereign states in the world (Total States in the World). This variable captures all the states that could potentially contribute to global environmental externalities. It differs from Number of Parties because it includes all states, not merely those who are parties to the treaty process. Both are expected to be positively associated with independent agreements and negatively associated with integrated agreements.

WEALTH AND GEOPOLITICS. The Wealth and Geopolitics Hypothesis suggests that a global treaty process will tend to encourage states to make independent agreements as the
distributions of wealth and influence change because this will generate preference divergence between developed and less-developed countries. I use three variables to evaluate this hypothesis. First, I use logged global Gross Domestic Product (\( \log(\text{Global GDP}) \)) to measure changes in aggregate global wealth over the timespan of a treaty process. Second, the binary variable \( \text{Post-1992} \) denotes each year of a treaty process beginning with 1992. This is a proxy for changes in global environmental politics since the 1992 UN Conference on Environment and Development (Sell 1996, DeSombre 2000a). And third, I measure the percent of global GDP that the developing states possess with the variable \( \text{G77 GDP Percent} \), which indicates the percent of global GDP accounted for by the G77/China states. The \( \text{Post-1992} \) and \( \text{G77 GDP Percent} \) variables are expected to be positively associated with independent agreements and negatively associated integrated agreements. The \( \log(\text{Global GDP}) \) variable is expected to be positively associated with integrated agreements and negatively associated with independent agreements.

OTHER VARIABLES. I include variables that are likely to affect the frequency of integrated or independent agreements but are not directly tied to one of the explanations for variation in the form of global environmental governance. The binary variable \( \text{Global Commons} \) indicates whether a treaty process covers a global CPR. The following issues were coded as global CPRs: oceans, whales, fish populations, biodiversity, endangered species, forests, and the atmosphere. I include lagged count variables for agreements \( (\text{Total Agreements (t-1)}) \), integrated agreements \( (\text{Total Int. Agreements (t-1)}) \), and independent agreements \( (\text{Total Ind. Agreements (t-1)}) \). These variables count the number of past agreements in place that year on the subject of a treaty process. Governments may become less inclined to make additional agreements as the total number increases, since those prior agreements may address the problem and further agreements might become less useful.
3.5 Statistical Analysis of Agreements

I analyze the relationship between the covariates and the dependent variables with time-to-event models. The dependent variables indicate when countries made an independent or integrated agreement following a convention already in place. Some time elapsed between the initial convention and the subsequent agreement. Just as importantly, integrated and independent agreements imply that governments had made earlier agreements on an environmental issue. They added to the rules and institutions already in place to govern the issue. Both the temporal and dependence dimensions of these agreements suggest that a time-to-event analysis should be used to evaluate the hypotheses.

INDEPENDENT AGREEMENTS. Figure 3.1 below displays the Kaplan-Meier survival estimates for treaty processes regulating different sectors. These are descriptive nonparametric estimates of the probability of not having an “event” occur by a given time (Rich et al. 2010). In this analysis, the “event” is an independent agreement. The x-axis denotes the years until an independent agreement after the previous one was made. The y-axis denotes the probability of not having had an independent agreement by that year. Estimates closer to 1 at \( t \) denote a lower the probability of having had an independent agreement. Estimates farther from 1 at \( t \) denote a higher the probability of having had an independent agreement.

These survival function estimates provide preliminary support for the Stakeholder Concentrations Hypothesis. They indicate that treaty processes regulating neither sector or regulating industry are associated with a lower probability of independent agreements relative to treaty processes regulating agriculture and land use or those regulating both sectors. In particular,
treaty processes regulating agriculture and land use or both sectors are associated with a higher probability of an independent agreement at early periods following the previous independent agreement. The sharper declines in the survival estimates for treaty processes regulating agriculture and land use or both sectors are important: they indicate that these processes are associated with independent agreements soon after the previous independent agreement. The same is not true of treaty processes regulating industry or those regulating neither sector. These survival estimates support the Stakeholder Concentrations Hypothesis.

Fig. 3.1 *Kaplan-Meier Survival Estimates of the Years Until an Independent Agreement*. This shows the Kaplan-Meier survival estimates for each sectoral category. Estimates closer to 1 correspond to a lower probability of an independent agreement by \( t \). Estimates farther from 1 correspond to a higher probability of an independent agreement by \( t \).

I estimated Cox proportional hazards models of the years until an independent agreement, with robust standard errors clustered on *Treaty Process*. These provide estimates of the relative
“hazard” of countries making an independent agreement. Since treaty processes can correspond to a sequence of independent agreements, this sequence may change the baseline hazard of a treaty process after each additional independent agreement is made. I model this heterogeneity in the baseline hazard after each new independent agreement is made by stratifying the baseline hazards on the sequence of independent agreements corresponding to a treaty process. Stratification can model the heterogeneity of baseline hazards associated with repeated events (Box-Steffensmeier and Jones 2004, Chapter 10). In this case, the repeated events are repeated independent agreements. I use stratified Cox models to model the hazard of repeated independent agreements, conditional on the covariates.

Since the sector variables are binary categories, I exclude one of the sector variables and that variable serves as the reference category for estimates of the other sector variables. Thus, the coefficient estimates are relative to the reference category not included in a model specification, enabling a comparison of treaty processes regulating different sectors in terms of the “hazard” of an independent agreement. Table 3.3 reports the coefficient estimates (Appendix 3.1).

Overall, the results support the Stakeholder Concentrations Hypothesis. Regulating agriculture and land use is associated with a higher hazard of an independent agreement relative to regulating neither sector (Models 2 & 4). Regulating both sectors has a higher hazard relative to regulating industry or neither sector (Models 1 & 3). However, regulating agriculture and land use is not associated with a lower or higher hazard than regulating both sectors (Models 2 & 4). These hazard ratio estimates are consistent with the survival estimates in Figure 3.1 above.

*Treaty processes regulating sectors with diffuse stakeholders are more prone to encouraging states to make independent agreements than treaty processes regulating concentrated stakeholders.*
Predicted hazards provide one way of assessing the magnitude of the differences in regulating sectors with varying stakeholder concentrations. Figure 3.2 plots the mean predicted hazard ratios across all the models for each sectoral category. It also plots the distributions of predicted hazard ratios across all the models for each sectoral category. These predicted hazards strongly support the Stakeholder Concentrations Hypothesis: regulating sectors with more diffuse stakeholders corresponds to a higher hazard of independent agreements. In particular, the more that stakeholders operate in diffuse markets, the higher are the predicted hazards of an independent agreement.

![Predicted Hazards](image)

**Fig. 3.2** *Predicted Hazards (Years Until an Independent Agreement).* The left plot shows the predicted hazard ratios, averaged over the observations in a model and then over all the models, separated by the sectoral category. The right plot shows the predicted hazard ratios, averaged over the observations in a model, separated by the sectoral category.

Robustness checks confirm these findings. Excluding the treaty process on international rivers, which has a disproportionate number of years with an independent agreement compared to other processes in the sample, does not alter the findings. Nor does excluding climate change from the analysis alter the findings. Moreover, testing for non-proportional hazards yields null
estimates for three of the four sectoral categories. This suggests that the relationship between regulating sectors with varying stakeholder concentrations and the incidence of independent agreements does not vary over time, expect for those covering neither sector. The effects of regulating concentrated or diffuse stakeholders on un-integrated cooperation remain stable over time.

The results do not support either of the alternative explanations. Table 3.3 reports that all three variables corresponding to the Wealth and Geopolitics Hypothesis have null hazard ratios in each of the four models. This strongly debunks the Wealth and Geopolitics Hypothesis on why governments would form un-integrated cooperation on the global environment. Moreover, neither of the variables corresponding to the Number of States Hypothesis is positively associated with independent agreements. The number of parties in a treaty process is negatively related to independent agreements – the opposite of the Number of States Hypothesis. These estimates indicate that treaty processes with more parties are less prone to encouraging independent agreements than those with fewer parties. The number of sovereign states in the world has a null hazard ratio estimate. Having more states in the world is neither positively nor negatively related to independent agreements.

INTEGRATED AGREEMENTS. Turning to integrated cooperation, Figure 3.3 below displays the Kaplan-Meier survival estimates of the probability of an integrated agreement for each category of regulated sectors. Recall that these are descriptive nonparametric estimates of the time until an event occurs. In this case, the event is an integrated agreement. An estimate closer to 1 corresponds to a lower probability of having had an integrated agreement by \( t \). An estimate farther from 1 corresponds to a higher probability of having had an integrated agreement by \( t \). Sharp vertical declines indicate a significant change in the probability of having
had an integrated agreement; gradual vertical declines indicate a gradual change in the probability of having had an integrated agreement.

![Graph showing Kaplan-Meier survival estimates for different sectors.](image)

**Fig. 3.3** *Kaplan-Meier Survival Estimates of the Years Until an Integrated Agreement.* This shows the Kaplan-Meier survival estimates for each sectoral variable. Estimates closer to 1 correspond to a lower probability of an integrated agreement by \( t \). Estimates farther from 1 correspond to a higher probability of an integrated agreement by \( t \).

These survival estimates support the Stakeholder Concentrations Hypothesis. They indicate that treaty processes regulating industry encourage repeated integrated agreements. The steady drop in the survival estimates for treaty processes regulating industry suggests that governments make integrated agreements soon after they made the previous integrated agreement. Treaty processes regulating agriculture and land use take longer to encourage governments to make integrated agreements. Specifically, there are no estimated drops in the survival estimates corresponding agriculture and land use between 0 and 5 years after the
previous integrated agreement – and the drop is not steep between years 5 through 10 after the previous integrated agreement compared to processes regulating industry.

These relative declines are important: they indicate that treaty processes regulating industry encourage more integrated agreements soon after the prior integrated agreement compared to treaty processes regulating agriculture or land use. Treaty processes regulating neither sector prompt integrated agreements early on but not subsequently, unlike those regulating industry. These survival estimates are largely consistent with the Stakeholder Concentrations Hypothesis.

I estimated Cox proportional hazards models of the years until an integrated agreement, with robust standard errors clustered on Treaty Process. As in the analysis of independent agreements, I model heterogeneity in the baseline hazard after each new integrated agreement is made by stratifying on the sequence of integrated agreements corresponding to a treaty process. Stratification can model the heterogeneity of baseline hazards associated with repeated events – in this case, repeated integrated agreements. These models estimate the relative hazards of repeated integrated agreements, conditional on the covariates.

Since the sector variables are binary categories, I exclude one of the sector variables and that excluded variable serves as the reference category for estimates of the other sector variables. Thus, the coefficient estimates are relative to the reference category not included in a model specification, enabling a comparison of treaty processes regulating different sectors in terms of the “hazard” of an integrated agreement. Table 3.4 reports the coefficient estimates (Appendix 3.1).

Overall, the results provide only mixed support the Stakeholder Concentrations Hypothesis. Regulating agriculture and land use is associated with a lower hazard of an
integrated agreement relative to any of the other treaty processes, expect those covering neither sector (Model 6). However, regulating industry does not have a higher hazard of an integrated agreement relative to regulating both sectors, contrary to the Stakeholder Concentrations Hypothesis (Models 5 & 8). And regulating both sectors has a higher hazard of an integrated agreement than regulating neither sector, also contrary to the Hypothesis (Model 7).

Integrated cooperation on global environmental issues stemming from agriculture and land use is unlikely compared to issues stemming from other combinations of sectors (e.g., industry). However, integrated cooperation on neither sector is not more likely than integrated cooperation on both sectors. This contrary finding may reflect a combination of two factors. First, there is limited regulatory need for many integrated agreements on geographically concentrated issues such as wetlands or economically concentrated issues such as fisheries zones. Second, governments confront political divergence on making many integrated agreements on contentious issues such as climate change, persistent organic pollutants, or international rivers. Consequently, there may be less demand for integrated cooperation on concentrated issues stemming from neither sector but greater demand for integrated cooperation on diffuse issues faces political obstacles.

According Figure 3.4 below, regulating neither sector and regulating both sectors have comparable predicted hazard ratios, but the greatest disparity is between agriculture and land use, on the one hand, and industry, on the other. These estimates are consistent with the findings earlier: treaty processes regulating agriculture and land use are more prone to encouraging independent agreements than treaty processes regulating industry. Regulating agriculture and land use corresponds to drastically different international cooperation patterns than regulating industry.
Robustness checks confirm these findings. Excluding either the treaty process on international rivers or the process on climate change from the sample supports the finding that regulating agriculture and land use has a lower hazard of integrated agreements than regulating industry. Excluding the process on international rivers shows that regulating neither sector has a lower hazard of integrated agreements than regulating both sectors, although this is not true when excluding climate change. Tests for non-proportional hazards yield null estimates, except for a declining hazard corresponding to treaty processes regulating neither sector. Regulating each of the other three categories has a stable relationship with integrated agreements over time.

The results provide qualified support for the Wealth and Geopolitics Hypothesis. To support that hypothesis, we would need positive estimates for logged global GDP but negative estimates for Post-1992 and the G77’s share of global GDP, because these latter two variables are associated with more global division and geopolitical and economic competition. In the models, the signs and significance levels on logged global GDP and the G77 percent of global
GDP support the hypothesis. A higher global GDP is associated with more integrated agreements but a greater share of that GDP in the G77 states is negatively associated with integrated agreements. Thus, (i) more wealth in the world corresponds to integrated global cooperation on the environment and (ii) a greater share of that wealth in the developing countries corresponds negatively to integrated cooperation. However, the signs on the post-1992 variable are not negative and significant. The post-1992 period has not seen fewer integrated agreements, contrary to the idea that the post-1992 period has contributed to less integrated cooperation on the global environment.

The evidence is more mixed regarding the Number of States Hypothesis. Only one of the variables corresponding to this hypothesis is negatively associated with integrated agreements, providing partial support. Specifically, the number of parties in a treaty process has a null relationship with integrated agreements: *having more parties in the treaty process does not translate into fewer integrated agreements on the global environment*. However, estimates indicate that having more sovereign states in the world is associated with a lower hazard of integrated agreements. This is consistent with the Number of States Hypothesis: *more sovereign states in the world dampen the prospects of integrated agreements on the global environment*.

3.5.2 Discussion

The empirical strategy leverages variation in the concentration of stakeholders responsible for pollution in the sectors regulated (and not regulated) by the treaty processes. Estimates based on the sector variables show how governments react to different regulated sectors, each with varying market concentrations, after making a global environmental treaty
process. Treaty processes regulating sectors with economically concentrated stakeholders are associated with integrated regimes; they rarely prompt independent agreements. Treaty processes regulating sectors with economically diffuse stakeholders are associated with more independent agreements. Parties decide that the convention they had formed for a given problem stemming from these sectors should not be the sole platform for mitigating the problem.

Market characteristics are consistent with these international cooperation patterns. Industry and land use have vastly different market concentrations worldwide, particularly at the producer level. National industries contributing to global environmental pollution are often in one of two sectors: chemicals or manufacturing. The Lists of Participants used to construct the sector variables indicate that these companies are often organized at national and international levels, have large trade associations, and include capital-intensive firms in upstream producer markets, if not also in downstream consumer markets. Innovations can spread top-down because multinational producers can diffuse their technologies to downstream consumers with varying experience in using technology (Arora and Gambardella 2011).

Agricultural sectors do not share these market characteristics. Food production comes from diverse communities within and across countries that have heterogeneous resource bases (Shih and Wright 2011, 49). The LOPs indicate that farming communities have organized national trade associations. However, some farming associations also have local or provincial goals to a greater extent than the industry associations – and the international associations exist to protect the interests of multinational biotechnology companies based in North America or Europe (e.g., CropLife International), not indigenous farmers. Agricultural innovation is generally a bottom-up process involving considerable risk because of intense price competition (Shih and Wright 2011, 74). Technological diffusion happens in local networks in the developing
world, not on large scales (Abdulai and Huffman 2005). The heterogeneity of settings where land use reforms could reduce pollution prevents the generalized solutions that multi-national companies in industry can sometimes diffuse to meet global environmental standards.

The statistical findings highlight a distinction between global regulations whose costs in the first instance fall on wealthy countries (e.g., industrial pollutants) and those whose costs in the first instance fall on lower-income countries (e.g., land use and agricultural production). When costs fall on wealthy countries, as in reducing chemical pollution, preferences between wealthy and lower-income countries converge. Wealthy countries take action and lower-income countries benefit from the diffusion of new technologies developed to meet new pollution standards. By contrast, when costs fall on lower-income countries, as in land use or agricultural reforms, they confront capacity problems and lack the incentive to undertake costly reforms. They resist pressure from wealthy countries to adopt reforms: preferences diverge. The use of independent institutions and agreements reflects these differences. Preference divergence prompts governments to proliferate institutions and agreements on an environmental problem and preference convergence encourages them to create integrated regimes.

Alternative explanations do not account for variation in the form of global environmental governance, particularly with respect to un-integrated cooperation. The changing distribution of global wealth and geopolitical influence was not a significant factor in the development of un-integrated global environmental cooperation. However, it was more significant in diminishing integrated cooperation. Post-1992 changes in global wealth and geopolitics have not contributed to un-integrated cooperation but the changing distribution of global wealth has dampened integrated cooperation. Moreover, the number of state parties in a treaty process was not a significant source of un-integrated cooperation. *In fact, having more parties in a treaty process*
has detracted from un-integrated cooperation. Growth in the total number of sovereign states has been negatively associated with integrated cooperation but has not been positively associated with un-integrated cooperation. Thus, having more sovereign states in the world has dampened integrated cooperation but has not spurred un-integrated cooperation. Overall, the number of states with control over the issue and macro-level changes in global wealth and geopolitics in recent decades have not consistently encouraged both less integrated cooperation and more un-integrated cooperation on the global environment. Their impacts have been less consistent compared to regulating sectors with varying stakeholders and market concentrations.

3.6 Global Governance of Climate and Stratospheric Ozone

I substantiate the statistical findings by relying on a focused comparison of the global governance of two atmospheric issues: climate change and ozone layer depletion. This comparison enables a precise measure of the consequences of regulating sectors with varying stakeholders by focusing on two issues featuring different stakeholder concentrations and different international cooperation patterns. I rely on this focused comparison to map the precise relationship between varying sectoral concentrations and international institutions for financial assistance and technology transfer in the regimes for climate change and ozone layer depletion.

Climate change and ozone layer depletion have presented different technological, economic, and development challenges. Businesses affecting the mitigation of climate change are more diffuse than those affecting the protection of the ozone layer. They are in multiple sectors involving diffuse upstream and downstream markets. Moreover, the international institutions for climate change mitigation and adaptation differ considerably from those
developed to protect the ozone layer, particularly with respect to whether they are integrated under a single treaty regime. Therefore, this focused comparison enables us to leverage variation in stakeholders to understand variation in global governance. Table 3.5 summarizes variation relevant to the Stakeholder Concentrations Hypothesis.

Table 3.5 Stakeholders, Barriers to Innovation, and Government Preferences Across Issue-Areas

<table>
<thead>
<tr>
<th>Issue-Area</th>
<th>Stakeholders</th>
<th>Barriers to Innovation</th>
<th>Government Preferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate Change</td>
<td>Energy consumers, land owners, power plants, industry</td>
<td>Large investment start-up; implementation limitations; market uncertainty and fragmentation</td>
<td>Divergent preferences over time within and across national wealth categories</td>
</tr>
<tr>
<td>Ozone Depletion</td>
<td>Chemicals companies, consumers of refrigerants</td>
<td>Limited market uncertainty; known investment needs; minor adjustment obstacles</td>
<td>Convergent preferences over time across national wealth categories</td>
</tr>
</tbody>
</table>

For valid inferences, I rely on similarities between the two treaty processes. Both processes have long included developed and large developing economies, as well as nearly all the G77/China members, although their subsidiary instruments have different memberships. Both processes have also operated by a consensus decision rule, under which a proposal must not be the subject of a stated objection by a party for it to pass. The UNFCCC and the Montreal Protocol were negotiated within five years of each other and both have spanned the period 1992-2012. Both processes also handle a global atmospheric commons problem. These similarities limit the extent to which important confounding variables have contributed to variation in the form of global governance.

For the focused comparison, I conducted 45 semi-structured interviews with representatives from national governments, international organizations, and non-governmental
organizations across five countries and three continents. Interviewees were selected using LOPs from the UNFCCC and Montreal Protocol meetings and by snowball sampling. I also made field observations as an observer at two official meetings of the Montreal Protocol.¹

3.6.1 Where Global Economic Changes Affected Global Atmospheric Institutions

Global economic changes have contributed to a paradigm shift in global environmental politics since the 1992 Rio Conference. During the International Negotiating Committee (INC) process, the United States did not expect China’s GHG emissions to increase as rapidly as they would over the next twenty years (Interview 30, US State Department). They did not expect China’s economy to grow at the rate it would grow in that timespan. Although the US expected that at some point, China’s GHG emissions would surpass the US’s GHG emissions, they expected it would take longer than it proved to take. Consequently, the extent to which the United States and Europe relied on China and other large developing economies for effective climate change mitigation rose quickly because they recognized that emissions from the developing world were rising faster than emissions from the developed world were stabilizing (Interview 4, UNFCCC Secretariat). This contributed to the importance of the BRICS (Brazil, Russia, India, China, and South Africa) in the climate change negotiations. However, it did the same in the Montreal Protocol negotiations because the demand for refrigerants and fluoro-products was rising rapidly in the large developing countries relative to the stabilizing demand in the developed world. The demand for air conditioning will continue to outpace that in the

developed world by wide margins (Interview 40, fluoro-product industry). In the UNFCCC and the Montreal Protocol processes, parties recognized that the changing structure of global economic wealth and the industrialization underway in large parts of the world meant that investments in atmospheric protection would need to shift from the industrialized countries to the industrializing countries (Interview 27, US State Department; Interview 34, international organization).

Over the 1990s and 2000s, these changes contributed to disagreements and politicized negotiations on climate change to a greater extent than on ozone layer protection. The United States became more aware of China as an economic competitor than Europe had been during the 1970s and 1980s, when the US had assertive environmental protection policies at the international level (DeSombre 2000b). The US was sensitive to the competition-distorting effects of an imbalanced climate change regime in which the United States would accept legally binding GHG limitations without China doing the same (Interview 25, US State Department). US efforts to install flexibility in the Kyoto climate regime and its ultimate rejection of the Kyoto Protocol under the Bush administration reflected the growing concern for US companies competing against foreign companies under different regulatory constraints (Interview 13, US State Department). The institutional shape of the Kyoto climate regime and the choice by the largest country emitter of GHGs (the US) both reflected the economic transformations underway during the 1990s and 2000s. The bifurcated two-track structure of the UNFCCC process since 2007 was largely a result of the bargains struck in 1992, 1995, and 1997 between the United States, Europe, and large developing countries, each party having different priorities and goals. Those main parties had other priorities during the advent of the UN ozone protection regime under the Vienna Convention and the Montreal Protocol (Interview 20, White House).
The Montreal Protocol began as a developed country “pact” (Interview 20, White House). The importance of developing country contributions to ozone layer depletion was not paramount at that period. After the Protocol was adopted and entered into force, the United States sought to have China and other large developing countries join the Protocol under a principle of common but differentiated responsibilities. That principle had not existed in legal and institutionalized form prior to the Montreal Protocol (Interview 34, international organization). The United States was willing to give China more time to meet the same legal requirements as the United States faced and provided some of the financing to achieve implementation of those commitments. In other words, the US was willing to finance implementation in the developing countries, known as Article 5 parties under the Protocol. It has been more reluctant to accept similar responsibilities under the UNFCCC process (Interview 13, US State Department). Over time, the financial mechanism of the Montreal Protocol process has been considered the main reason for that treaty’s success in protecting against the dangers of both ozone layer depletion and climate change resulting from fluorinated gases entering the atmosphere (Interview 36, US EPA).

The rising importance of large developing countries in protecting the atmosphere from human interference has altered the bargaining dynamics and politics of the Montreal Protocol and the UNFCCC processes. However, during the twenty years after the 1992 Rio Conference, the ozone and climate regimes have followed two entirely different pathways. The Montreal Protocol has internalized more of the responsibility and institutions to reduce ozone layer depletion. In 1990, 1992, 1995, 1997, 1999, and 2007, parties either amended or adjusted the Protocol to add more requirements. It also achieved universal membership – the only environmental treaty to have universal membership (Interview 37, Environment Canada). The UNFCCC process has contributed to an un-integrated global regime for climate change, far from
the integrated and consolidated structure of the regime for ozone protection (Victor 2011). Over the twenty years when the structure of economic wealth and the contributions of developing countries to global environmental externalities have changed, these global treaty processes have followed divergent pathways. The economic changes and political shifts associated with those changes cannot explain these divergent pathways because those changes occurred during the same 1992-2012 period of each treaty process. The only difference – an important one – is that the Montreal Protocol was adopted five years before the UNFCCC. The integrated development of the ozone regime and the un-integrated development of the climate regime have followed in those two decades.

3.6.2 Where Stakeholder Concentrations Affected Global Atmospheric Institutions

STAKEHOLDER CONCENTRATIONS. The distribution of stakeholders in these treaty processes vary considerably because of the discrete characteristics of ODS and the diffuse characteristics of GHG emissions in national economies. Stakeholders in the Montreal Protocol process come largely from industries involving discrete consumer products and retail items: refrigerants, air conditioning, inhalers, foams, flame retardants, etc. Some stakeholders come from the agricultural sector because of the limited but declining use of Methyl Bromide, an ODS used as a pesticide in the United States and few other countries (Mayfield and Shelley 2012). Although the applications of ODS chemicals are discrete, the upstream producer market has long been dominated by a small number of multi-national chemical companies based in the United States and Japan: DuPont, Dow Chemical, Honeywell, and Daikin Industries. The downstream manufacturing markets are more diffuse but generally concentrated compared to land use sectors.
because these firms manufacture consumer goods that require high levels of financial capital and human capital expertise. In fact, some of the fluoro-chemical companies are integrated both upstream and downstream; they manufacture and provide inputs to different portions of the in-house supply chain before selling consumers products (Interview 43, fluoro-product industry).

Stakeholders in the UNFCCC process are more economically diffuse than stakeholders in the Montreal Protocol process. A former Executive Secretary of the UNFCCC remarked, “the climate change process relates to a large number of greenhouse gases which are in thousands if not millions of applications in the energy sector, transportation, buildings, land use practices, etc.” (Interview 10, UNFCCC Secretariat). Unlike the Montreal Protocol, local stakeholders such as municipalities and national farm associations regularly attend the UNFCCC meetings to represent the interests of sub-national regions, lobby national governments, and raise awareness (Interview 14, NGO; Interview 29, NGO).

INNOVATION PROSPECTS. How have these stakeholder differences affected innovations in climate change mitigation and ozone layer protection? Fluoro-chemical companies develop ODS substitutes when they expect demand for newer chemicals in the downstream industries. For the downstream industries, the costs of converting to newer chemicals can be passed onto consumers of finished products without much revenue loss if consumption regulations punish or dis-incentivize the use of cheaper chemicals (Interview 37, Environment Canada). The concentration of firms in downstream industries provides confidence to the upstream fluoro-chemical companies that they will recoup investments. According to a long-time participant in the fluoro-chemicals industry, DuPont would make substitutes for Methyl Bromide if not for the diffuse downstream agricultural market that dis-incentivizes innovations (Interview 40, fluoro-product industry). Companies like DuPont and Honeywell
have targeted investments in more concentrated industries like refrigerants, coolants, and inhalers. One early study says that fluoro-chemical companies generally recover capital investment in six months to two years, meaning that investment in newer ozone-safe chemicals has not been prohibitively risky from a company’s standpoint (Hope 1996, 37).

In the fluoro-chemicals industry and downstream industries, businesses have anticipated future conversions in technology. The expectation of technological change has grown after successive transitions away from older chemicals with high ozone-depleting potential (ODP). The expectation of new chemicals begins after a transition from older ones precisely because large fluoro-chemicals producers like DuPont, Honeywell, and Daikin Industries recognize that transition chemicals are not permanent solutions (Interviews 39-42, fluoro-product industry).

Producers of refrigerants and air conditioning are concentrated enough for fluoro-chemical producers that a level-playing field and restrictions on the sale and import of older chemicals can incentivize large investments in ODS substitutes (Interview 37, Environment Canada). The technical capacities of downstream markets are robust enough to keep low any uncertainties about implementation. Instead, the uncertainty comes from regulators and the Montreal Protocol process itself, particularly recently as governments have debated the phase-down of hydrofluorocarbons (HFCs) (Interview 41, fluoro-product industry). Impediments to innovation come not from stakeholder characteristics as much as from the political process among governments when they debate new regulations under the Montreal Protocol.

By contrast, energy sectors in large advanced economies have not faced the same expectations for rapid transitions as ODS producers have since the 1980s. In the United States, policy officials have recognized that rapid energy transitions would raise costs and affect national wealth, limiting the exposure of the energy sector to regulatory pushes away from fossil
fuels (Interview 13, US State Department). Without low-cost alternatives to carbon-based energy, policy incentives have come from tax credits and public funding for RD&D (e.g., the 2009 Recovery and Reinvestment Act), in contrast to the “policy push” that has driven innovation in fluoro-chemicals over the past two decades. The focus has been on accelerating the pace of incremental transitions away from fossil fuels.

Besides energy sector innovation, governments and companies face non-technical barriers that make incremental changes the only feasible option in land use reform. For example, introducing biofuels requires re-allocation of land resources in wealthy and lower-income countries, which results in social, political, and economic consequences that are often unexpected and difficult to model in planning policy (Creutzig et al 2012). Technical innovations and policy interventions would need to overcome informational and social barriers to introduce biofuels on a wide scale in land-rich countries (Wheeler et al forthcoming). Similarly, reducing deforestation in the tropics involves policy challenges because of the local nature of the problem (Burgess et al 2012). A growing number of industries have a stake in the outcome of forestry negotiations under the UNFCCC (Interview 23, European Commission; Interview 32, Danish Ministry of Climate and Energy). Diffuse stakeholders in the land use sector create implementation challenges and consequently dis-incentivize the mass application of new techniques or potential policy mechanisms to lower GHG emissions from these diffuse actors.

Downstream consumer markets for energy or agriculture demonstrate resistance to price increases. Consumers of fluorinated refrigerants are also wary of price increases, but lowering prices on substitutes satisfies their demands. The same is not true in agriculture, for example, which has long demonstrated reluctance toward lowering the application of fertilizers (Interview 45, fertilizer industry expert). This dis-incentivizes innovation and consequently prevents
environmental externalities from declining because local actors oppose changing common practices – a situation that has characterized the use of ozone-depleting pesticides for over a decade in the United States (Erin and Shelley 2012). In addition to price barriers, therefore, informational and other factors inhibit innovation in climate change mitigation in large GHG-emitting sectors.

INTERNATIONAL TECHNOLOGY TRANSFER INSTITUTIONS. How have these reactions to stakeholder characteristics affected international technology transfer institutions in these processes? Unlike the Kyoto Protocol to the UNFCCC, the Montreal Protocol does not have an institution for North-South technology transfer because the process has not needed a formal institution to achieve its objectives. Businesses and parties to the Protocol have internalized the technology transfer functions necessary to lower global ODS consumption and production. The Montreal Protocol has a decentralized system for facilitating North-South technology transfer, enabled by stakeholders that possess the capital and expertise needed to make and apply ODS technologies (Andersen, Sarma, and Taddonion 2007).

The Montreal Protocol has not included a technology transfer institution because the trade restrictions imposed on ODS imports have facilitated trade in newer chemicals. Consequently, companies from the United States, Europe, and Japan have been willing to invest in conversion projects in developing countries because of market demand. The only Montreal Protocol institution in place to facilitate this decentralized approach to technology transfer is the Technical and Economic Assessments Panel (TEAP) of the Protocol, which has provided timely assessments to downstream industries on replacements to older chemicals.

Downstream industries that use fluorinated chemicals or their substitutes treat the Montreal Protocol process as a signal of when to switch to newer chemicals and large fluoro-
product manufacturers use the process as a signal of when to invest in those chemicals. That enables the downstream companies to sell their products in foreign markets where Montreal Protocol controls are in place, although developing countries have a ten-year grace period before they reach the same phase-out deadlines as the developed countries. Countries that import consumer goods including the ozone-safe technologies need not make additional changes to the imports to lower their ozone-depleting potential enough to meet obligations under the Montreal Protocol because those imports already have the substitutes in place. Technology diffusion occurs via exports that include newer chemicals that are already compliant under the Montreal Protocol when they enter customs and do not require post-import changes.

The Montreal Protocol has facilitated technology transfer via trade in part by prohibiting the export and import of substances under its control regime. The United States first adopted a trade barrier in accepting the Montreal Protocol in 1988 to protect domestic producers against foreign companies using CFCs and halons. Under the Protocol, trade in controlled substances is prohibited to encourage parties to reduce their production and consumption of these chemicals (Interview 37, Environment Canada). Parties adopt domestic regulations when they ratify the Montreal Protocol or its subsidiary amendments to ban the import of controlled substances. In exporting products with ODS substitutes, these companies have facilitated technology diffusion without a large concern about competitive disadvantages in the foreign markets.

Multinational corporations producing fluoro-chemicals and manufacturers of consumer products have voluntarily invested in conversion projects in developing countries that accepted obligations under the Montreal Protocol. These companies have financed more of the conversion to low-ODS technologies than the formal institution under the Montreal Protocol for these purposes, the Multilateral Fund. According to one expert on the Montreal Protocol, the Fund acts
mainly as a political instrument among developed and developing countries as a sign of commitment to offsetting the costs of conversion in developing economies (Interview 40, fluoro-product industry). Company incentives have come from regulations adopted on a series of ODS, beginning with CFCs and halons, and then HCFCs, that created markets for newer chemicals. With companies from the United States, Europe, and Japan providing much of the finance for conversion projects in developing economies, governments have not needed to establish a formal mechanism for technology transfer.

Parties receive updated information on different technologies and economic conversion costs from the TEAP – a body composed of experts from developed and developing countries. These experts come from the sectors that use fluorinated chemicals or their substitutes and from the science and engineering fields. They play a clearly defined role in distributing information about technology options to the contracting parties of the Protocol (Interview 36, US UPA). This reduces the burden on lower-income countries that lack the expertise to assess the economic costs and technical requirements of meeting specific obligations under the Protocol. Moreover, it means that parties to the Protocol need not develop alternative mechanisms to provide technical and economic assessments on conversions to ODS substitutes and newer chemicals (Interview 36, US EPA). Over time, more information about the conversion process from older to newer fluorinated gases has reduced the burden on governments, internationally and domestically, to make alternatives to the TEAP.

In contrast to the ozone layer regime, the climate change regime has numerous institutions for technology transfer in part because of the much wider scope of potential producers and consumers of innovations. Some of these exist under the auspices of the UNFCCC and its Kyoto Protocol, but several others operate independently of either treaty. Under lower
expectations of rapid technological transition, energy companies have sought opportunities to open new markets and establish partnerships through global governance institutions. For example, energy firms have played an important role in the Clean Development Mechanism (CDM) and other institutions created to achieve climate change mitigation goals, such as the Clean Energy Ministerial (Interview 10, UNFCCC Secretariat; Interview 35, US Energy Department). Non-UNFCCC institutions, in particular, have been used as mechanisms for sharing information about technology programs and commercializing clean energy technologies dealing with carbon capture and storage, renewables, and energy efficiency (Interview 9, White House). Energy firms view these institutions as informal international mechanisms for becoming suppliers of new technologies in foreign markets, despite the inertia that characterizes demand for clean energy.

The primary institution for technology transfer under the UNFCCC is the CDM of the Kyoto Protocol (Schneider, Holzer, and Hoffmann 2008). The CDM allows businesses in the advanced developed economies to earn credits for supplying technology to developing countries that reduce greenhouse gas emissions relative to what otherwise would have taken place – a principle called “additionality.” The Executive Board of the CDM authorizes projects and outsources the responsibility of determining the credits that parties receive to private non-state actors, mainly businesses. The CDM was negotiated at the Kyoto conference in December 1997 to provide all parties an incentive to ratify the Protocol and implement watered down obligations – or what some participants call a “win-win” bargain for wealthy and emerging economies (Interview 6, UNFCCC Secretariat). This is not how participants in the Montreal Protocol have characterized their support for technology transfer.
Although the CDM has recently been valued at over three times what its original creators estimated it would be as of 2010, it represents a fraction of the institutional activities on technology transfer for climate change mitigation (Newell and Paterson 2010). Since 2005, several multilateral dialogue processes and an international organization with legal auspices have formed to coordinate efforts on clean energy technology partly because of market uncertainties. Institutions like the Asia-Pacific Partnership, the Clean Energy Ministerial, the International Partnership for Energy Efficiency Cooperation, and the International Renewable Energy Agency were all created and designed to enable companies to either commercialize technologies or to facilitate information-sharing and transnational collaboration in energy technology. Within the Clean Energy Ministerial, for example, governments have selected which of three general areas they will prioritize in the discussions because of stakeholder preferences and policy goals in those governments (Interview 35, US Energy Department). Except for the International Renewable Energy Agency, the discussions are not conducted under the auspices of a legal treaty and generally seek to harmonize approaches and build confidence among governments.

Unlike ozone-safety technologies with discrete uses, carbon-intensive industrial processes and the emission of carbon dioxide are pervasive enough that governments have found opportunities to collaborate outside the UNFCCC and the CDM to encourage energy savings and clean energy development in more flexible international forums (Interview 11, US State Department). Since carbon-intensive energy production is decentralized and price competition is intense, facilitative mechanisms such as those in place for transferring ozone-friendly technologies would not adequately promote global diffusion of new energy technologies. The slow pace of transitioning to cleaner energy has given impetus to form multiple institutions
outside the UNFCCC process. The market conditions have encouraged more government involvement to spur technology transfer on climate change mitigation.

INTERNATIONAL FINANCIAL INSTITUTIONS. How have stakeholder concentration differences affected the international financing of projects on these two atmospheric issues? In the ozone regime, the Multilateral Fund of the Montreal Protocol has served as the institutional mechanism that provides offsetting funds to Article 5 parties to meet their obligations under the Protocol. The Fund is mandated to cover all incremental costs in transitioning away from ODS. The amount of financing provided through the Fund has historically remained minor compared to what many acknowledge is needed for mitigating and adapting to climate change. Inside national bureaucracies, the funding lines to the Montreal Protocol have come through environment ministries and have remained transparent and stable over time (Interview 34, international organization). By contrast, finance ministries have handled some share of financing for climate change, reflecting the much larger financial assistance needed to address climate change issues such as adaptation support.

The Multilateral Fund is considered one of the critical mechanisms – if not the most critical mechanism – for success in phasing out ODS. The Fund has had sufficient financial support from the wealthy countries, even receiving thanks from major developing countries like China for funding conversion projects (Author’s observations, MOP 23/COP 9 Montreal Protocol). It does not impose different eligibility requirements on different Article 5 parties, reflecting that their funding needs vary in quantity but not in purpose or goals. Large emerging economies require more funding than smaller economies but the application and target of financing is fundamentally the same. Parties have replenished the Fund on successive three-year intervals – and this has facilitated a global phase-out of nearly 100 ODS chemicals. The wealthy
countries currently are willing to finance the phase out of HFCs, which have zero ozone-depleting potential but are potent climate-warming gases (Interview 15, European Commission; Interview 36, US EPA).

The only international institution outside the Montreal Protocol that funds ozone projects is the Global Environmental Facility (GEF), which funds conversion projects in the so-called economies in transition (i.e., former Soviet Union). However, the GEF’s coverage has dwindled to seven countries and the projects it has funded are a fraction of those directly funded under the Montreal Protocol (Interview 44, GEF). The Multilateral Fund remains the financial clearinghouse of the regime.

By contrast, international financing institutions for climate change have not become internalized in the UNFCCC. The Framework Convention has long had the GEF as a financial mechanism. Although the GEF has increasingly funded climate change projects, especially since 2005, the demand for funding has outweighed its resources. Governments seeking assistance for adaptation relief have used the UNFCCC and the Kyoto Protocol, which has three funds administered by the GEF. Recently, the Green Climate Fund was launched by a decision of the COP, although observers are not clear about the consequences of this new financing mechanism for wider landscape of climate financing (Interview 31, World Bank). The multiplicity of funds, even within the UNFCCC and its Kyoto Protocol, stands in contrast to the centralized approach under the Montreal Protocol’s Multilateral Fund.

Moreover, the complexities of UNFCCC financing rules contrast with the simplicity of the Montreal Protocol’s approach. The qualifications for receiving support under the Kyoto funds vary. For example, only the least developed countries are eligible for support from their

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fund program. The operational rules of the recently established Green Climate Fund have not yet been determined – and eligibility for those funds is also undetermined. By contrast, there are no distinctions among Article 5 parties under the Montreal Protocol with respect to their access to the Multilateral Fund’s resources. *The numerous eligibility distinctions in UNFCCC funding mechanisms reflect the fundamentally different financing needs of developing countries in mitigating and adapting to climate change, involving different stakeholders with varying interests and capacities to make adjustments.*

The demand for alternatives to the UNFCCC and Kyoto Protocol financing mechanisms has increased. This has prompted a proliferation of independent institutions at regional and global levels providing climate financing. Outside the UNFCCC process, the United Nations reports, the World Bank and regional development banks (e.g., Asian Development Bank, Inter-American Development Bank) have increased their support for adaptation projects, either through loans or other forms of development assistance (Haughey 2008-9, UNFCCC 2008). Because of the synergies between adaptation to climate change and local economic development and poverty eradication, UN development agencies (e.g., United Nations Development Programme) have made climate change financing a larger priority and have provided project support that the UNFCCC institutions are not as well equipped to provide, particularly in developing economies (Interview 31, World Bank).

### 3.6.3 Discussion

Table 3.6 below summarizes the expectations stemming from the Stakeholder Concentrations Hypothesis and the Wealth and Geopolitics Hypothesis. Stakeholder differences
in climate change governance and ozone layer governance have generated different incentives for governments in establishing the financing and technology transfer institutions of these regimes. However, changes in global wealth and the geopolitical implications of transformations in the distribution of wealth have not contributed to these changes. Governments have relied on multinational chemical companies to invest in, manufacture, and diffuse technologies for ozone layer restoration. The restrictions on producing and consuming controlled ODS – and restrictions on importing controlled ODS – have incentivized these corporations to dominate the technology transfer functions and much of the financing functions of the regime. Governments have invested public financing in the MLF, creating an integrated financing mechanism for the regime.

Table 3.6 Summary of Observable Expectations and Observed Outcomes

<table>
<thead>
<tr>
<th>Observed Outcomes</th>
<th>Observable Expectations</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Financing of ozone projects integrated under the MLF.</td>
<td>Integrated cooperation on ozone depletion</td>
<td>Stakeholder Concentrations</td>
</tr>
<tr>
<td>(ii) Un-integrated financing for climate change projects.</td>
<td>Un-integrated cooperation on climate change</td>
<td></td>
</tr>
<tr>
<td>(iii) Decentralized technology transfer for ozone protection.</td>
<td>Un-integrated cooperation on ozone</td>
<td>Wealth and Geopolitics</td>
</tr>
<tr>
<td>(iv) Independent technology transfer institutions for climate change mitigation (but dominated by CDM).</td>
<td>Un-integrated cooperation on climate change</td>
<td></td>
</tr>
</tbody>
</table>

However, governments have not been able to rely on companies to service the technology transfer functions of climate change mitigation because the incentives for innovation have not been compelling. Weak restrictions on high-GHG processes and products, competitiveness concerns, and diffuse downstream consumer markets have stultified innovation in the sectors contributing to climate change. Bottom-up processes of innovation have emerged instead of the top-down innovation in ozone layer protection. Consequently, wealthy governments have spread
financing of projects across different multilateral institutions and have created multiple institutions to achieve narrow technology transfer objectives. Governments have taken a greater burden because the incentives for the private sector have only been in place when markets were created (e.g., CDM market) but that has been challenging compared to the same task in protecting ozone.

3.7 Conclusion

Why would governments form un-integrated cooperation on global environmental issues? The transaction costs of creating new global regimes, or of using alternative ones, would tend to be higher than creating integrated global regimes. The use of independent international institutions suggests that the transaction costs of global environmental treaty regimes vary.

Using original panel data and qualitative data from negotiation participants and field observations, this chapter argued that treaty processes involving diffuse stakeholders are prone to encouraging un-integrated cooperation because they do not enable stakeholders to lower mitigation costs. Persistent and diffuse mitigation costs create political problems between wealthy and lower-income countries because they pose distributional problems. The wealthy countries are unwilling to finance expensive adjustments and reforms in lower-income countries, in part because of the persistent and high costs. They pursue un-integrated cooperation to minimize political divergence and manage mitigation costs.

Specifically, governments tend to form un-integrated cooperation on diffuse pollution from agriculture and land use but form integrated cooperation on industrial pollution. The more that financing burdens shift from private companies to governments and the more that mitigation
costs remain high or persistent, wealthy governments prefer to separate the issue across different institutions, agreements, and regimes. However, they do this not because it represents the ideal situation. It does not. Un-integrated global cooperation is costly and tends to involve contradictions – or the potential for contradictions – that make it harder for governments to economize on maintaining institutions and harness the synergies from those institutions. They make un-integrated global regimes involving independent agreements and institutions because diffuse stakeholders create political and regulatory barriers preventing governments from harnessing a single treaty regime to regulate pollution from sectors with diffuse markets.

Transformations in the global economy do not explain the divergent pathways of global regimes such as those for climate change and ozone protection. In the twenty years since the 1992 Rio Conference, the large developing countries have become more influential over the fate of the global environment because of industrialization underway in their national economies and increases in natural resource consumption in those societies. However, over that timespan, several regimes have become more integrated: governments have lowered transaction costs and have harnessed the institutions of those regimes for deeper cooperation. The politics of these different regimes has varied not because of economic transformations in the world and the corresponding geopolitical transformations over that time but because of the stakeholder differences that have made some global treaty regimes more ineffective from political and regulatory standpoints than others.
Appendix 3.1

Table 3.1 Treaty Processes in the Sample

<table>
<thead>
<tr>
<th>Treaty Process Subject</th>
<th>Founding Convention</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetlands</td>
<td>Ramsar Convention on Wetlands</td>
<td>1971</td>
</tr>
<tr>
<td>Trafficking in Endangered Species</td>
<td>Convention on International Trade in Endangered Species</td>
<td>1973</td>
</tr>
<tr>
<td>Desertification</td>
<td>Convention to Combat Desertification</td>
<td>1994</td>
</tr>
<tr>
<td>Movement of Industrial Chemicals &amp; Pesticides</td>
<td>Rotterdam Convention</td>
<td>1998</td>
</tr>
<tr>
<td>Plant Genetic Resources</td>
<td>International Treaty on Plant Genetic Resources</td>
<td>2001</td>
</tr>
<tr>
<td>Ozone-Depleting Substances</td>
<td>Vienna Convention on the Protection of the Ozone Layer</td>
<td>1985</td>
</tr>
<tr>
<td>International Rivers</td>
<td>Convention on the Non-Navigational Uses of Watercourses</td>
<td>1997</td>
</tr>
<tr>
<td>Plant Breeding</td>
<td>Convention on the Protection of New Varieties of Plants</td>
<td>1961</td>
</tr>
<tr>
<td>Ocean Pollution from Commercial Ships</td>
<td>Convention for the Prevention of Pollution of the Sea by Oil</td>
<td>1954</td>
</tr>
<tr>
<td>Whaling</td>
<td>Convention on the Regulation of Whaling</td>
<td>1946</td>
</tr>
<tr>
<td>Exclusive Economic Zones</td>
<td>Conventions on the Law of the Sea</td>
<td>1958</td>
</tr>
<tr>
<td>Illicit Fishing</td>
<td>Agreement on Port Measures to Prevent Illegal Fishing</td>
<td>2009</td>
</tr>
<tr>
<td>Hazardous Wastes</td>
<td>Basel Convention</td>
<td>1989</td>
</tr>
<tr>
<td>Intentional Dumping from Ships</td>
<td>London Convention on Dumping of Waste at Sea</td>
<td>1972</td>
</tr>
<tr>
<td>Climate Change</td>
<td>Framework Convention on Climate Change</td>
<td>1992</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Convention on Biological Diversity</td>
<td>1992</td>
</tr>
<tr>
<td>Tropical Forestry</td>
<td>Agreement on the International Tropical Timber Bureau</td>
<td>1977</td>
</tr>
</tbody>
</table>

Note: The names of some founding treaties are shortened.
Table 3.3 Cox Proportional Hazards Models of Years Until an Independent Agreement

<table>
<thead>
<tr>
<th>Reference Category</th>
<th>Industry</th>
<th>Ag &amp; Land Use</th>
<th>Neither Sector</th>
<th>Both Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model Number</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulated Sectors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>−1.960</td>
<td>3.126</td>
<td>−2.562</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.041)</td>
<td>(1.065)</td>
<td>(0.785)</td>
<td></td>
</tr>
<tr>
<td>Agriculture &amp; Land Use</td>
<td>1.486</td>
<td>4.744</td>
<td>−1.239</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.842)</td>
<td>(1.201)</td>
<td>(0.645)</td>
<td></td>
</tr>
<tr>
<td>Neither Sector</td>
<td>−3.498</td>
<td>−4.974</td>
<td>−6.063</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.234)</td>
<td>(1.415)</td>
<td>(1.190)</td>
<td></td>
</tr>
<tr>
<td>Both Sectors</td>
<td>2.458</td>
<td>1.190</td>
<td>6.032</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.885)</td>
<td>(1.114)</td>
<td>(1.142)</td>
<td></td>
</tr>
<tr>
<td><strong>Wealth and Geopolitics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-1992</td>
<td>−0.062</td>
<td>−0.075</td>
<td>0.027</td>
<td>−0.081</td>
</tr>
<tr>
<td></td>
<td>(0.756)</td>
<td>(0.760)</td>
<td>(0.675)</td>
<td>(0.753)</td>
</tr>
<tr>
<td>G77 GDP Percent</td>
<td>−0.124</td>
<td>−0.098</td>
<td>−0.158</td>
<td>−0.135</td>
</tr>
<tr>
<td></td>
<td>(0.190)</td>
<td>(0.193)</td>
<td>(0.180)</td>
<td>(0.192)</td>
</tr>
<tr>
<td>log(Global GDP)</td>
<td>0.371</td>
<td>0.225</td>
<td>1.029</td>
<td>0.394</td>
</tr>
<tr>
<td></td>
<td>(1.691)</td>
<td>(1.726)</td>
<td>(1.483)</td>
<td>(1.638)</td>
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<tr>
<td><strong>Number of Parties &amp; States</strong></td>
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<td></td>
<td></td>
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<td>−0.016</td>
<td>−0.016</td>
<td>−0.016</td>
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<tr>
<td></td>
<td>(0.005)</td>
<td>(0.06)</td>
<td>(0.005)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Total States in the World</td>
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<td>0.044</td>
<td>0.013</td>
<td>0.042</td>
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<tr>
<td></td>
<td>(0.072)</td>
<td>(0.076)</td>
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<td>(0.069)</td>
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<tr>
<td><strong>Other Variables</strong></td>
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<tr>
<td>Global Commons</td>
<td>0.744</td>
<td>0.709</td>
<td>0.530</td>
<td>0.622</td>
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<tr>
<td></td>
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<td>(0.448)</td>
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<td>(0.266)</td>
</tr>
<tr>
<td>Total Agreements (t-1)</td>
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<td>(0.023)</td>
<td>(0.022)</td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.034)</td>
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<td></td>
</tr>
<tr>
<td>Total Int. Agreements (t-1)</td>
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<td>−0.048</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.034)</td>
<td></td>
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</tbody>
</table>

Note: The dependent variable is years until the next independent agreement. Coefficient estimates are reported, not hazard ratios. Robust standard errors (in parentheses) are clustered on Treaty Process. Baseline hazards are stratified on the sequence of independent agreements. The Efron method of ties is used. Bold estimates: p value ≤ 0.05.
### Table 3.4 Cox Proportional Hazards Models of Years Until an Integrated Agreement

<table>
<thead>
<tr>
<th>Reference Category</th>
<th>Industry</th>
<th>Ag &amp; Land Use</th>
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<th>Both Sectors</th>
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<td><strong>Model Number</strong></td>
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<td></td>
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<td><strong>Regulated Sectors</strong></td>
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<td></td>
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<td>Industry</td>
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<tr>
<td></td>
<td>(0.767)</td>
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<tr>
<td>Agriculture &amp; Land Use</td>
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<td>−1.016</td>
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<td></td>
<td>(0.752)</td>
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<td></td>
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<td>(0.712)</td>
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<td></td>
<td>(0.838)</td>
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<td>(0.618)</td>
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<tr>
<td><strong>Wealth and Geopolitics</strong></td>
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<tr>
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<td>(0.097)</td>
<td>(0.091)</td>
<td>(0.101)</td>
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<tr>
<td>log(Global GDP)</td>
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<td>1.943</td>
<td>1.735</td>
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<td>(0.618)</td>
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<td><strong>Number of Parties &amp; States</strong></td>
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<td>Number of Parties</td>
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<td>Total States in the World</td>
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<td><strong>Other Variables</strong></td>
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<tr>
<td>Global Commons</td>
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<td>−0.021</td>
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<td></td>
<td>(0.696)</td>
<td>(0.703)</td>
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<td>Total Ind. Agreements (t-1)</td>
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<td>−0.048</td>
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<td></td>
<td>(0.031)</td>
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<td>(0.023)</td>
<td></td>
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<td>N</td>
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<td>507</td>
<td>524</td>
<td>507</td>
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<tr>
<td>Treaty Processes</td>
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<td>18</td>
<td>18</td>
<td>18</td>
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<tr>
<td>Log likelihood</td>
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<td>−188.589</td>
<td>−192.624</td>
<td>−187.042</td>
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<tr>
<td>$\chi^2$</td>
<td>226.11</td>
<td>161.90</td>
<td>99.63</td>
<td>119.34</td>
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</table>

Note: The dependent variable is years until the next integrated agreement. Coefficient estimates are reported, not hazard ratios. Robust standard errors (in parentheses) are clustered on Treaty Process. Baseline hazards are stratified on the sequence of integrated agreements. The Efron method of ties is used. Bold estimates: p value ≤ 0.05.
Appendix 3.2

Dependent Variables

*Integrated Agreement* (0, 1). *Independent Agreement* (0, 1). The following keywords were used to identify operational dependence on the founding convention or its subsidiary instruments: “implements”, “follows”, “in accordance with”, “accords with”, “replaces”, “supersedes”, “lapses with”, “enabled by”, “observes,” “under the provision of,” and “consistent with.” All these indicate that the agreement is operationally dependent on the founding convention or its subsidiary instruments.


Sector Variables

*Industry, Agriculture and Land Use, Neither Sector, Both Sectors.* (0, 1). To determine the regulated sectors, I identified whether at least ten percent of attendees covered (i) industry, (ii) agriculture, or (iii) land use. If that threshold was satisfied in more than 75 percent of the meetings, I coded the treaty process as regulating that sector, provided the secondary sources corroborated the attendees data.

The following keywords were used to identify the sectoral coverage of a ministry or non-government group: “industry,” “chemical,” “toxic,” “manufacture,” “waste,” “fluoro,” “ship,” and “build” for industry; “agriculture,” “food,” “crop,” “seed,” “fertilizer,” and “pesticide” for agriculture; “forest,” “indigenous,” and “rural” for land use.

Source: Lists of Participants from treaty secretariat webpages.

Covariates


*G77 GDP Percent*. Percent of global GDP of G77 member states (as of 2012). Source: World Penn Table.

*Post-1992* (0, 1). This denotes whether the year is 1992 or a later year.

*Global Commons* (0, 1). This denotes whether the subject of the treaty process is a CPR. The following subjects are recorded as CPRs: oceans, whales, fish populations, biodiversity, endangered species, forests, and the atmosphere.

*Number of Parties* (0, …, 197). This denotes the number of contracting parties to the founding convention. Sources: treaty secretariat webpages.
Total States in the World (0, …, 195). This denotes the number of sovereign states in the world. Source: Correlates of War State System Membership version 2011.

Total Agreements (t-1) (0, …, 89). This denotes the total number of agreements in place in a given year, lagged by one year. Non-binding agreements are only recorded for the year they were negotiated, not subsequent years. Legal agreements are recorded for all years after they were adopted, including the year of adoption, until they are terminated, superseded, replaced, or left to expire. Sources: treaty secretariat webpages, International Environmental Agreements Database Project.

Total Int. Agreements (t-1) (0, …, 71). This denotes the total number of integrated agreements in place in a given year, lagged by one year. Non-binding agreements are only recorded for the year they were negotiated, not subsequent years. Legal agreements are recorded for all years after they were adopted, including the year of adoption, until they are terminated, superseded, replaced, or left to expire.

Total Ind. Agreements (t-1) (0, …, 89). This denotes the total number of independent agreements in place in a given year, lagged by one year. Non-binding agreements are only recorded for the year they were negotiated, not subsequent years. Legal agreements are recorded for all years after they were adopted, including the year of adoption, until they are terminated, superseded, replaced, or left to expire.
CHAPTER FOUR

Regulating Concentrated and Diffuse Stakeholders: Field Surveys on Governing Mercury and Biodiversity

4.1 Introduction

Over two decades, the international community has sought to regulate a growing range of global environmental problems. In June 1992, governments completed historic conventions on climate change and biodiversity. These followed an earlier pair of conventions on ozone layer depletion and the transboundary movement and disposal of hazardous wastes. The succession of global conventions on these policy issues has substantially increased the legal mandates and institutions for managing human influences on global health and the environment. In recent years, several authors have highlighted the proliferation of environmental agreements and the corresponding fragmentation of international law to explore the substantive consequences of this ongoing trend in global politics (Biermann et al. 2009, Stephens 2009).

With the proliferation of international environmental agreements, various global regimes have followed different pathways. Despite its goal of managing biogenetic resources, the 1992 Convention on Biological Diversity shares this responsibility with the International Treaty on Plant Genetic Resources for Food and Agriculture, completed in November 2001. A single treaty with subsidiary instruments does not govern the maintenance, distribution, and sharing of genetic resources used in agriculture. Multiple independent treaties and non-binding instruments share these responsibilities (Raustiala and Victor 2004). Global cooperation on biodiversity remains un-integrated.
By contrast, the chemicals conventions negotiated under the United Nations Environment Programme (UNEP) have remained narrowly focused and consist of integrated institutions and rules on the issues for which they were negotiated. The global chemicals regimes negotiated under UNEP auspices have not experienced un-integrated development comparable to that underway in managing global biodiversity. Instead, a process for harnessing the synergies among the UNEP chemicals conventions is underway (Perrez 2006). What explains variation in the form of international cooperation on chemicals and biodiversity?

This chapter addresses why chemicals and biodiversity regimes have followed different pathways by reporting the expectations and beliefs of those who participated in negotiating global environmental institutions. It employs original survey data from negotiators and other participants involved in UN negotiations on a mercury treaty and an intergovernmental science-policy institution for biodiversity and ecosystem services. It employs field surveys of negotiators and stakeholders involved in the global governance of chemicals and biodiversity to understand the divergent forms of cooperation on these issues. Responses to the surveys clarify the relationships between stakeholders, technological innovation, mitigation costs, political disagreement among countries, and forms of international cooperation in the global governance of chemicals and biodiversity.

I investigate the expectations of individuals directly involved in negotiating global environmental agreements and institutions when they were involved in those negotiations. Because of the proximity of the data to the locations, individuals, and timing of decisions on a new agreement and institution, I am able to characterize the relationship between stakeholders and international cooperation without relying on observed behavior after critical regime-building decisions were made. I measure the beliefs and expectations of negotiators and stakeholders who
contributed to a new treaty and a new institution for global environmental governance *while those beliefs and expectations were most impactful* – during the negotiations.

The data measure the expectations and beliefs of negotiators and stakeholders covering chemicals and biodiversity to evaluate the consequences of varying stakeholder concentrations. Although the stakeholder concentrations argument is about outcomes, participants’ *ex ante* expectations will tend to conform to negotiated outcomes because those participants will seek to anticipate future events and decisions. The expectations and beliefs of negotiators and stakeholders are critical in decisions on international environmental cooperation because they play a role in shaping the development of rules and institutions in international negotiations. In that respect, the expectations and beliefs of government negotiators and non-government stakeholders affect the form of international environmental rules and institutions. Studying beliefs and expectations at the participant level is critical for understanding what the individuals responsible for negotiating and influencing these international cooperation patterns expect to do collectively in the future.

In this spirit, I collected systematic survey data and supplementary data from primary-source interviews, field observations, and textual sources relevant to the negotiations on a UN convention on mercury emissions and releases. I collected the same types of data relevant to the negotiation of an intergovernmental institution for science-policy interface on biodiversity and ecosystem services. The data measure the expectations and beliefs of negotiators and stakeholders covering chemicals and biodiversity to evaluate the consequences of regulating concentrated and diffuse sectors. These data detail how different variables link stakeholder concentrations to the form of international cooperation on mercury pollution and biodiversity loss and ecosystems loss. They map the relationships connecting stakeholders, technology,
disagreement among governments, and the form of international cooperation – a mapping inferred from the statistical evidence in Chapter Three.

Respondents expect integrated agreements on mercury emissions but expect un-integrated agreements on biodiversity and ecosystems. Respondents also believe that stakeholders are more concentrated in mercury management than in biodiversity and ecosystems management. They further believe that technology will have a greater impact in managing mercury emissions than in managing biodiversity and ecosystems. And there is greater disagreement among countries in the biodiversity negotiations than in the mercury negotiations. Overall, government negotiators and non-government participants in the development of the mercury convention and the biodiversity science-policy institution believe that problems with diffuse stakeholders are associated with less technological innovation and more disagreement among parties – and that un-integrated international cooperation is more practical under these circumstances than integrated cooperation.

Most importantly, respondents in the mercury negotiations independently converged on a role for international financing and other issues relevant to global environmental governance more than respondents in the biodiversity and ecosystems negotiations. This signals a common set of expectations on the policy goals and geographic target areas of an international regime for mercury but more mixed expectations and views for biodiversity and ecosystems. *When stakeholders are concentrated, the policy goals and international instruments to achieve those goals become more precise for negotiators and stakeholders to envision and develop.*

Negotiators and non-government stakeholders converge on more precise goals and international instruments when stakeholders are in concentrated sectors.
These findings are robust to higher levels of issue aggregation. Respondents have views on industrial pollution in general that are consistent with their views on mercury. Respondents also have views on diffuse pollution from agriculture and land use that are consistent with their views on biodiversity and ecosystems.

4.2 Stakeholder Concentrations and the Development of Global Governance on Chemicals and Land Use

NARROW AND BROAD MANDATES. Concentrated stakeholders have a greater capacity to narrow the scope of regulations than diffuse stakeholders. They are more able to overcome barriers to collective action than diffuse stakeholders (Olson 1965). They can better target efforts and make the investments necessary to secure policies closer to their preferred policies. They are able to expose diffuse stakeholders to policy externalities (Lowi 1964).

In the environmental field, concentrated stakeholders usually produce pollution from so-called point sources. Point sources are often industrial plants and large facilities whose operations emit pollution from pipes or production processes, both of which have concentrated and fixed locations. Concentrated stakeholders have the incentives and capacities to influence policymakers seeking to impose new regulations on point sources of pollution.

In international environmental negotiations, concentrated stakeholders can more effectively lobby to influence government decisions over regulations than diffuse stakeholders. They have the incentives and capacities to narrow the prospective scope of international regulations on their products and processes. This makes narrowly defined regulation more likely. Concentrated stakeholders prefer narrow mandates for regulation to broad mandates.
By contrast, diffuse stakeholders usually produce pollution from so-called diffuse sources. Diffuse sources are not limited to industrial plants or large facilities. They can be individuals using automobiles and airline transportation. They can be land use practices such as extracting palm oil from forests or harvesting timber for export to foreign markets. They can also be farmers using fertilizer and pesticides on their crops. Diffuse stakeholders have the incentives to influence policymakers seeking to impose new regulations on their practices but they have more obstacles to effective collective action.

In international environmental negotiations, diffuse stakeholders are relatively unable to lobby effectively to influence government decisions over regulations than concentrated stakeholders. They have the incentives but not the capacities to narrow the prospective scope of international regulations on their practices. This makes regulation broad; mandates for regulations are broad and general. Diffuse stakeholders face broader mandates for regulations than concentrated stakeholders.

STANDARDIZING AND TAILORING INNOVATIONS. Concentrated stakeholders can apply standardized innovations in their production facilities and production practices. They can re-apply an innovation to point sources of pollution. Since the point sources are comparable in a specific industry, standardized technological innovations to reduce pollution from the point sources can be applied in similar situations and at similar points of pollution. Concentrated stakeholders are conducive to standardized innovations. Producers need not tailor innovations much because the points of application are comparable enough that they can assimilate standardized technologies. This means producers need not target investments in making innovations for highly specific situations. They can target investments in generally applicable
technologies that could be applied by a class of downstream consumers with similar adjustment needs.

Diffuse stakeholders are generally reluctant to make innovations because the markets they operate in dis-incentivize risky investments and large adjustments. Moreover, diffuse stakeholders are generally local actors: farmers, individual consumers, forest managers, etc. They are unlikely to have comparable circumstances that are conducive to general innovations that can be standardized across different settings. Innovations are more likely to be tailored to the specific needs of specific communities and individuals. The opportunity for producers to make standardized innovations that diffuse consumers would assimilate into their practices is low: only minor innovations created at local scales and adapted to specific individual or community circumstances are likely to encourage adjustments. They can learn to apply an innovation but that takes time because diffuse stakeholders such as small farm owners and forest managers do not possess the human capital resources of concentrated stakeholders like chemical corporations. Innovations would be minor and tailored to the specific needs of local stakeholders.

TOP-DOWN GOVERNANCE. National governments are inclined to create narrow regimes for concentrated stakeholders involving top-down governance. The narrowness of the regime reflects the political lobbying capacities and interests of concentrated stakeholders. The top-down structure of governance reflects the opportunity to make standardized innovations at the global level and diffuse them to local application points. Concentrated stakeholders enable governments to make integrated regimes with an emphasis on general regulations inducing innovations that can be diffused across different stakeholders in concentrated downstream markets. This is relatively efficient for governments: they need not create tailored regulations. They can make them relatively general because innovations to lower environmental externalities
stem from concentrated stakeholders that are also inclined to make standardized innovations for
downstream markets. On the other hand, it is relatively inefficient to the extent that the
regulatory mandates are narrow. Governments would need to make several narrow regimes to
regulate a problem or set of problems stemming from concentrated stakeholders. Thus, each
regime becomes efficient and integrated but they have narrow mandates and that means
governments need more narrow regimes that each become integrated to regulate concentrated
stakeholders.

BOTTOM-UP GOVERNANCE. Governments are inclined to make broad regimes to
regulate diffuse stakeholders because the sources of pollution are diffuse. However, they are
unable to keep them as effective as integrated regimes because innovations cannot be
standardized at the global level and then diffused to local stakeholders. Innovations must be
tailored to specific communities and individuals because they are reluctant to make adjustments
and are more willing to accept innovations scaled up from local levels than scaled down from a
general global level. Governments eventually pursue bottom-up governance to regulate diffuse
sources of pollution because efficient integrated governance is unable to reduce environmental
externalities. More costly and tailored bottom-up governance is more likely to produce marginal
improvements. This is conducive to un-integrated cooperation spanning different levels – global,
regional, and local. Diffuse stakeholders eventually induce governments to adopt more local and
sub-regional perspectives on what is needed for reducing pollution.

CHEMICALS AND LAND USE. Managing chemicals presents a favorable set of
political and regulatory challenges. Although stakeholders are concentrated, they are capital-
intensive, and they have informational and technical resources for assimilating technologies and
making changes to meet environmental standards. Chemicals pollution stems primarily from
point sources such as industry and secondarily from diffuse sources such as agriculture. The industrial sources have historically been more manageable than the agricultural sources, as the regulation of refrigerants and pesticides under the Montreal Protocol has illustrated (Parson 2003, Mayfield and Shelley 2012). Governments would prefer to avoid using un-integrated institutions and agreements for chemicals management because that would not enable them to economize on the public costs of cooperation. Moreover, they can achieve more environmental benefits by channeling resources for specific target areas. Spreading financial resources across multiple institutions is not politically advantageous, as it is in regulating diffuse sources of pollution, and does not produce the same environmental benefits as concentrating resources into an integrated financial mechanism. Integrated chemicals regimes are relatively efficient and cost-effective for national governments to maintain.

Managing land use requires making adjustments across a range of stakeholders with local perspectives, price sensitivity, limited capacities, and narrow information. Local landowners are relatively ill equipped to make cost-effective changes and the pace of technical innovation remains slow relative to concentrated chemicals industries. Internalizing all the major institutions and rules under a single treaty regime that manages land use becomes politically infeasible because of divergent national preferences over international regulations. The regulatory challenges of global environmental problems with diffuse stakeholders compound the political differences among national governments. Independent institutions with narrow mandates become attractive options because they limit stakeholder participation and separate issues over which there is more agreement from those involving more discord. Using independent institutions enables governments to target policy interventions, minimize mitigation costs, and dampen political disagreement.
4.3 Comparing Mercury Pollution with Biodiversity Loss

I evaluate this argument with a focused comparison of international cooperation on mercury pollution and international cooperation on biodiversity loss. The analysis contrasts beliefs on technology, stakeholders, and political disagreement among parties as they relate to the international management of mercury, on the one hand, and the international management of biodiversity and ecosystems, on the other. It applies the stakeholder concentrations argument to two policy domains – mercury management and biodiversity and ecosystems management – to explain the relationships among the main variables of the argument.

Mercury pollution, on the one hand, and biodiversity loss, one the other, are not generally compared because they lack nominal similarities, unlike atmospheric pollution issues such as climate change and ozone layer depletion. I know of no other study making this comparison. Generally, environmental research has focused on chemicals separately from biodiversity.

Nonetheless, the differences between these policy issues provide a basis for analyzing how international cooperation expectations vary with the composition of stakeholders. Figure 4.1 below indicates how stakeholders in the Convention on Biological Diversity (CBD) and the Intergovernmental Negotiating Committee (INC) on a mercury treaty differ on three dimensions: (i) the total number of participants at CBD and mercury INC meetings, (ii) the total number of non-governmental organizations (NGOs) at these respective meetings, and (iii) the ratio of international groups to all groups represented at these meetings. These dimensions are presented in that order, top to bottom.
Fig. 4.1 Participants and Represented Organizations at the CBD and mercury INC meetings. Participants from NGOs are designated in Lists of Participants. Sources: Lists of Participants from the CBD and UNEP Mercury webpages.
These dimensions reflect the extent to which the stakeholders in the negotiations on biodiversity are diffuse relative to those in the negotiations on mercury.\(^1\) Although the Conference of the Parties to the CBD began in 1994 and the mercury INC process began in 2010, the participants data presented in Figure 4.1 reinforce the stakeholder differences between these two negotiating processes.

The biodiversity meetings have far more participants than the mercury meetings. There are also more NGOs at the biodiversity meetings. And the ratio of international groups to all groups is higher at the mercury convention meetings. That ratio serves as one indicator of whether stakeholders are organized at the international level or whether they have largely local or national priorities. This measures the extent to which they have an interest in and ability to organize internationally, which depends on their concentration, among other variables. In terms of stakeholder concentration, these two issue-areas are at contrasting ends of the spectrum. I leverage stakeholder differences in mercury pollution and biodiversity loss to assess how these differences are associated with prospective international cooperation on mercury and biodiversity, respectively.

\textit{4.3.1 Background on Mercury Pollution and Biodiversity Loss}

Mercury is a naturally occurring element with the symbol Hg under the Periodic Table of Elements. It is a heavy metal that takes a liquid form in standard room temperature and pressure

\(^1\) After the first Conference of the Parties under the Minamata Convention on Mercury, should it occur, such a comparison would be more equivalent, since the CBD meetings are official meetings of a convention already in force but the mercury INC meetings did not have that status.
conditions. For over 150 years, mercury has been known to have dangerous health consequences for humans (Selin and Selin 2006). The most infamous example of its human health consequences occurred in Minamata, Japan, during the 1950s and 1960s, when over one thousand Japanese citizens were poisoned with “methylmercury” released into the local water by a chemical plant, Chisso Corporation. For several decades, scientists have been aware of the significant environmental consequences of mercury releases and emissions into nature, including aquatic ecosystems.

Mercury emissions and releases stem from a diverse range of sources, most of which are linked to industry and energy production (UNEP 2013). Until recent years, the main source of global mercury emissions was coal-fired power production, with oil and gas production contributing much smaller fractions to global emission totals (Rallo et al. 2012). The main sources from industrial production are cement production and waste incineration. The main sources from industrial processes (as opposed to products) are in the production of chloride and sodium hydroxide – chemicals that serve as inputs in hundreds of products in dozens of industries worldwide. Mercury is also used in dentistry as fillings (known as “amalgam”) and in select medicinal applications. Nonetheless, the vast share of global mercury emissions and releases on an annual basis stem from a small group of capital-intensive chemical and production industries and from the combustion of fossil fuels for energy production.

According to the most recent UNEP assessment, a growing share of global mercury emissions stems from artisanal and small-scale gold-mining (ASGM), largely in resource-rich poorer countries (UNEP 2013). The rising price of gold worldwide has increased the demand for gold-mining, prompting unsanctioned and illegal gold-mining to prosper in poorer countries where economic opportunities are limited. Unlike the other main sources of global mercury
emissions, ASGM happens almost exclusively in the developing countries and at the individual miner level, not the plant level. Whereas large corporations whose plants emit or release mercury usually can make adjustments to lower those emissions and releases, no such opportunity exists in ASGM because the adjustments would need to occur at the individual miner level. One study found that educating miners regarding the technologies that limit the release of mercury from gold refinery was essential to reducing mercury emissions from ASGM in Ghana (Hilson, Hilson, and Pardie 2007). No comparable informational barriers exist in reducing mercury emissions from energy production or industrial processes. Thus, within mercury management, there is variation in stakeholder concentrations: ASGM has diffuse producers and the other mercury-emitting industries have concentrated producers.

By contrast, biodiversity loss and ecosystem loss stem from both local and global sources – and the contribution of any single source to these problems is difficult, if not impossible, to measure with accuracy. Biodiversity loss stems not merely from businesses in the industrialized or industrializing portions of the world, but also from less capital intensive and more scattered sectors involving land and marine life (Zaccai and Adams 2012). Unlike mercury emissions and releases, biodiversity loss and ecosystem loss arise from economic activities in rural and urban settings and has long been a complicated management challenge for lower-income societies and wealthy societies alike.

The localized dimensions of land use make it complicated for policymakers and experts to identify standardized practices that can be applied universally with comparable outputs. Strategies of ecosystem services – designed to have positive externalities for other local beneficiaries – can have contradictory consequences (Bennett, Peterson, and Gordon 2009). This poses a complicated problem for experts and policymakers because it means they must tailor
management strategies to the circumstances of local settings and may need to experiment with different strategies through a trial-and-error process before selecting a preferred one, which would inevitably increase the costs of policy interventions (Jack, Kousky, and Sims 2008). The same is not true of mitigating mercury emissions and releases: policymakers could reasonably expect the same mitigation technology or strategy in one location to have similar implementation requirements and consequences in another location, although challenges in this regard vary.

The stakeholders whose economic activities would need to change to reduce mercury emissions and releases are more identifiable and limited in both number and organization than the stakeholders whose economic activities would need to change to stem biodiversity loss and ecosystem loss. Those economic activities responsible for mercury emissions and releases are linked to capital-intensive industries and processes that also contribute to biodiversity loss by direct or indirect means, with the exception of ASGM. In fact, through the release of mercury into the seas and oceans, those same plants that contribute to global mercury pollution also contribute to biodiversity loss and ecosystem loss because mercury emissions penetrate aquatic ecosystems. Although remedies to reduce mercury emissions and releases into these ecosystems would have positive externalities for biodiversity, the same might not be true of ecosystem services, which are broad-ranging and have a variety of expected and unexpected consequences.

4.3.2 Mercury and Biodiversity Negotiations

Biodiversity has been a subject of international negotiation at the UN for much longer than mercury. Since 1992, the CBD has served as a hub for UN regulatory programs and legal requirements on biodiversity management. With 193 States Parties as of January 2013, the CBD
is the closest to a universal convention covering the full range of issues on the global biodiversity agenda. It covers three broad policy areas on the agenda: (i) preserving biological diversity, (ii) preserving the sustainable use of biological diversity, and (iii) providing for the fair and equitable sharing of genetic resources. Parties have adopted two protocols to the CBD, the first in 2001 on biosafety relating to genetic resources and the second in 2010 on access and benefit-sharing arising from the use of genetic resources. Parties also adopted an amendment to the 2001 protocol on biosafety to add liability rules.

By contrast, the mercury convention was the most recent addition to the UN collection of environmental conventions, finalized on 19 January 2013 in Geneva, Switzerland, and awaiting signatures at a forthcoming Diplomatic Conference in October 2013 in Japan. Formal negotiations on the Minamata Convention on Mercury began in 2010, after the UNEP Governing Council established an INC process to prepare a legally binding instrument on mercury before February 2013 and provided the mandate for the INC. Before the Governing Council’s decision in February 2009, mercury had not been the primary subject of formal negotiations at the UN level, except under the Convention on Long-Range Transboundary Air Pollution (CLRTAP), which is administered by the UN Economic Commission for Europe (Andresen, Rosendal, and Skjærseth 2012). In 1998, parties to CLRTAP adopted a Protocol on Heavy Metals, thereby providing regulations on mercury.

4.3.3 Hypotheses

I evaluate four hypotheses with this focused comparison.
H1. *International management expectations.* Participants in the mercury meetings believe that parties will make integrated agreements on mercury. Participants in the biodiversity meetings believe that parties will make un-integrated agreements on biodiversity and ecosystems.

H2. *Technology beliefs.* Participants in the mercury meetings are less skeptical about the prospects of new technology that helps to manage mercury emissions than participants in the biodiversity meetings are about the prospects of new technology that helps to manage biodiversity and ecosystems.

H3. *Stakeholder diffuseness.* Participants in the mercury meetings believe that the stakeholders responsible for mercury emissions and releases are more concentrated than participants in the biodiversity meetings believe that the stakeholders responsible for biodiversity loss and ecosystem loss are concentrated.

H4. *Disagreement among parties.* Participants in the mercury meetings believe there is less disagreement among parties in the negotiations on mercury than participants in the biodiversity meetings believe there is disagreement in the negotiations on biodiversity and ecosystems.

### 4.4 Data

I evaluate these hypotheses primarily with survey data from participants in United Nations negotiations on the new mercury convention (Minamata Convention on Mercury) and formal negotiations on the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES). I collected the survey data on mercury from a sample of participants at the 5th Session of the Intergovernmental Negotiating Committee (INC) to prepare a legally binding instrument on mercury, 13-18 January 2013, Geneva, Switzerland. I collected the survey data on biodiversity and ecosystems from a sample of participants at the 1st Plenary Session of the IPBES (IPBES) and the Stakeholders Meeting preceding it, 20-26 January 2013,
Bonn, Germany. Table 4.1 provides geographic and institutional affiliation summaries of each sample.

Each sample represents a “stratified convenience sample” (Fink 2009). They are each “stratified” because the sampling was designed to collect a representative number of survey respondents based on the geographic and institutional representation at each meeting. They are each a “convenience” sample because the sampling procedure was not randomized to avoid an unrepresentative sample of respondents along geographic or institutional dimensions. The population for each sample is all participants attending each meeting (Mercury INC: 786, IPBES: approximately 450). The sample sizes are 85 (Mercury INC) and 51 (IPBES), representing about 11 percent of the Mercury INC population and about 11 percent of the IPBES population.

Table 4.1 Sample Summary Statistics

<table>
<thead>
<tr>
<th>Affiliation</th>
<th>Mercury INC</th>
<th>IPBES</th>
<th>Region</th>
<th>Mercury INC</th>
<th>IPBES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>56</td>
<td>35</td>
<td>North America</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Business</td>
<td>7</td>
<td>1</td>
<td>Europe</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Environmental NGO</td>
<td>5</td>
<td>1</td>
<td>Asia-Pacific</td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>IGO</td>
<td>8</td>
<td>9</td>
<td>Africa</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>4</td>
<td>Latin America</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Multiple affiliations</td>
<td>0</td>
<td>1</td>
<td>Multiple regions</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

When sampling is not randomized, the typical approach to inference with survey data is to construct a statistical model of the data-generating process. However, due to the limited number of respondents (N=136), a statistical model would not have the power to avoid Type II errors. Moreover, under random sampling, each sample could be used to determine a margin of error for each response. With the Mercury INC sample, the margin of error would be 10 percent with a confidence level of 95 percent. With the IPBES sample, the margin of error would be 13
percent with a confidence level of 95 percent. However, under convenience sampling, the
sampling procedure means a margin of error cannot be determined.

Principally, I use the responses for descriptive inference (King, Keohane, and Verba
1994). I use the responses as systematic micro-level data on what participants in the negotiations
on mercury and biodiversity believe about stakeholders, innovation, technology, disagreement
among governments, and international cooperation. A difference of means test using the $\gamma^2$
statistic requires random sampling. Consequently, the data cannot provide rigorous support for a
causal explanation but they can be used to evaluate the hypotheses as detailed, systematically
collected descriptive evidence.

4.4.1 Survey Instruments

The survey instruments – in paper form – were designed to limit the differences and
discrepancies in the questions asked of the two samples. This was done to preserve comparability
and limit the extent to which variation in the responses between the two samples stems from
different question wording. For example, respondents to the Mercury INC survey were asked
Question (i) and respondents to the IPBES survey were asked Question (ii).

Question (i): In your view, what will parties do in managing mercury emissions?
Question (ii): In your view, what will parties do in managing biodiversity and ecosystems?

This illustrates how the survey questions were tailored to the themes of the meeting but
otherwise made comparable in their wording.
The unique characteristics of the sample and the sampling conditions precluded the use of any well-established templates as a reference for the design of the survey instruments or their questions. The specialized characteristics of the sample and circumstances of the sampling also precluded formal pre-tests of the instruments with other samples or under other sampling conditions that resemble those at the two meetings. Instead, brief interviews were conducted as a form of pre-testing the questions before the instruments were finalized and the sampling had begun. The English version of each instrument was translated into Spanish (Latin America) and French to facilitate a more representative sample based on geographic composition.\(^2\) Having three versions of each survey instrument enabled representatives from many regions of the world to answer in either their native language or in the language they used at the meeting.

### 4.4.2 Samples

Sampling occurred inside the international conference centers where the negotiations occurred. Typically, UN environment negotiations operate by a schedule that the chair of the meeting sets and adjusts in consultation with States Parties and the relevant secretariat. Several breaks in the formal proceedings occur during a meeting for eating and other purposes. Several intermissions in the formal proceedings occurred on each day of each meeting. These intermissions and the timing of when formal proceedings resumed structured the sampling procedure. At the Mercury INC meeting, several discussions occurred simultaneously, as parties deliberated over different parts of the treaty text in different conference rooms. At the IPBES

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\(^2\) I contracted with a translation company with ISO-9001 certification that performs translation services for Fortune 500 companies, among other clients.
meeting, most of the deliberations in a conference room occurred in plenary hall. Consequently, there were more locations for potential sampling at the Mercury INC meeting than at the IPBES meeting, in addition to the larger number of participants at the Mercury INC meeting than at the IPBES meeting. Moreover, the Mercury INC meeting lasted longer each day on average than the IPBES meeting but the IPBES meeting had a Stakeholder Meeting prior to the start of official proceedings, unlike the Mercury INC meeting. Table 4.2 shows the total number of respondents, the total number of participants sampled, and the total number of non-responses or surveys not returned on each day of each meeting (Appendix 4.1).

Potential respondents were sampled at a number of locations and points in the course of the meetings. The majority of respondents were sampled when they were not in a conference room featuring formal proceedings, although a minor share of the respondents were sampled and responded while present at formal proceedings and deliberations over the treaty text (Mercury INC) or the governing texts of IPBES (IPBES). Sampling locations included conference rooms and plenary hall, cafeterias, and seating areas inside the conference centers. Respondents were asked to leave the surveys wherever they chose to complete them, although most completed them at the precise location where they were sampled. In a minority of cases, respondents returned the surveys directly to me inside the conference center instead of leaving them at the precise sampling location.

4.4.3 Variable Construction, Item Nonresponse, and Supporting Data

I used some responses as variables in themselves and other responses jointly to construct a scale measuring a latent belief or viewpoint attributed to each respondent, or to construct an
index of observable traits. I constructed one index and three scales from those joint responses. To avoid “order bias” – that is, bias arising from the ordering of related questions in sequences – the questions corresponding to a given scale were separated in the survey instrument, sometimes into different sub-sections. Although studies suggest this limits internal consistency in the responses, it increases the likelihood they are independent responses. The scales and the index were standardized along the unit interval [0, 1].

To construct the scales and index, I relied on questions with responses and left the scale score or index score for a respondent empty if any of the constitutive questions corresponding to it did not have a response. For example, instead of relying on the two constitutive questions that did have responses to construct a scale score consisting of three question responses, I left the scale score empty. This represents a conservative approach to constructing the scales or index used in the analysis because it seeks to preserve consistency in the responses used to construct the scales or index at the expense of not maximizing use of the responses to construct them.

As supporting data, I conducted semi-structured interviews with survey respondents at the meetings and afterwards on the beliefs measured by the survey instruments and on related issues. The interviewees were non-randomly selected from the pool of survey respondents and meeting participants. I also prepared field notes based on my observations at the international conference centers where the meetings were held, including in rooms where treaty text was under negotiation and deliberation (Mercury INC meeting) and governing texts of IPBES were under negotiation and deliberation (IPBES meeting). I collected primary documents from the mercury convention negotiations and negotiations on the Nagoya Protocol on Access and Benefit-Sharing under the CBD, the most recent treaty on biodiversity completed at the UN level. The primary interviews, field observations, and texts provide substantive information on
the latent beliefs or expectations measured by the survey instruments and related issues. Written remarks on the survey instruments by the respondents provide similar information on those beliefs or expectations. These supporting data are useful for qualifying and substantiating the conclusions drawn from the survey responses.

4.5 Analysis of Survey Data and Supporting Data

According to H1, participants at the Mercury INC meeting should expect that governments will make integrated agreements on mercury but participants at the IPBES meeting should expect that governments will make un-integrated agreements on biodiversity and ecosystems. H1 stems from the argument that parties are more inclined to make international environmental regimes that consolidate legal obligations and operational responsibilities under an integrated set of agreements when stakeholders are concentrated and technological innovations can lower mitigation costs for all parties. When stakeholders are diffuse and innovations are less likely to diffuse across countries, governments would make un-integrated agreements that spread responsibilities across independent rules and institutions, some of which do not include legal obligations and have only a fraction of institutional capacities necessary to mitigate the problem. H1 is the core hypothesis stemming from the stakeholder concentrations argument, as it relates to this chapter.

Respondents were asked, “In your view, what will parties do in managing mercury emissions / biodiversity and ecosystems?” Responses are displayed in Figure 4.2. An overwhelming proportion of Mercury INC respondents answered that parties will make one agreement on mercury and then follow it with modifying agreements such as amendments or
protocols. In fact, more respondents answered that parties will make one agreement with no follow-up agreements than those who answered that they will make un-integrated agreements. However, that difference is minor. Nearly 60 percent of IPBES respondents answered that parties will make un-integrated agreements on biodiversity and ecosystems – nearly twice as many as answered that they would make one agreement followed by amendments. These distributions support H1.

**Fig. 4.2 International Management Expectations by Sample.** Respondents were asked, “In your view, what will parties do in managing mercury emissions / biodiversity and ecosystems?” Some provided multiple answers. Sample sizes are as follows (left to right): 82, 48.

In contrast to the mercury negotiations, negotiations on biodiversity have had a long history at the UN level. The CBD was negotiated over a four-year period from 1988 through 1992. Even before the CBD, several other conventions were in place on specific species and for
specific regions. Participants at the IPBES meeting, nearly all of whom participate in several biodiversity-related conventions, recognize the overlap between those conventions. Participants in various conventions covering different biodiversity issues attended the 1st Plenary of IPBES.

Nonetheless, the benefits of a convention process are less clear among those participants than at the mercury convention meeting. One business representative remarked that the international agreements model is only one way to address the problem of biodiversity loss and ecosystems loss, after completing the IPBES survey. Local and regional initiatives were also important, remarked the respondent. No similar remarks, written or otherwise, came from a respondent to the Mercury INC survey. Instead, the UN mercury convention was viewed as an instrument for facilitating technical conversion and financial assistance to reduce a transboundary pollution problem.

What if we consider mediating factors such as knowledge and experience or geographic and institutional background? Do more knowledgeable and experienced respondents have expectations that support H1? Do negotiators from Western governments have expectations that support H1? To answer these questions, I constructed a variable distinguishing respondents at each meeting based on their knowledge and experience on the subject of the negotiations and a variable distinguishing negotiators from Western governments and all other participants. The index measure of knowledge and experience Knowledge-Experience Index was constructed using an additive score of responses to three questions asking about specific meeting attendance and years of work on environmental issues. The variable Western Govt indicates whether a respondent is a negotiator from a Western government, which for the purposes of this analysis is any participant affiliated with a government in North America or Europe.
Figure 4.3 below displays the distribution of responses based on the knowledge and experience of respondents. Consistent with H1, the most knowledgeable and experienced respondents answered in largely the same way as the full sample from each meeting. Those with high knowledge and experience from the Mercury INC sample overwhelmingly answered that they expect parties to make integrated agreements on mercury emissions. More respondents with high experience and knowledge from the IPBES sample answered that they expect parties will make un-integrated agreements on biodiversity and ecosystems than answered that they will make integrated agreements.

**Fig. 4.3** International Management Expectations by Knowledge and Experience by Sample. Sample sizes are as follows. Top row (left to right): 11, 4. Middle row (left to right): 13, 18. Bottom row (left to right): 58, 26.
Those with moderate experience and knowledge answered similarly as those with high experience and knowledge, but the separation between the responses is greater in the high knowledge-experience group. In the Mercury INC sample, the margin between “Integrated agreements” and “Un-integrated agreements” is nearly 70 percent among the high knowledge-experience respondents but is 25 percent among the moderate knowledge-experience respondents. Similarly, in the IPBES sample, the margin between “Integrated agreements” and “Un-integrated agreements” is nearly 40 percent among the high knowledge-experience respondents but is less than 20 percent among the moderate knowledge-experience respondents. A higher proportion of more experienced and knowledgeable respondents have expectations that support H1 than less experienced and knowledgeable respondents.

Similarly, this difference in the expectations of Mercury INC respondents and the IPBES respondents holds among respondents from Western governments and other respondents. Respondents from Western governments at the Mercury INC meeting overwhelming expect parties to make integrated agreements on mercury emissions. Respondents from Western governments at the IPBES meeting overwhelmingly expect parties to make un-integrated agreements on biodiversity and ecosystems. Interestingly, respondents at each meeting unaffiliated with a Western government answered similarly as did respondents from a Western government. However, the share expecting un-integrated agreements on biodiversity and ecosystems at the IPBES meeting was within 20 percentage points of the share expecting integrated agreements.

Overall, delegates from Western governments shared similar expectations as delegates from non-Western governments and organizations at the mercury meeting: they expect integrated agreements on mercury pollution. Delegates from Western governments overwhelming expected
un-integrated agreements on biodiversity and ecosystems; however, the separation between that expectation and an expectation of integrated agreements was narrower among delegates from non-Western governments and other institutions. These findings suggest that government negotiators from Western countries and other participants shared similar expectations, indicating that H1 has support across these institutional and geographic categories.

4.5.2 Technology Skepticism

According to H2, we should expect that there is more skepticism over technological solutions at the IPBES meeting than there is at the Mercury INC meeting. This expectation stems from the types of economic activities contributing to mercury pollution, on the one hand, and biodiversity loss and ecosystem loss, on the other. Technology would usually be less applicable in many more contexts for reducing biodiversity loss or providing ecosystem services than in reducing mercury emissions and releases. Moreover, a larger proportion of non-government representatives at Mercury INC meetings come from the business community and a collection of industries that produce the environmental problem than those at the IPBES meetings. A larger share of all non-government representatives at the Mercury INC meetings comes from trade associations (e.g., World Coal Association) and individual multinational corporations (e.g., Exxon Mobil) than at the IPBES meetings (e.g., CropLife International). I expect that participants at the IPBES meeting had greater skepticism over the prospects of technological solutions to the problems of managing and preserving biodiversity and ecosystems than participants at the Mercury INC meeting had about the technological solutions to mercury pollution.
Figure 4.4 presents the distribution of a variable *Technology Skepticism* that measures the extent of such skepticism. This variable was constructed from responses to three questions. It shows that there is more skepticism among the IPBES respondents than among the Mercury INC respondents, consistent with H2.

![Box plot of Technology Skepticism by Sample](image)

**Fig. 4.4 Technology Skepticism by Sample.** Sample sizes are as follows (left to right): 81, 49.

The application of technology is relatively less clear in providing for biodiversity protection and ecosystem services than in reducing mercury emissions. Two respondents who decided not to complete the IPBES survey after initially accepting it said that technology-oriented questions are not appropriate or relevant to the issues covered at the IPBES meeting. One participant who did answer the survey remarked that technology is likely to help reduce biodiversity loss and ecosystem loss but did not affirm anything more specific about how or which technologies would be useful. By contrast, a respondent to the mercury survey answered
that although technology would not help governments agree on a mercury convention, “what
could be achieved under the convention would increase.”

In the mercury negotiations, technology transfer represented one of the main topics of
negotiations since the mercury INC process began in 2010. Except for ASGM, the largest
contributions of mercury emissions come from industrial processes and energy production.
Parties recognized that the growth of industry and energy consumption in Asia, in particular,
meant that reducing global mercury emissions required technical conversions in developing
countries in East Asia and South Asia. A UNEP report issued in 2008 made clear that the future
growth of atmospheric mercury pollution would come largely from industrializing parts of Asia
(UNEP 2008).

In the wealthy countries, the technologies for reducing mercury emissions are already
available and policies need only facilitate the conversions already underway by complete phase-
outs in several industries. In the battery industry, lithium batteries are already available for
consumers to purchase and costs are declining over time. Only minor regulations would be
needed to phase out older mercury-filled batteries (Interview 47, United Nations). Similarly,
companies in the chlor-alkali industry have already started converting away from the mercury-
cell process of producing chlorine and sodium hydroxide, which are used in many industries as
input chemicals, to the so-called membrane process that does not include mercury (Interview 51,
World Chlorine Council). They began creating membrane production plants before the UNEP
Governing Council launched the mercury INC process in February 2009.3 In the mining industry,
companies in Japan, Germany, and Spain have developed technologies for capturing and storing

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3 “Conversion Away from Mercury to Alternative Technology in the Chlor-Alkali Industry,” UNEP Partnership
Document, June 2012.
mercury emissions from acid plants. Japanese firms in the mining industry have captured
mercury emissions from acid plants for nearly four decades (Interview 48, Japan Mining Industry
Association). Some industries such as the European cement industry have already made
adjustments to comply with relevant national or European laws on mercury emissions (Interview
52, European Cement Association).

Parties recognize that although the prospects for technological change vary across
industries contributing to mercury emissions, less wealthy countries generally face the greatest
conversion challenges. Transferring the technology and knowledge necessary to capture mercury
emissions from acid plants in the mining industry is complicated. The Basel Convention may
prohibit some direct transboundary transfers and licensing of the storage technology is not yet
settled. Many acknowledge that the greatest challenge in reducing mercury emissions might
come from eliminating ASGM in countries like Kirgizstan that are mineral-rich and rely on
primary mining for a relatively large share of employment. Only in a minority of industries is
wealth not a barrier to reducing mercury emissions. For example, several less wealthy countries
use alternatives to mercury-based dental fillings but some wealthy countries (e.g., the United
States) continue using them in large volumes because of lobby opposition to their elimination
(Interview 50, World Alliance for Mercury-Free Dentistry).

Industries with ongoing conversions to mercury abatement technologies or processes are
generally concentrated, with the exception of the ASGM industry. For example, there are two
major producers of alternatives to dental amalgam in the United States who also produce the
There is one major producer in Australia and a few major producers in Europe. Although the
chlor-alkali industry is not as concentrated as the dental fillings industry, the World Chlorine
Council has membership representing nearly 90 percent of the chlorine production in the world. It is a capital-intensive industry in operation for several decades that includes transnational firms like Dow Chemical (Interview 51, World Chlorine Council). And although cement producers usually service national consumers, not international ones, the industry is usually concentrated on a national level, represented by a trade association.

ASGM clearly differs from these other industries (Interview 54, Swiss Government). Many ASGM sites are illegal because they are unsanctioned for mining. By some accounts, the use of mercury in gold mining dates back to 1,000 C.E. Unlike other industries contributing to global mercury emissions, ASGM faces informational and cultural barriers to conversion. One study finds that teaching miners to use technologies that would reduce mercury emissions in ASGM is a significant complication in Ghana (Hilson, Hilson, and Pardie 2007). Some miners decided not to use the technology and continued their traditional method for recovering pure gold from ore.

To what extent does skepticism over technological solutions correspond to general beliefs about the “difficulty” of managing point source pollution from industry or diffuse pollution from land use and agriculture? Beliefs about the feasibility of technological solutions may correspond to beliefs about the difficulty of managing a category of environmental problems, not just a specific one. “Difficult” environmental problems might be difficult precisely because of impractical or costly technology solutions. I investigate the extent to which respondents believed that technological solutions correspond to the difficulty of managing an environmental problem.

Respondents were asked about the difficulty of reducing international pollution when it comes from point sources such as industry. They were limited to three ordinal responses: (1) Very difficult, (2) Difficult, and (3) Slightly Difficult. A small fraction of respondents either
selected more than one choice or wrote in another response (e.g., “should be simple.”) Among the Mercury INC respondents, skepticism over technological solutions to reducing mercury emissions increases as the perceived difficulty of reducing international pollution from industry grows. This relationship is consistent with the premise that technology skepticism and the perceived difficulty of reducing industrial pollution are positively related. Among the IPBES respondents, skepticism over technological solutions has the reverse relationship with the perceived difficulty of reducing international pollution from point sources such as industry. Technology skepticism is highest among those who responded that reducing international pollution form industry is only slightly difficult. The two groups of respondents expressed different views about the feasibility of having technology reduce industrial pollution.

Similarly, respondents were asked about the difficulty of reducing international pollution when it comes from diffuse sources such as agriculture and land use. They were limited to three ordinal responses, as in the industrial pollution question: (1) Very difficult, (2) Difficult, and (3) Slightly Difficult. No respondent added any choice or wrote in another answer not provided on the survey instrument. Figure 4.5 below shows the mean of Technology Skepticism by response to the question asking about the difficulty of reducing international pollution from diffuse sources such as agriculture and land use, separated by meeting.

In each sample, technology skepticism is associated with a higher perceived difficulty of reducing international pollution form diffuse sources such as agriculture or land use. Both of these samples show a positive relationship between technology skepticism and the difficulty of reducing international pollution from diffuse sources. Moreover, for each ordinal response option (“very difficult,” “difficult,” or “slightly difficult”), the mean of technology skepticism is higher in the IPBES sample than in Mercury INC sample, consistent with H2.
**Fig. 4.5** This shows the mean of *Technology Skepticism* by response to the question, “How simple or difficult is it to reduce international pollution when it comes from *diffuse* sources such as agriculture or land use”, separated by sample. Sample sizes are as follows (left to right): 80, 49.

### 4.5.3 Stakeholder Diffuseness

According to H3, participants at the Mercury INC meeting should believe that the stakeholders responsible for mercury pollution are limited to a relatively small number of industries whose producers are concentrated. However, participants at the IPBES meeting should believe that the stakeholders responsible for biodiversity loss and ecosystems loss are diffuse, not concentrated in a small set of industries composed of concentrated producers. In a sense, the stakeholders in the mercury negotiations are a subset of those in the biodiversity negotiations.
This does not imply that the same representatives at the mercury meetings should also be present at the CBD meetings. Rather, it means that participants at the IPBES meeting believe that the stakeholders in biodiversity negotiations are diffuse and highly heterogeneous, while participants at the Mercury INC meeting believe that stakeholders in that process are concentrated and relatively less heterogeneous.

To evaluate H3, respondents were asked two questions pertaining to the actors responsible for mercury emissions (Mercury INC) and for biodiversity loss and ecosystem loss (IPBES). They were also asked what steps are necessary to reduce mercury emissions (Mercury INC) or biodiversity loss and ecosystem loss (IPBES). Based on their responses to these two questions, I constructed a scale, Stakeholder Diffuseness, which measures the perceived diffuseness of the sources of the environmental problem motivating the negotiations. Ranging on the unit interval [0, 1], higher values correspond to a belief that stakeholders responsible for the environmental problem are diffuse and scattered: they are distributed locally, nationally, and globally. Lower values correspond to a belief that stakeholders are concentrated, relatively definable, and largely national or international in scale.

Figure 4.6 below shows the distributions of Stakeholder Diffuseness by sample. The Mercury INC respondents answered that stakeholders responsible for mercury emissions are relatively more concentrated than the IPBES respondents answered about the stakeholders responsible for biodiversity loss and ecosystem loss. The modal response to the question, “Who are the main actors primarily responsible for mercury emissions,” was “National businesses and industries are mainly responsible” by an overwhelming margin (58/83) in the Mercury INC sample. By contrast, the IPBES respondents provided very mixed answers, suggesting less clarity over which actors are the main contributors to biodiversity loss and ecosystems loss.
Nearly as many respondents answered that national businesses and industries are responsible as those who answered that it is not clear whether national businesses and industries are more or less responsible than local communities and landowners. This mixed set of answers from the IPBES sample, compared to the one-sided answers from the Mercury INC sample, is important.

Respondents had relatively mixed views on which actors make the biggest contribution to biodiversity loss and ecosystem loss but had a convergent view on which actors make the biggest contribution to mercury emissions.

**Fig. 4.6** Stakeholder Diffuseness by Sample. Sample sizes are as follows (left to right): 80. 49.

These views are consistent with the characteristics of stakeholders and predominant views on protecting biodiversity and ecosystems. Stakeholders view science-policy interface on biodiversity as a bottom-up process involving local communities, unlike the science-policy
interface on climate change, which has adopted a top-down model for information aggregation and distribution on climate science research. One survey respondent wrote, “IPBES has a very different task (more than IPCC),” reflecting that the local nature of biodiversity and ecosystem services makes the scientific input more varied and potentially more complicated than on climate change. More generally, a recent paper contends that the causes and responsible parties in biodiversity loss are more diffuse and complicated than those in climate change (Zaccai and Adams 2012).

For example, parties have accepted the importance of indigenous and local communities in protecting biodiversity. In negotiating the Nagoya Protocol on Access and Benefit-Sharing to the CBD, parties acknowledged the relevance of creating a procedure for prior informed consent involving local and indigenous communities (UNEP/CBD/WG8J/5/4 2007). They also sought to respect “traditional knowledge” of genetic resources in creating the regime for access and benefit-sharing. Similarly, parties emphasized the need for “traditional knowledge” in the IPBES work program, in contrast to the work program of the Intergovernmental Panel on Climate Change (IPCC), which places no such emphasis on traditional or local knowledge.5

Science assessments of biodiversity and ecosystems reflect this emphasis on local communities and traditional land use. The Sub-Global Assessment (SGA) Network is expected to provide support for IPBES to create scientific assessments on the state of biodiversity and ecosystems to a global policy audience. Unlike the IPCC, which provides a similar service to the United Nations Framework Convention on Climate Change, the SGA Network reflects a belief

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4 Author’s observations, Stakeholders Consultation, 1st Plenary Session of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany, 20 January 2013.

5 Author’s observations, 1st Plenary Session of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany, 21-26 January 2013.
by stakeholders that biodiversity and ecosystems are bottom-up issues for the global policy community that require a combination of local, regional, and global science assessments for effective policy remedies to emerge. Attendees at the 1st Plenary of IPBES held a side-event where sub-national assessment was a topic of presentation and questions.6

To what extent are beliefs about technology and beliefs about stakeholders linked? A main premise of the stakeholder concentrations argument is that more diffuse stakeholders have greater barriers to technological innovation and may not consider new technology as a potential solution to the environmental problem they seek to remedy. We have already found that Mercury INC respondents have less technology skepticism than the IPBES respondents. We have also found that the mercury respondents believe stakeholders are more concentrated in their issue than the biodiversity respondents believe that stakeholders are in their issue. To what extent are these beliefs linked? Answering this question would help to more closely evaluate the relationships between stakeholders and technical innovation identified as important in the stakeholder concentrations argument.

To answer this question, I plotted the mean of Technology Skepticism against Stakeholder Diffuseness and separated by sample. There is no clearly positive relationship between Technology Skepticism and Stakeholder Diffuseness. Specifically, the Mercury INC sample shows a jagged relationship between beliefs about stakeholder diffuseness and technology skepticism. The same is largely true for the IPBES sample. In the IPBES sample, the highest value on Stakeholder Diffuseness is associated with the lowest Technology Skepticism value, contrary to expectations. These findings do not support the hypothesized link between

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6 Author’s observations, 1st Plenary Session of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany, 23 January 2013.
stakeholder diffuseness and technological innovation. However, they also do not falsify the link. The evidence is inconclusive.

4.5.4 Disagreement among Parties

According to H4, participants in the IPBES meeting should believe that there is more disagreement among parties in managing biodiversity and ecosystems than participants in the mercury negotiations should believe there is in managing mercury emissions. The stakeholder concentration argument suggests that at the global level, more diffuse stakeholders and a lack of technical innovation that reduces mitigation costs for wealthy and less wealthy countries would encourage disagreement over the main issues, usually involving financial or technical transfers. These transfers would be highly contentious – and would remain so – when stakeholders are diffuse because mitigation costs would remain steady over time and the constellations of interests would have more trouble converging on a settlement that different governments would find acceptable. The same would not happen when stakeholders are in economically concentrated markets. Thus, more disagreement should arise over environmental problems with diffuse stakeholders than with concentrated stakeholders.

To evaluate H4, respondents were asked two questions about the disagreement among parties and the extent to which parties have delayed settlements in the negotiations on mercury (Mercury INC) or biodiversity and ecosystems (IPBES). The responses to both questions were used to construct a variable, Disagreement among Parties, which ranges along the unit interval [0, 1]. Figure 4.7 shows the distributions of this variable by sample.
As expected, and consistent with H4, IPBES respondents answered that there is more disagreement among parties over the main issues in the negotiations on biodiversity and ecosystems than Mercury INC respondents answered there is over the main issues in the negotiations over a mercury agreement. The main issues in the mercury negotiations were politically contentious but were considered solvable. The same has not been apparent in the negotiations on biodiversity (Nijar nd).

![Box plot showing Disagreement among Parties by Sample](image)

**Fig. 4.7 Disagreement among Parties by Sample.** Samples sizes are as follows (left to right): 80, 46.

How do these responses comport with beliefs about international financing and technology transfer? One premise of the stakeholder concentrations argument is that disagreement among parties at the global level arises in part from the needs for international technical and financial transfers between countries, implying the existence of distributive regimes between countries whose domestic firms and industries compete with each other in foreign markets. Barriers to technical innovations from which Western and Japanese firms can
profit reduce their opportunities for mutually beneficial international transfers with the lower-income counties. This encourages disagreement over implementation and mitigation obligations between wealthy and lower-income countries. The wealthy countries want the lower-income countries to implement obligations and the lower-income countries want financial support.

What do the participants at these two UN meetings believe about international financing and technology transfers? To assess their perspectives on international transfers, the respondents were asked, “Where is it more difficult to manage mercury emissions / biodiversity and ecosystems?” Responses to this question point to where the respondents believe financial and technological transfers would need to go to mitigate the environmental problem. To the extent that wealthy countries have greater difficulty in mitigating an environmental problem – or when it is not clear which category of parties has greater difficulty – we would expect less disagreement between wealthy and less wealthy parties over financing and other transfers. When there is a clear belief among most participants that the lower-income countries would need technological and financial transfers to meet obligations under a convention (e.g., Minamata Convention on Mercury, Convention on Biological Diversity), the potential for disagreement and the degree of disagreement would rise accordingly.

Figure 4.8 below plots responses to the question on where it is more difficult to manage mercury emissions or biodiversity and ecosystems, respectively. Interestingly, respondents in the Mercury INC sample answered that it is more difficult to manage mercury emissions in the less wealthy countries than respondents in the IPBES sample answered it is more difficult to manage biodiversity and ecosystems in the less wealthy countries. The margin is nearly 20 percent lower in the IPBES sample than in the Mercury INC sample. Among the respondents, there is less clarity over where it is more difficult to manage biodiversity and ecosystems than there is over
where it is more difficult to manage mercury emissions. A margin of nearly 20 percent more responded that it is “Not clear” in the IPBES sample than in the Mercury INC sample.

![Bar chart with responses to “Where is it more difficult to manage mercury emissions / biodiversity and ecosystems?” by sample. Sample sizes are as follows (left to right): 84, 50.](image)

**Fig. 4.8** Responses to “Where is it more difficult to manage mercury emissions / biodiversity and ecosystems?” by sample. Sample sizes are as follows (left to right): 84, 50.

It is important to be cautious about over-interpreting this finding. Nonetheless, it seems to imply that the direction of any financial and technical transfers between countries is less clear in managing global biodiversity and ecosystems than in reducing mercury emissions. Because of the technological and financial needs of mitigating mercury emissions and releases, the pathway of transfers is clearer in the mercury issue than in the biodiversity issue. Beliefs about the magnitude of international financing or technology transfer necessary to manage mercury emissions are not comparable with beliefs about the magnitude of international financing and technology transfer necessary to manage biodiversity and ecosystems. To the extent that
participants view these problems differently, as they clearly do based on the evidence, their beliefs on international transfers would also fundamentally differ. In particular, global financing and technology transfer mechanisms in the management of mercury are clearly useful and important in light of the beliefs about technology and stakeholders in that policy area. Global financing or technology transfer mechanisms in the management of biodiversity and ecosystems would not have a clear role or added value, in light of beliefs about technology and stakeholders on that policy issue.

In that interpretation, the diffuseness of the problem makes the purpose of international transfers less clear – and complicates the overall international strategy. This may be one reason why integrated approaches to the mercury problem are more widely expected, since they could channel technology and financial transfers more efficiently than an un-integrated regime could. It may also explain why un-integrated regimes for biodiversity and ecosystems are widely expected, since channeling these resources is not recognized as important and relevant on that issue. Stakeholder concentration and the prospect of technological solutions seem to encourage independent convergence among participants on the policy goals and target areas of reducing mercury emissions at the global level. The same independent convergence on specific policy goals and target areas does not seem to exist in protecting biodiversity and ecosystems at the global level. Diffuse stakeholders make international management goals and strategies less clear for negotiators and stakeholders.

During the mercury negotiations, the core political settlement rested on financing by the wealthy countries for implementation and compliance by the lower-income countries. Throughout the 5th Session, it was clear that the Contact Group on Selected Technical Issues could not complete its work without a high-level political agreement on financing and
implementation between the United States, Europe, and other wealthy parties, on the one hand, and China, India, and especially Brazil, on the other hand. The other technical issues could not come together until the financing-implementation issue was settled on the last night of negotiations. This reflects what the survey data and respondent side-notes suggest: there was not much uncertainty over what is needed to reduce mercury emissions and releases or who needs to do most of the adjustment. In other words, the basic international strategy for mitigating the mercury problem was clear to the main participants at the meeting. The major obstacle was financing, both in how the financing would be provided and whether it would be adequate for meeting the treaty obligations.

Parties settled on having the Global Environmental Facility (GEF) as the financial mechanism of the mercury convention on the last night of the 5th Session. The developing countries had spent nearly the whole INC process objecting to having the GEF as the financial mechanism of the convention and preferring an independent mechanism modeled after the Multilateral Fund of the Montreal Protocol. Assurances of adequate and transparent funding and the potential for synergies with the other financing responsibilities of the GEF helped to convince the objecting parties to accept the package offered by the US and other wealthy countries (Interview 46, GEF). This helped to finalize the core settlement that brought together other parts of the convention that had been settled by technical experts but depended on the core political settlement.

Overall, negotiations over the mercury convention were relatively brief compared to other UNEP convention negotiations. The number of industries potentially affected by the

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7 Author’s observations, 5th Session of the Intergovernmental Negotiating Committee to prepare a legally binding instrument on mercury, Geneva, Switzerland, 13-18 January 2013.
convention and the complexity of technical issues and sensitivity of core political issues under negotiation generated disagreement among several parties. Brazil was opposed to a convention, even nearly four years after the UNEP Governing Council initiated the INC process and at the final meeting in January 2013. Nonetheless, between the Open-Ended Working Group to prepare for the INC process in October 2009 and the conclusion of negotiations at the 5th Session of the INC in January 2013, governments took about 3.5 years to complete a convention with multiple phase-out schedules and complex reporting and assistance obligations. Their challenge was overcoming financial issues and narrowing the convention to meet the minimum demands of industry, not developing a general strategy for regulating the problem of mercury emissions. That general strategy was relatively clear from the beginning of the process.

4.6 Robustness Checks: Industrial Pollution and Diffuse Pollution

One limitation of comparing expectations and beliefs on the international management of mercury pollution to those on the international management of biodiversity loss and ecosystems loss is that they are not equally narrow or broad as global environmental issues. They do not occupy the same level of aggregation on the global agenda. Mercury is a specific chemicals issue for the international community; biodiversity is a more general issue for the international community. Mercury occupies a narrower subset of the global chemicals regulation agenda than biodiversity occupies in the global land regulation agenda. This difference would qualify the findings to the extent that the aggregation level accounts for the pattern of expectations and beliefs evident from the analysis.
To assess whether the findings are robust to the level of aggregation of these issues on the global environmental agenda, I use responses to general questions regarding industrial pollution and diffuse pollution. Industrial pollution and diffuse pollution are comparably broad issues on the global environmental agenda. To the extent that respondents have beliefs and expectations on industrial pollution and diffuse pollution that are consistent with the pattern of beliefs and expectations on mercury management and biodiversity and ecosystems management, this would indicate that the findings are not a function of the different levels of aggregation of these issues on the global environmental agenda.

In addition to questions about expectations over mercury emissions or biodiversity and ecosystems loss, respondents were asked their views on the most practical approach to reducing pollution from “point sources such as industry” and the most practical approach to reducing pollution from “diffuse sources such as agriculture and land use.” To the extent that responses to these general questions are consistent with their expectations over international cooperation on the specific issues of mercury and biodiversity, it would suggest that respondents possess specific expectations that are consistent with general views on international environmental cooperation. This would indicate that their expectations on mercury management, on the one hand, or biodiversity and ecosystem management, on the other, are embedded in latent beliefs about international management responses.

Respondents were asked a pair of questions about the more practical approach to reducing international pollution from different sources. Specifically, respondents in each sample were asked, “Which approach is more practical for reducing pollution from point sources such as industry?” They were also asked, “Which approach is more practical for reducing pollution from diffuse sources such as agriculture or land use?” The first question is intended to measure a belief
about managing industrial pollution, of which mercury emissions are a specific example. The second is intended to measure a belief about managing diffuse pollution, such as that which contributes to biodiversity loss and ecosystem loss.

Figure 4.9 below reports the distribution of responses to these questions. Responses to the question on “point sources of pollution such as industry” suggest that the responses to the mercury expectations question are consistent with more general beliefs. Nearly 80 percent of Mercury INC respondents answered that they believe integrated agreements are more practical for reducing pollution from industry than un-integrated agreements. Although they also answered by a majority that integrated agreements are more practical for reducing pollution from agriculture and land use, the margin of respondents who selected “integrated agreements” and those who selected “un-integrated agreements” in reducing pollution from agriculture or land use is only 20 percent in the mercury sample. They overwhelmingly answered that integrated agreements are more practical for reducing industrial pollution by a margin of nearly 60 percentage points.

IPBES respondents answered differently. They did not overwhelmingly answer that integrated or un-integrated agreements are more practical for reducing industrial pollution. However, on the agricultural and land use pollution question, they answered by nearly a margin of 20 percentage points that un-integrated agreements are more practical than integrated ones in reducing pollution from agriculture or land use.

Overall, respondents answered these questions consistently with expectations following from the stakeholder concentrations argument. Whatever the baseline beliefs of respondents to managing a pollution problem, their beliefs on the more practical approach to regulating the problem depended on whether the pollution stems from industrial or diffuse sources. In the view
of these government negotiators and non-government stakeholders, the concentration of the pollution source affects the relative practicality of the international response options.

Fig. 4.9 The top row displays responses to the question, “Which approach is more practical for reducing pollution from point sources such as industry?” The bottom row displays responses to the question, “Which approach is more practical for reducing pollution from diffuse sources such as agriculture or land use?” Sample sizes are as follows. Top row (left to right) 82, 48. Bottom row (left to right): 82, 47.
The practicality of different international response options is linked to the perceived difficulty of reducing pollution from industrial and diffuse sources. Respondents at each meeting were asked about the difficulty of reducing international pollution when it comes from point sources such as industry. They were also asked about the difficulty of reducing international pollution when it comes from diffuse sources such as agriculture or land use. By measuring beliefs on the relative “difficulty” of reducing these different pollution sources, I investigated whether the respondents’ beliefs on the difficulty of reducing pollution from industry or agriculture and land use are consistent with their beliefs on the practicality of integrated cooperation on these pollution sources.

At the mean, respondents at each meeting answered that reducing international pollution when it comes from point sources such as industry is less difficult than reducing international pollution from diffuse sources such as agriculture or land use. The vast majority of Mercury INC respondents answered that it is more practical to reduce industrial pollution with integrated agreements than with un-integrated agreements. A plurality also answered that reducing industrial pollution is “difficult” – and a larger shared answered “slightly difficult” than “very difficult.” By contrast, a majority of IPBES respondents answered that un-integrated agreements are more practical for reducing international pollution from diffuse sources such as agriculture or land use. And the same number of IPBES respondents answered that reducing this pollution is “difficult” as answered that it is “very difficult.” In that respect, views on the practicality of integrated cooperation are linked to the perceived difficult of reducing pollution. *In the view of these government negotiators and non-government stakeholders, the more difficult it is to reduce pollution, the less practical it is for integrated cooperation to reduce that pollution.*
4.7 Synthesis: Stakeholder Concentrations and Global Environmental Governance

The previous chapter analyzed the relationship between stakeholder concentrations and the development of global environmental governance with data on treaty processes. It clarified when governments make integrated global environmental regimes and when they settle for making un-integrated regimes. I characterized the international cooperation patterns associated with regulating sectors involving varying market concentrations and stakeholders. The analysis provided a macro-level explanation of global regime development over decades-long timescales.

In this chapter, I investigated a number of questions pertaining to the expectations of individuals directly involved in negotiating global environmental agreements and institutions when they were involved in those negotiations. Because of the proximity of the data to the locations, individuals, and timing of decision-making on a new treaty and institution, I characterized the relationship between stakeholders and international cooperation without relying on observed behavior after critical regime-building decisions were made. Rather, I evaluated the stakeholder concentrations argument with ex ante data from negotiators and participants whose beliefs and decisions contributed to a new treaty and institution for global environmental governance when those beliefs and decisions were most impactful. I leveraged negotiators’ beliefs and viewpoints in this chapter, not the outcomes of beliefs and viewpoints, as in the prior chapter. This chapter complemented the prior one with a different empirical strategy, taking participants in meetings as the unit of analysis instead of years of treaty processes as the unit of analysis. It presented a micro-level analysis to complement the macro-level analysis in the previous chapter.
Both the macro-level analysis of Chapter Three and the micro-level analysis of this chapter show that stakeholder concentrations affect the form of global environmental governance. Stakeholders in diffuse markets make integrated cooperation on global environmental problems unrealistic from a political standpoint and complicated from a regulatory standpoint. Diffuse stakeholders encourage governments to create un-integrated cooperation on a global environmental problem. By contrast, stakeholders in concentrated markets enable governments to secure environmental improvements cost-effectively. Governments are inclined to create integrated regimes and to channel their resources into a single treaty process.

Respondents at the mercury convention meeting differed from those at the IPBES meeting on the main variables of the stakeholder concentrations argument. First, they overwhelmingly expect the mercury regime to become integrated over time, while respondents at the IPBES meeting expect the management of biodiversity and ecosystem to remain un-integrated. This difference is robust to affiliation (or non-affiliation) with a Western government and is especially apparent among those with the most knowledge and experience on these issues. Second, the Mercury INC respondents were less skeptical of technology solutions to mercury emissions abatement than the IPBES respondents were about technology solutions to biodiversity and ecosystems management. Third, the Mercury INC respondents viewed the stakeholders whose actions are responsible for mercury emissions as more concentrated than the IPBES respondents viewed stakeholders whose actions are responsible for biodiversity loss and ecosystems loss. Fourth, the Mercury INC respondents believe there was less disagreement among parties in the mercury convention negotiations than the IPBES respondents believe there has been in the negotiations on biodiversity and ecosystems. And fifth, participants
independently converged on relatively clear policy goals and geographic target areas for financing and other elements of international mercury management but participants did not converge on a clear purpose for financing or on geographic target areas in managing biodiversity and ecosystems. Other primary data sources and follow-up interviews and debriefings with respondents support these findings.

The fifth finding is the most important one. Respondents in the mercury negotiations converged on a role for financing and other issues relevant to global environmental governance more than respondents in the biodiversity and ecosystems negotiations. This signals a clearer common belief about the policy goals and geographic target areas of an international regime for mercury than for biodiversity and ecosystems. When stakeholders are concentrated, the policy goals and international instruments to achieve those goals become clearer for negotiators and stakeholders. They converge more on the international tools and goals of regulation when the stakeholders are concentrated.

Beliefs on mercury management and on biodiversity management are not simply functions of the different levels of aggregation of these issues on the global environmental agenda. Respondents reported views on the practicality of integrated cooperation in reducing pollution from industry and from agriculture or land use. They also reported views on the relative difficulty of reducing pollution from these general categories of sources. Responses indicate that their beliefs on the difficulty of reducing pollution were linked to whether the pollution stems from industrial or diffuse sources. Specifically, industrial pollution is less difficult to reduce than diffuse pollution from agriculture or land use. Moreover, the concentration of the pollution sources affects the practicality of the international response options. Industrial pollution was
viewed as more conducive to integrated cooperation than diffuse pollution from agriculture or land use.

4.8 Chemicals and Biodiversity Regimes: Narrow but Integrated, Broad but Un-integrated

The expected pathway of the UNEP chemicals and waste regimes provides a contrast with the historical pathway of the biodiversity regime. An experienced Swiss negotiator remarked that he expects the mercury regime to become part of a consolidated chemicals regime that encompasses the various existing UNEP chemicals agreements (Interview 54, Swiss Government). Instead of expecting separate and independent treaty processes, as governments have made since the 1989 Basel Convention, he expects governments to eventually harness the synergies of those treaty processes and form a consolidated regime for chemicals management. Instead of remaining independent, the various UNEP chemicals conventions would slowly become institutionally integrated, producing an integrated regime for global chemicals regulation. Since 1992, the opposite has occurred in biodiversity governance. In the decades after the Convention on Biological Diversity was negotiated, governments have used other international institutions as diverse as the World Trade Organization, the World Intellectual Property Organization, and the UN Food and Agriculture Organization to take on issues under the mandate of the CBD. The expected integration of global chemicals management presents a sharp contrast with the historical un-integrated cooperation on global biodiversity.

This contrast illustrates how the form of global environmental cooperation depends on whether governments seek to regulate concentrated stakeholders or diffuse stakeholders. The UNEP chemicals conventions have been narrowly focused, prompting governments to make
successive conventions on specific portions of the chemical “life cycle,” from production, to shipment, to disposal and storage. The chemicals and waste sectors lobbied against an omnibus framework convention on chemicals in the mid-1990s. They feared that a framework convention would provide a broad mandate for governments to pursue future regulations (Interview 47, Swiss Government). They also lobbied against a convention on heavy metals (i.e., mercury, cadmium, and lead) but settled for a convention on mercury. Chemical industry associations acquiesced to narrow conventions on specific chemicals or practices that would not be prohibitively costly to phase out or replace. Thus, the UNEP chemicals conventions were narrowly constructed from the beginning. Governments acquiesced to industry and industry acquiesced to governments.

Despite the narrow mandate of each UNEP chemicals convention, they have been highly integrated. Governments have not made agreements on the substances and practices regulated under the conventions outside their legal or operational contexts. Even bilateral agreements between the United States and other states that are parties to the 1989 Basel Convention reference obligations of those states under the convention. They observe rules under the Basel Convention. Integrated chemicals management under each convention has relied on concentrated producers and concentrated markets for innovation. Governments have avoided un-integrated cooperation to economize on transaction costs and to continue cooperation under the UNEP conventions. The current “synergies process” underway to more closely integrate the different conventions together reflects the desire of governments to economize on the expense of having independent narrowly focused conventions that each deal with part of the life cycle of chemicals management (Interview 54, Swiss Government). Thus, what started out as narrow conventions that became individually integrated have become increasingly fused together.
Contrast this with the Convention on Biological Diversity. An omnibus convention, the CBD has a broad mandate to govern major issues in biodiversity, including genetic resources. The diffuseness of stakeholders in the negotiations leading to the CBD did not produce a similarly narrow convention as the UNEP chemicals and waste conventions. Governments instead negotiated a broad convention with a focus on different issues on the biodiversity agenda, thereby attracting the interest of stakeholders as diverse as biotechnology companies in the United States and small farm associations in developing countries. There was not concerted and unifying effort by the different stakeholders to have a narrow convention.

In the twenty years since the CBD was negotiated, the global biodiversity regime has become more un-integrated. Governments increasingly rely on different international organizations to manage plant genetic resources (Victor and Raustiala 2004). Unable to effectively protect biodiversity in a single treaty regime, governments have sought to undertake initiatives in different international organizations and at UN and sub-UN levels. Thus, what started out as broad became un-integrated. Diffuse stakeholders had a totally different impact on the global biodiversity regime than concentrated stakeholders had on the global chemicals and waste regime.
### Table 4.2 Sampling Summary Statistics

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<th>Meeting</th>
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<th>Rejected</th>
<th>Non-Return</th>
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Note: “Responded” means a participant returned a survey at least partially completed. “Rejected” means a participant chose not to complete the survey. “Non-Return” means that a respondent chose to complete a survey but did not return it.
CHAPTER FIVE

Forms of Un-integrated International Cooperation on Climate Change: Transaction Costs and Markets for Innovation

5.1 Introduction

Earlier chapters analyzed variation in the form of international environmental cooperation by explaining the conditions for integrated and un-integrated cooperation on global environmental issues. They demonstrated that diffuse stakeholders encourage national preferences to diverge over international environmental cooperation. Diffuse stakeholders prevent mitigation costs from declining, which exacerbates distributive problems. They also make top-down strategies for altering private incentives impractical or ineffective. Governments react to these conditions by forming un-integrated cooperation on global environmental issues such as climate change and biodiversity loss. When concentrated economic actors contribute to environmental externalities, national preferences converge. Integrated cooperation becomes less costly over time, creates markets for innovation, and facilitates effective solutions from the top down.

However, the earlier chapters did not explain variation in the forms of un-integrated cooperation. Governments sometimes have a choice in how they pursue un-integrated environmental cooperation. Governments may create new international rules and institutions that do not rely on existing rules and institutions. These are de novo rules and institutions. They do not depend on pre-existing rules and institutions for their legal status or implementation. For example, Germany sought to create a new international organization to promote renewable
energy. These efforts contributed to forming the International Renewable Energy Agency (IREA) in April 2009. IREA does not rely on the rules or institutions of another international treaty or international organization. It operates and exists under its own auspices and mandate. It is a de novo international organization.

Alternatively, governments may extend the mandate of another international institution to create rules on an environmental issue. They may extend the mandate to regulate an environmental issue that was not previously regulated under that mandate. For example, the International Maritime Organization (IMO) adopted an amendment to Annex VI of the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL). This amendment controls GHG emissions from commercial tankers on the high seas. Technically, this is a climate change issue insofar as GHG emissions mitigation is under the mandate of the UNFCCC and the Kyoto Protocol. However, the Kyoto Protocol requests that the IMO address bunker fuels used in commercial shipping. In this case, governments chose not to create a de novo international institution to regulate GHG emissions from commercial shipping. They used the IMO.

Under what conditions do governments create de novo international rules and institutions to regulate an environmental issue when they pursue un-integrated cooperation? Under what conditions do they extend the mandate of an existing international organization or treaty to regulate the environmental issue? *Fundamentally, what explains variation in the form of un-integrated international environmental cooperation?*

Un-integrated environmental cooperation sometimes presents governments with an option between making de novo rules and institutions or using pre-existing rules and institutions for regulatory goals that are outside the mandate they previously maintained. The earlier chapters
analyzed the first problem that governments face: whether to pursue integrated cooperation under a preexisting set of rules and institutions or pursue un-integrated cooperation, which entails not building on those rules and institutions. The earlier chapters did not analyze what exactly governments do in the event they decide to pursue un-integrated cooperation.

The initial problem of whether to pursue integrated cooperation represents the first stage in a sequence of choices. The choice of how to pursue un-integrated international environmental cooperation may be considered the second stage in that sequence of choices. Given that governments have decided not to build on existing rules and institutions intended for a specific environmental issue, they face a choice of how to pursue un-integrated cooperation. Should they make de novo rules and institutions to regulate the environmental issue? Or should they extend the mandate of an existing international organization or treaty to apply its rules and institutions to address that environmental issue?

In this chapter, I analyze the conditions under which governments make de novo institutions. My analysis also outlines the conditions under which they extend the mandates of existing treaty processes. I draw on the same explanations for variation in the form of international environmental cooperation evaluated in the prior chapters. Specifically, I evaluate how well stakeholder concentrations explain the choice between the two forms of un-integrated international environmental cooperation: creating de novo rules and institutions or extending the mandates of existing rules and institutions. I also evaluate how well variation in the number of states with control over the environmental issue explains this choice. Does variation in stakeholder concentrations explain the form of un-integrated cooperation? Or does variation in the number of states with control over the issue explain the form of un-integrated cooperation?
To explain variation in the form of un-integrated international environmental cooperation, I frame the analysis within two scope conditions. First, there are independent rules and institutions whose mandates could be extended to regulate the environmental issue. And second, stakeholders contributing to the environmental externalities are in diffuse markets.

The first scope condition means that governments have the choice to either create de novo rules and institutions or extend the mandate of existing rules and institutions to regulate an environmental problem. Although governments always retain the option to make de novo rules and institutions, they do not always have an existing set of rules and institutions that may be applied to the environmental problem they seek to manage. Governments can make de novo rules and institutions by negotiating them “from scratch.” However, they cannot always use existing rules and institutions to regulate an environmental issue because those rules and institutions do not exist across all environmental issues. The option between de novo rules and institutions, on the one hand, and existing rules and institutions with a different mandate, on the other, implies the existence of multiple sets of independent rules and institutions that can be applied to regulate problems with cross-cutting relevance across those rules and institutions. This is the first scope condition: there is cross-cutting relevance across independent rules and institutions to the environmental issue governments seek to regulate.

Moreover, the earlier chapters demonstrated that un-integrated environmental cooperation stems from economically diffuse stakeholders. Although the growth of international environmental law and the proliferation of international environmental agreements have generated more cross-cutting relevance between independent rules and institutions, governments do not invariably have numerous rules and institutions whose mandates can be applied to regulate an environmental issue. Rather, the earlier chapters demonstrated that un-integrated
global environmental cooperation is systematically associated with diffuse stakeholders. In governing some issues, there are no other rules or institutions, outside of the integrated ones, that could be applied to manage the issue. Rather, stakeholders are concentrated enough for governments to harness the benefits of integrated cooperation at minimal transaction costs. This is the second scope condition: the environmental externalities stem from stakeholders in diffuse markets.

Climate change meets both scope conditions. Economic actions contributing to climate change are diffuse, stemming from energy production and consumption, land use and forestry, transportation, and industry. Moreover, climate change has cross-cutting relevance across several independent international organizations in large part because the economic actions that contribute atmospheric GHG emissions are diffuse across sectors. I analyze variation in the form of un-integrated international environmental cooperation by focusing specifically on patterns of international cooperation on climate change.

Qualitative data from interviews, primary documents, and field observations demonstrate that variation in stakeholder concentrations between the UNFCCC and other treaty processes prompted governments to use non-UNFCCC institutions for climate change mitigation. Governments selected treaty processes whose stakeholders are in concentrated markets that make technological innovation and diffusion more likely to mitigate GHG emissions cost-effectively. This facilitated preference convergence among national governments inside these non-UNFCCC treaty processes.

Governments only created de novo rules and institutions when no other treaty process could be extended to serve the specific mitigation goals that governments sought to achieve. The United States and partner governments consistently sought to economize on transaction costs by
not making de novo treaty processes. Consistent with the stakeholder concentrations argument, governments were sensitive to the transaction costs of making de novo treaty processes. They did not want new treaty processes because it would have been costly to make and maintain them. This supports the premise that governments are reluctant to pay new start-up costs. They would rather economize on transaction costs by using existing rules and institutions to manage a problem for which those rules and institutions were created. They pursued un-integrated cooperation on climate change by relying on existing treaty processes to economize on start-up costs. They selected treaty processes whose stakeholders could achieve climate change mitigation goals more cost-effectively than the stakeholders in the UNFCCC.

The data do not support the Number of States Hypothesis. According to this hypothesis, governments would choose among existing international institutions based on which had fewer state parties to minimize preference heterogeneity. The United States, Canada, and the European Union have sought to raise the climate mitigation contributions of the Montreal Protocol, despite its having more parties than in the UNFCCC. Similarly, the International Maritime Organization and the International Civil Aviation Organization also have at least 170 state parties – and several governments have pursued climate change mitigation goals in these independent international organizations. Having more states included in these non-UNFCCC treaty processes encouraged preference convergence by preventing competitive distortions in the regulated industries. Businesses have preferred broad cooperation to harmonize regulations. This pattern is consistent with the “internationalization” of US domestic environmental regulations during the 1970s and 1980s (DeSombre 2000b).

The only extent to which the Number of States Hypothesis finds support in the pattern of un-integrated cooperation on climate change is that the United States has sought to use small
“clubs” to achieve minor climate change objectives. These clubs have been limited to relatively few member states, thereby limiting the number of states involved in the discussions and programs of these clubs. This was by design: the United States did not want extensive involvement from 190 parties in these informal groups. Nonetheless, limits on membership have hampered the legitimacy and achievements of these de novo institutions – and other institutional characteristics contributed as much to their success as the number of states they included.

5.2 Treaty Processes and De Novo Institutions in Climate Change Cooperation

After the UNFCCC was negotiated, governments worked on climate change issues within the Framework Convention process. When the Kyoto Protocol was completed, they had committed even further to the UNFCCC process by adopting new obligations, rules, and institutions under the Framework Convention. They created an integrated regime for climate change. After the George W. Bush administration decided to reject the Kyoto Protocol, the development of international cooperation on climate change began to change. The biggest changes occurred after the Kyoto Protocol entered into force in February 2005.

Figure 5.1 presents a timeline of institutional developments in multilateral climate change governance between 1992 and 2012. Multiple international initiatives outside the UNFCCC, which added rules or institutions to climate change governance, are bolded and italicized to distinguish them from other events, most of which occurred under UNFCCC auspices. The highlighted events made (or were intended to make) varying contributions to climate change governance that governments had not been able or willing to pursue inside the UNFCCC.
**Fig. 5.1** *Timeline of Institutional Developments in Multilateral Climate Change Governance.* This indicates some – certainly not all – contributions in international climate change governance inside and outside the UNFCCC over 1992-2012. The numbering of events in a given year is in no particular order.
The timeline details that governments have sought to use existing treaty processes (e.g., Montreal Protocol, IMO, ICAO) to achieve climate change mitigation goals by adopting treaties under these processes. The United States and the European Union have worked on convincing parties to the Montreal Protocol to adopt an amendment on hydrofluorocarbons (HFCs), which are not ozone-depleting substances (ODS) but have high global-warming potential (GWP). The European Union has pursued a treaty on GHG emissions from civil aircraft under the ICAO. And parties to the IMO adopted an amendment in July 2011 on GHG emissions from commercial tankers, under which new tankers would need to be more energy efficient.

However, the United States and other governments have also formed de novo institutions consisting of far fewer states than involved in the UNFCCC. Informal bodies such as the Major Economies Forum, the Clean Energy Ministerial, the Climate and Clean Air Coalition, and (formerly) the Asia-Pacific Partnership on Clean Development and Climate were all formed between 2005-2012 to contribute to climate change mitigation in minor ways. Unlike the treaty processes used for new climate agreements, these de novo institutions are not legal creations. They were not founded and do not operate under treaty auspices.

Over 2005-2012, the United States governments and several other likeminded governments formed de novo institutions and used existing treaty processes to compensate for inaction under the UNFCCC on climate change mitigation. The form of un-integrated cooperation on climate change has consisted of legal agreements, and attempts at legal agreements, under treaty processes, as well as de novo institutions with limited memberships, limited goals, and informal foundations. Why have the United States, European Union, and other governments sought to use the Montreal Protocol and the IMO for climate change mitigation?
Why did the US and other governments create de novo institutions such as the Major Economies Forum or the Climate and Clean Air Coalition? How did they design these de novo institutions?

5.3 Explaining the Form of Un-integrated Cooperation on Climate Change

According to the stakeholder concentrations argument, governments would pursue un-integrated international cooperation on climate change because the diffuseness of stakeholders contributing to climate change encourages preference divergence between governments and makes integrated cooperation infeasible and ineffective. Chapter Three’s analysis of the relationships between stakeholders, innovation prospects, mitigation costs, national preferences, and international cooperation on financing and technology transfer in ozone protection and climate protection explained how diffuse stakeholders impose political constraints on governments in mitigating climate change.

Mitigation costs remain high because innovation is stagnant. Diffuse downstream markets involving intense price sensitivity and varying capacities and willingness to assimilate technical innovations dis-incentivize new practices and technologies (e.g., energy and agriculture markets). This maintains mitigation costs at stable levels, instead of the drops that occur in more concentrated upstream-downstream markets. Wealthy governments are reluctant to make large financial contributions to climate change mitigation, and therefore spread their contributions across multiple institutions such as the World Bank, the GEF, and programs specific to the UNFCCC. They also need to make more robust institutions for technology transfer to provide incentives for innovation in the upstream producer markets, because the producers are otherwise reluctant to make large investments in new technologies.
Extending this argument, we should expect that stakeholder concentrations also affect the form of un-integrated cooperation on climate change. Variation in stakeholder concentrations should encourage governments to use international institutions involving more concentrated stakeholders than those in the UNFCCC. Governments would seek to limit stakeholder concentrations because that would make technical innovation and diffusion more likely, which would lead to preference convergence among governments by lowering mitigation costs. This would enable the United States and developed countries to arrive at mutually acceptable bargains with large developing countries. Governments would select international institutions whose stakeholders would achieve climate change mitigation goals under cost-effective regulations.

A premise of the stakeholder concentration argument is that governments would craft un-integrated cooperation on climate change to economize on transaction costs and start-up costs. By selecting international institutions with concentrated stakeholders, governments would minimize political disagreements by providing different sides with a greater stake in agreement than could be achieved in the UNFCCC because of stakeholder diffuseness.

The premise that governments are reluctant to pursue un-integrated cooperation because it does not enable governments to economize fully on transaction costs and regulatory costs should translate into few attempts to form de novo treaty processes. Forming de novo institutions is financially, politically, and bureaucratically costly. Governments need to invest in those institutions with limited budgets. They prefer not to make marginally greater investments when they can economize on those investments by using existing treaty processes to achieve policy goals.

We should expect un-integrated cooperation on climate change to involve two characteristics, summarized in a hypothesis.
**Stakeholder Concentrations Hypothesis**: Governments select international institutions for climate change mitigation that have more concentrated stakeholders than the UNFCCC. They economize on transaction costs by only creating de novo institutions in the absence of existing ones whose mandates could be extended to achieve specific mitigation goals.

The number-of-states explanation for variation in the form of international environmental cooperation would predict a different pattern of un-integrated cooperation on climate change. Governments would be sensitive to the number of parties in treaty processes whose mandates could be extended to make climate change mitigation contributions. Governments would view the number of states in a given treaty process as the main indication of the preference heterogeneity of that treaty process. They would seek to limit preference heterogeneity in facilitating climate change mitigation by selecting international institutions with fewer parties. In making de novo institutions, they would also seek to limit preference heterogeneity among participating governments by including fewer states than involved in the UNFCCC. In that respect, they would craft de novo institutions to limit state membership to an exclusive few who could make important contributions and leave other states out of the de novo institutions. I evaluate the hypothesis stemming from this explanation of the form of un-integrated cooperation on climate change.

**Number of States Hypothesis**: Governments select international institutions for climate change mitigation that have fewer state parties than in the UNFCCC. They limit preference heterogeneity in de novo institutions by limiting membership to significantly fewer state parties than in the UNFCCC.

Multiple observations would falsify each of these hypotheses. If governments made de novo multilateral institutions for climate change mitigation when pre-existing institutions could
have performed comparable functions, this would falsify the Stakeholder Concentrations Hypothesis. If governments used existing international institutions whose stakeholders are not equipped to mitigate climate change emissions, or which are more diffuse than those in the UNFCCC, this would also falsify the Stakeholder Concentrations Hypothesis. However, if governments pursued un-integrated cooperation on climate change in international institutions with more parties than in the UNFCCC or the Kyoto Protocol, this would falsify the Number of States Hypothesis. If governments made de novo institutions with more parties than involved in the UNFCCC or the Kyoto Protocol, this would also falsify the Number of States Hypothesis.

I evaluate the hypotheses with a combination of primary qualitative and quantitative data. Mainly, I use interview data from 45 negotiators and other participants in the UN climate change negotiations and other global environmental institutions. The negotiators and other participants spanned different international organizations, national governments, and non-governmental organizations involved in the UNFCCC and the Montreal Protocol. I also use field observations from personal attendance in Montreal Protocol meetings where the HFCs amendment was a topic of debate.¹ I supplement the interviews and field observations with primary source documents and quantitative data.

5.4 Stakeholders and Markets in the Choice of International Institutions

The United States and the European Union have recognized that one advantage of using the Montreal Protocol and the IMO to mitigate climate change is that these treaty processes have

long histories of promoting private sector engagement (Interview 30, US State Department; Interview 16, European Commission). Lists of Participants indicate that producer companies in both the commercial shipping industry and fluoro-product industry regularly participate in meetings of these treaty processes as observers (Ozone Secretariat, IMO Secretariat). These producer markets are highly concentrated compared to the range of other producer markets making large contributions to climate change.

STAKEHOLDER CONCENTRATIONS. Figure 5.2 below displays three measures of stakeholder concentration differences across the IMO, Montreal Protocol, and UNFCCC processes. The top measure indicates that there were far more participants attending the UNFCCC meetings than either the Montreal Protocol meetings or meetings of the Marine Environment Protection Committee of the IMO (IMO-MEPC). The middle measure indicates that there were far more non-governmental groups that attended the UNFCCC meetings than either the Montreal Protocol or IMO-MEPC meetings. The bottom measure indicates that the ratio of international groups to all groups attending the IMO-MEPC is much higher than the corresponding ratios for the UNFCCC and the Montreal Protocol, respectively. The ratio for the Montreal Protocol is slightly higher than the ratio for the UNFCCC in most years.

These measures show that the UNFCCC process has had more stakeholders than the other two processes. They also show that stakeholders in the UNFCCC are organized at local or national levels more than the stakeholders in the other two treaty processes. Organizing at local and national levels more than the international level is one indication of the diffuseness of stakeholders. Local and national organization reflects more diffuse and heterogeneous stakeholders. Their goals and objectives are local or national in scale, in contrast to international associations that have global goals and objectives.
Fi. 5.2 Participants and Represented Organizations at the IMO, Montreal Protocol, and UNFCCC. Participants from NGOs are designated in Lists of Participants. Sources: Lists of Participants from the IMO, Montreal Protocol, and UNFCCC Secretariat webpages.
The ratio of international non-governmental groups to all non-governmental groups serves as one indicator of whether stakeholders share similar priorities at high levels of aggregation or have different priorities. Moreover, it measures the extent to which stakeholders have an interest in and ability to organize at the international level, since organizing at higher levels of aggregation depends in part on stakeholders’ capacity to overcome barriers to collective action. Generally, the capacity to overcome barriers to collective organization depends on the concentration or diffuseness of stakeholders, among other conditions (Olson 1965). The UNFCCC has more stakeholders with local and national priorities than the IMO or Montreal Protocol processes, but the IMO has the most aggregated groups.

TECHNOLOGICAL INNOVATION. The IMO and Montreal Protocol have encouraged private sector innovations and technological diffusion over several decades. The commercial shipping industry has modified tankers in compliance with regulations under MARPOL to protect the marine environment from oil discharges and other wastes (Mitchell 1994). Similarly, fluoro-product companies have made substitutes to older ODS to comply with control measures under the Montreal Protocol and move the stratospheric ozone layer on a path to recovery (Parson 2003). However, the UNFCCC has not promoted technological development and diffusion on a scale that experts have determined is necessary to avoid potentially dangerous levels of GHG concentration in the atmosphere (IPCC 2008).

Unlike upstream producers with a stake in the UNFCCC process, upstream producers with a stake in the IMO and Montreal Protocol have had financial incentives in new regulations. New regulations in those industries create markets for innovations. Some participants in the Montreal Protocol, for example, are suspicious that the United States seeks a new amendment to the Protocol to control HFCs because it would serve the interests of US-based fluoro-product
corporations (Earth Negotiations Bulletin, 19 November 2012). New amendments under MARPOL create a similar market for new tanker technologies in the commercial shipping industry, promoting a continuous stream of small-scale innovation in tanker equipment (Mitchell 1994).

New regulations have sought to encourage technological innovation and diffusion in the energy sector. However, regulations have been more profitable for upstream producers in fluorinated chemicals than for energy companies, in part because of downstream market differences. The downstream market for energy is extremely diffuse and consumers are generally price sensitive (Reiss and White 2005). Price sensitivity in energy markets has dis-incentivized costly investments in transformative technologies on an industrial scale, as innovations only seem to move forward during unusual periods of price escalation (Newell 2011).

By contrast, the relative concentrations of certain downstream markets for fluoro-products have encouraged product differentiation and investment in alternative technologies by upstream producers when new regulations are in place (Interview 41, fluoro-product company). Although fluoro-product consumers are also price sensitive, concentrated downstream consumer markets enable the upstream producer companies to make profitable investments by differentiating products sufficiently to meet the demands of heterogeneous downstream consumers in the air-conditioning and refrigerants markets (Author observations, 32nd OEWG). They tend not to make similar investments in the agricultural use of ODS as pesticides (Interview 40, fluoro-product company).

The history of innovation under MARPOL has been similar to that under the Montreal Protocol. Downstream market concentration in commercial shipping has produced positive network externalities (Mitchell 1994). When the move towards new technologies begins, more
tanker owners and shipping companies join the group of actors adopting new technologies. It becomes less profitable to continue using older technologies because new regulations create new incentives for producer companies and they can sell new tankers and other vessels to concentrated downstream markets. For example, new regulations on energy efficiency under MARPOL will translate into energy savings for operators and owners of large commercial tankers – the downstream consumers. They have a financial incentive to accept more energy efficient vessels (Interview 16, European Commission). This gives the upstream producer companies an incentive to accept MARPOL regulations that call for greater energy savings.

5.4.1. Selecting Treaty Processes

MONTREAL PROTOCOL. The United States, Canada, and Mexico proposed an HFCs amendment under the Montreal Protocol, despite the Kyoto Protocol’s inclusion of HFCs in the basket of six GHGs. The Montreal Protocol’s success has depended on technological innovations and capital investments by large multi-national corporations. The regulatory instruments needed to incentivize these corporations to innovate and diffuse ODS substitutes meant that achieving additional climate change mitigation goals under the Montreal Protocol would require adopting an HFCs amendment but would not require significantly more rules or new institutions. The United States, Canada, and European Union could rely on large multi-national corporations to innovate and diffuse alternatives to HFCs if they were to convince other governments to adopt an amendment to control the growth of HFCs. A Canadian negotiator remarked that providing a level playing field for industry would incentivize technological development and diffusion:
“Industry in the US, or Japan, or China are not necessarily worried that they are going to lose to competitors in other countries, although you have the differentiation obviously between developed and developing countries. But in the final analysis, there is a kind of level playing field that is created at least among non-Article 5 countries, first, and then the whole world. And without having that it is hard to imagine how industries will want to invest in alternatives and to switch to other things. If you did it just by saying, well, under the UNFCCC and the Kyoto Protocol, if some countries decided that they would reduce HFCs by 6 percent or 10 percent or whatever, that does not give industry any indication of what other countries are going to do. What gives them the confidence is when you say, in our country, we are going to do this and industries in other countries are not going to take advantage of that and promote cheaper products still using HFCs. So it is really important having that kind of regime providing that kind of transparent view of what is going to happen in the future. And it is clear for the sectors, the industry sectors, what is going to happen and when, and to have that level playing field” (Interview 37, Environment Canada).

The transition towards HFCs has followed regulations against using older chemicals under the control regime of the Montreal Protocol. Parties to the Protocol have acknowledged that the success of ODS controls has ironically promoted the transition towards HFCs in developed and developing economies (Interview 34, international organization). Observers and governments now worry that the success of the Montreal Protocol in protecting climate will evaporate over time because of the transition towards HFCs that would contribute to significant climate warming through 2100 (Velders et al. 2009, Interview 36, US Environmental Protection Agency (EPA)). The US and likeminded governments have viewed the Montreal Protocol as a suitable platform for regulating HFCs, despite their legal inclusion in the Kyoto Protocol “basket of gases,” in part because the previous phase-outs of ODS under the Protocol contributed to the transition towards HFCs. The HFCs amendment has been viewed as an instrument for preventing the potential negative climate change consequences of the Montreal Protocol’s success (Interview 30, US State Department).
However, the decision to propose and advance the HFCs amendment under the Montreal Protocol reflects a deep understanding of the reasons for the Protocol’s success and the comparative advantages of the Montreal Protocol relative to the UNFCCC and the Kyoto Protocol. Governments in favor of the amendment recognize that the stakeholders necessary to reduce the emission of HFCs were already regulated under the Montreal Protocol. Adopting the HFCs amendment would add another layer of control measures to those same industries that had respected for decades the control measures of the Protocol (Interview 37, Environment Canada). The stakeholders whose actions contributed to the growth of HFCs were in the Montreal Protocol, represented at the meetings, but were one among many other groups represented at the UNFCCC and Kyoto Protocol meetings. Because HFCs represent a minor share of the global warming attributable to human activities, they have not been a major topic of conversation. Indeed, they never receive attention. One observer of both processes jokingly remarked that in the UNFCCC, “carbon dioxide takes all the oxygen out of the room” (Interview 20, White House). In the Montreal Protocol, the only major stakeholders are those that have contributed to the growth of HFCs use. Regulating the stakeholders in the Montreal Protocol would mean regulating those whose technologies have led to the growing use of HFCs. The same is not true of the UNFCCC and Kyoto Protocol because of the multifarious stakeholders whose actions have contributed to climate change. The concentration of the Montreal Protocol stakeholders has been viewed as an advantage of advancing HFCs reduction under that process instead of the Kyoto Protocol (Interview 36, US EPA).

INTERNATIONAL MARITIME ORGANIZATION. During the Kyoto Conference in December 1997, governments collectively decided to include a provision in Article 2 of the Kyoto Protocol that requests the IMO and ICAO to take action on bunker fuels under their
mandates. Earlier in 1997, the IMO parties had adopted a protocol to MARPOL 73/78 that added an annex on air pollution. This expanded the mandate of MARPOL to cover air pollution from the tanker fleets of MARPOL parties, which accounted for over 90 percent of the world’s total shipping tonnage on an annual basis (Griffin 1994, 489). During the Kyoto Conference, parties recognized that the new MARPOL annex on air pollution meant that IMO parties could eventually regulate GHG emissions from commercial shipping (Interview 26, US State Department).

The IMO seemed like an obvious platform for handling the problem of GHG emissions from commercial shipping vessels. According to a long-time participant in the UNFCCC negotiations,

“I can’t imagine that the Climate Convention would be more effective in controlling the emissions of ships than the IMO. In other words, there are difficulties in the IMO. But those difficulties would be transferred over to the [Climate] Convention if the Convention were to take this over” (Interview 24, UNFCCC Secretariat).

The United States and the European Union have favored using the IMO to take action against bunker fuels (Interview 16, European Commission; Interview 5, US State Department). Historically, the IMO has provided incentives for the tanker manufacturers and tanker owners to reduce pollution. By the 1980s, oil discharges at sea had dropped by 60 percent below their highest levels in the 1970s (Griffin 1994, 503). Under the 2011 amendment on energy efficiency, the IMO parties exempted existing fleets from the new energy efficiency requirement, enabling ship owners to continue using their expensive tankers without requiring that they become retrofitted with new equipment. However, they required that new tankers contracted for construction after 1 January 2013 have more efficient energy technology (Amendment to Annex
VI of MARPOL 2011). This compromise satisfied upstream tanker producers and downstream ship owners. The recent transition by containership companies towards slow-mode shipping is expected to generate energy savings, lowering the expected compliance costs of the new energy efficiency requirements under the MARPOL amendment (Interview 16, European Commission).

INTERNATIONAL CIVIL AVIATION ORGANIZATION. In the provision of the Kyoto Protocol that asks the IMO to take action on bunker fuels, the same reference is made to the ICAO and bunker fuels in civil aircraft. Unlike stakeholders in MARPOL, stakeholders in the ICAO have not developed a history of developing and diffusing new technologies for global environmental protection. While the 2011 amendment to Annex VI of MARPOL followed a long history of environmental protection under the IMO, the ICAO has lacked a comparable history of incentivizing more environmentally friendly civil aircraft. Instead, the lobby groups of international airline companies have resisted these actions. Political progress has been comparatively slow under the ICAO on a treaty to reduce GHG emissions from civil aircraft (Interview 3, British Department of Energy and Climate Change). The political convergence among governments that has occurred historically under the Montreal Protocol and the IMO for more environmental measures has not occurred yet under the ICAO, despite the concentration of stakeholders in the ICAO.

Downstream consumer markets may explain this variation in the positions of upstream-downstream industries involved in the ICAO and those involved in the Montreal Protocol and IMO, respectively. In the civil aviation sector, downstream consumers of air travel are diffuse and generally price sensitive because of product substitutability in the market for air travel (Lee and Mo 2011). Airline companies cannot readily provide differentiated products to these downstream consumers, unlike fluoro-product companies that can service demand among air
conditioning or refrigerants companies that make differentiated products for consumer markets. Each airline company faces a substitution problem: consumers can receive a similar service for a lower price if the company raises prices. They also face strong limitations in economizing on operating costs through new technology (Lee 2010). The structure of downstream consumer markets across these sectors make it less compelling for airline companies to accept regulations on greater energy efficiency than for tanker owners or downstream refrigerants companies to accept new environmental regulations. Downstream markets create different incentives at upstream portions of the product supply chains in these sectors. This has political consequences in international negotiations. Governments have divergent preferences over adopting new regulations.

5.4.2. Forming De Novo Institutions

MAJOR ECONOMIES FORUM. The United States has created de novo institutions only when negotiators and policymakers in the State Department and the White House did not have an existing treaty process whose mandate could be extended to achieve specific climate change mitigation goals. They only pursued de novo institutions in view of the landscape of international institutions already in place with cross-cutting relevance to GHG emissions. In the absence of a specific treaty process whose mandate could be applied to achieve a specific climate change mitigation goal, the United States government sought to form a de novo institution. This prompted the Bush administration to form the Major Economies Meetings in 2007, which the Obama administration re-launched under a different name (Major Economies Forum) in 2009.
Unlike the treaty processes that the United States has used for climate change mitigation outside the UNFCCC, it designed the Major Economies process to have features that none of the treaty processes handling climate change mitigation possesses. First, the Major Economies process has been informal, not established by a treaty. The United States and other participants in the talks have preferred an informal body to a legalized one because it entails no official commitments and has greater flexibility and fewer institutionalized procedures that obstruct progress (Interviews 5, 13, and 17, US State Department). Second, it contains a dynamic technology component in the form of the Clean Energy Ministerial, which Secretary of Energy Steven Chu launched in December 2009 (Interview 35, US Department of Energy). This component facilitates discussions on technology promotion and diffusion that seek to build confidence and coordination on specific clean energy technologies. And third, the Major Economies process has been limited to 17 states that make the largest contributions to global GHG emissions on an annual basis. In each of these respects, the United States has crafted the Major Economies process to differ from the UNFCCC and to complement non-UNFCCC treaty processes employed to achieve limited mitigation objectives (Interview 9, White House; Interviews 11 & 13, US State Department).

CLIMATE AND CLEAN AIR COALITION. The United States partnered with other governments and the United Nations Environment Programme (UNEP) to launch the Climate and Clean Air Coalition on Short-Lived Climate Pollutants (CCAC) in February 2012. Like the Major Economies Forum, CCAC was designed to serve limited climate change mitigation goals on issues not covered under the mandates of non-UNFCCC treaty processes. The only exception has been HFCs, which the United States and other CCAC partners have sought to regulate under the Montreal Protocol while also investing in the CCAC’s development. HFCs are an issue
addressed within CCAC and the subject of the North American amendment proposal under the Montreal Protocol. Besides that overlap, CCAC is intended to facilitate mitigation of climate change by promoting technologies on so-called “short-lived climate pollutants,” which include HFCs, black carbon, methane, and tropospheric ozone (CCAC 2012). Methane and HFCs are included in the basket of Kyoto Protocol gases, but black carbon and tropospheric ozone are neither included in the Kyoto Protocol nor any other regulation, existing or proposed, under another treaty process.

Like the Major Economies Forum, CCAC is an informal club of states that engage with non-government stakeholders to promote technology that substitute for those in use that emit short-lived climate pollutants. The United States and CCAC partner governments have sought to begin from a small group of likeminded states and build momentum in the process over time. Keeping CCAC informal and un-legalized also means that governments have flexibility and avoid legal commitments on climate change, which have hampered progress inside the UNFCCC (Victor 2011).

One difference between the CCAC and the Major Economies Forum is that CCAC membership is not fixed. It has grown over time to include more partner states and non-government groups, as well as more representatives from the scientific community working on climate change and air pollution. As of April 2013, the CCAC has 30 partner states and the European Commission. Another difference is that the CCAC conducts information and awareness-raising campaigns to promote climate-friendly technology to a wider range of stakeholders than those currently engaged in the CCAC. In these respects, CCAC differs from the Major Economies Forum – and for precisely these reasons, it has become more dynamic and investments from governments and non-governmental groups in CCAC have rapidly increased
since its founding in February 2012. Governments have not duplicated efforts in developing CCAC with the Major Economies process.

EARLIER DE NOVO INSTITUTIONS. During the Bush administration, the United States undertook a similar pattern of launching de novo institutions to achieve limited climate change mitigation objectives outside the UNFCCC with a small number of likeminded partner governments. These de novo institutions were not legalized and had limited technology promotion goals that engaged private sector actors and provided a platform for technology coordination and multi-national project development and collaboration (Interview 11, US State Department). Existing treaty processes did not have the requisite mandates to perform these specific functions or their agenda would not accommodate these specific issues. The lack of existing treaty processes to perform limited mitigation goals reinforced the Bush administration’s desire to look outside legal treaties in forming an international climate change strategy (Interviews 11 & 12, US State Department). The emphasis on non-legal institutions and technology promotion that engaged the private sector prompted the US government to launch a succession of small-scale multilateral initiatives to promote projects that were either not primary agenda items of the UNFCCC or were not within the mandates of non-UNFCCC treaty processes.

5.5 Number of States in the Choice of International Institutions

Governments have used non-UNFCCC institutions with varying memberships for climate change mitigation. Some have included more than 190 states and others have included as few as 6 states. Treaty processes have consisted of global memberships. De novo institutions have
included as few as 6 states and as many as 30 states. The membership compositions of these non-UNFCCC institutions have been an important characteristic attracting governments to use existing treaty process and form de novo institutions for climate change mitigation. The US sought to limit membership to make the de novo institutions dynamic and flexible.

However, governments have not sought to extend the mandates of existing treaty processes because they had fewer state parties than the UNFCCC or Kyoto Protocol. To the contrary, the inclusive and global composition of membership in the IMO, ICAO, and Montreal Protocol have made them more viable platforms for climate change mitigation, not less viable ones. The United States and the European Union have viewed the large membership sizes of these non-UNFCCC treaty processes as adding to their potential contributions in climate change mitigation. In crafting de novo institutions, the United States has sought to build momentum in a small group of critical states whose contributions to climate change are greatest on an annual basis. But the size of these groups has not been the main membership selection criterion. Instead, the *contribution* of the partner states has been a driving motivation for limiting membership, not the total number of partner states.

Figure 5.3 displays the total membership sizes for each year of four treaty processes: the IMO, ICAO, UNFCCC, and the Vienna Convention on the Protection of the Ozone Layer. It shows that the Vienna Convention, UNFCCC, and ICAO have near universal membership. In fact, the Montreal Protocol became the only environmental treaty to have universal membership. The IMO has fewer member states, although it reached 170 state parties in 2011. *Nonetheless, there was no significant difference in membership sizes among these treaty processes when the use of non-UNFCCC institutions rose between 2005-2012.* The non-UNFCCC processes either had as many state parties as the UNFCCC or had nearly as many. More importantly, each of
these four treaty processes includes large developing countries like the BRICS (i.e., Brazil, Russia, India, China, and South Africa) and others.

Fig. 5.3 Total State Parties and Total Sovereign States in the World. “Total states” refers to the total number of sovereign states in the world. Sources: Correlates of War States System Membership, Treaty Secretariat webpages.

5.5.1 Selecting Treaty Processes

While the North American parties have proposed the HFCs amendment, the number of state parties in the Montreal Protocol has been higher than the number of state parties in the UNFCCC or the Kyoto Protocol. Indeed, they have viewed the Montreal Protocol as more potentially effective in contributing to climate change mitigation than the Kyoto Protocol in part because of its universal membership (Interview 37, Environment Canada). All state parties under the Montreal Protocol are obligated to reduce the production and consumption of controlled ODS but the same is not true of the Kyoto Protocol, under which only the wealthy country parties are obligated to reduce GHG emissions. This has contributed to a convergence of national
preferences inside the Montreal Protocol and has prevented preferences from converging inside the Kyoto Protocol.

The United States views universal membership in the Montreal Protocol as contributing to its environmental effectiveness in part because that improves compliance with treaty obligations. Universal membership means that companies are subject to similar regulations by the point that developing states reach the same phase-out or phase-down obligations as the developed states after their ten-year grace period ends under each new amendment. “Leakage,” which occurs when companies use cheaper technologies because of different regulations, is not concerning for domestic companies using or producing fluorinated chemicals in the developed economies because those companies know that competitors in the developing economies will eventually face similar obligations. They know that companies in the developing economies will begin the transition away from older chemicals in anticipation of the end of their ten-year grace period (Interview 30, US State Department).

Universal membership mitigates competitiveness concerns since companies in the upstream and downstream industries using fluorinated chemicals know that competitors will face equivalent requirements under the Montreal Protocol. They know that there are no competitors located in a foreign country without similar obligations because all states are in the Protocol. The near universal membership in amendments to the Protocol has further mitigated potential concerns about losing competitiveness to foreign companies using next-generation chemicals in the refrigerants and air conditioning markets. Consequently, universal membership in the Montreal Protocol improves the environmental effectiveness of the treaty since all firms in the world that produce or consume the regulated chemicals are under legal obligations to comply with phase-out schedules. This has enabled the preferences of national governments to converge
inside the Montreal Protocol process by harmonizing interests among companies in the fluoro-
products industry worldwide (Interview 30, US State Department).

The same has been true of MARPOL. When governments inserted a provision in the Kyoto Protocol to request the IMO and ICAO to adopt rules on bunker fuels, the membership sizes were not far below the membership size of the UNFCCC. As of 31 March 2013, the total shipping tonnage regulated under Annex VI of MARPOL, which includes the amendment on energy efficiency, is 94.3 percent of total global shipping tonnage (Summary of Status of Conventions 2013). This mitigates concerns over competitive distortions: the major commercial shipping states such as Japan and South Korea know that countries with large shipping fleets have the same energy efficiency obligations for their national commercial tankers. Having nearly 95 percent of global tonnage covered under Annex VI presents governments with a reason to view the IMO as a potentially useful platform for making contributions in climate change mitigation. If only a fraction of global tonnage were covered under Annex VI, they might question the environmental effectiveness of an energy efficiency amendment such as the one they adopted in July 2011. Universal inclusion adds to the advantage of using this non-UNFCCC treaty process for climate change mitigation. It does not detract from the rationale of using the IMO to achieve climate change mitigation goals. Governments that would otherwise object to regulations over potential competitiveness distortions know instead that foreign competitors face similar regulations (Interview 5, US State Department). This facilitates preference convergence inside the MARPOL negotiations. Having a broad membership facilitates political convergence among governments.

5.5.2 Forming De Novo Institutions
The United States has crafted de novo institutions for climate change mitigation with a focus on limiting membership. In making the Major Economies Forum, and the predecessor institution under the Bush administration, the Obama administration sought to include the largest contributors to annual GHG emissions because it viewed having consensus among the largest national emitters as more important than having universal consensus (Interview 25, US State Department). Including all states in a global emissions agreement was not viewed as environmentally necessary. David Victor has argued that the key number of states for an effective emissions agreement is around 12 (Victor 2011). In this respect, the Number of States Hypothesis finds support in the pattern of un-integrated cooperation on climate change because de novo institutions have had far fewer states than the global treaty processes. The United States has long viewed the universal membership of the UNFCCC as an obstacle to effective action against climate change (Interview 11, US State Department).

Despite the belief that fewer members would translate into more effective action and faster progress by the members, negotiators commonly acknowledge that including the largest economies in the world in the de novo institutions does not change national policies. One former US negotiator remarked, “China still has the view that China has no matter where you meet them” (Interview 12, US State Department). On rare occasions in the Major Economies Forum, the combination of high-level participants, the non-legal basis of the discussions, and the small membership have contributed to minor breakthroughs. For example, in 2010, Indian Environment Minister Jairam Ramesh made an important proposal on transparency to representatives at a meeting of the Major Economies Forum in the lead-up to the annual UNFCCC meeting. It later served as a basis for the negotiated settlement on monitoring and
verification adopted by parties to the UNFCCC at the meeting in Cancun (Interview 27, US State Department). Nonetheless, the productivity of this process has been as much a function of the small membership size as the informality and high-level nature of the discussions. In that respect, the membership sizes of the de novo institutions have combined with the informality of discussions and specificity of goals to make positive contributions in climate change governance. The limited membership sizes have not alone made these contributions possible.

Limiting membership to only a select few parties had brought criticism on these de novo institutions for being exclusive and insulated from participation by the wider range of states. Although the exclusivity and insulation of these processes made them potentially potent sources of new mitigation actions against climate change, it limited their legitimacy by preventing the range of stakeholders and states with input in the UNFCCC into the discussions and programs of the US-led institutions (Interview 7, British Embassy-Berlin). The limited legitimacy of these de novo institutions made them less impactful within the UNFCCC process because states not included in them viewed them with suspicion (Interview 6, UNFCCC Secretariat). The CCAC has prevented similar accusations of insulation and exclusivity by making membership open to other states and non-state groups that meet certain accreditation requirements. CCAC state membership and the inclusion of scientists and non-state groups have grown rapidly since it began in February 2012.

5.6 Conclusion

The recent history of un-integrated international cooperation on climate change exhibits four patterns. First, governments have compared the UNFCCC with other treaty processes based
on their stakeholder concentrations to identify whether to use the UNFCCC or other treaty processes for specific climate change mitigation objectives. Second, governments have sought to economize on the start-up costs and transaction costs of un-integrated cooperation by relying on existing treaty processes with mandates that could be extended to address GHG emissions directly. Third, when governments have formed de novo institutions, they have generally limited those institutions to specific functions not addressed under the treaty processes. And fourth, the de novo institutions have had significantly fewer parties than the treaty processes that governments have used in pursuing un-integrated cooperation on climate change.

These four patterns provide stronger support for the Stakeholder Concentrations Hypothesis than the Number of States Hypothesis. Table 5.1 summarizes the expected and observed patterns of un-integrated cooperation on climate change. In pursuit of cost-effective climate change mitigation, governments have selected treaty processes in view of their stakeholders. The United States and other governments seeking to use non-UNFCCC institutions for climate change mitigation have selected treaty processes involving industries making sizeable contributions to global GHG emissions or whose industries are expected to make larger contributions to global GHG emissions in the future. These governments have pursued legal agreements under non-UNFCCC treaty processes that could rely on the stakeholders long participating in those processes to lower mitigation costs over time. Under the IMO and the Montreal Protocol, the history of technological innovation and diffusion has depended on the financial and human capital resources of concentrated upstream producers and relatively concentrated downstream consumers. This has motivated the United States and the European Union, among other parties, to extend or employ the mandates of the Montreal Protocol and the IMO’s MARPOL regime for climate change mitigation
Table 5.1 Expected and Observed Patterns of Un-integrated Cooperation on Climate Change

<table>
<thead>
<tr>
<th>Observations</th>
<th>Expectations</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside UNFCCC, all treaty processes used for climate change mitigation have</td>
<td>Governments select treaty processes with more concentrated stakeholders</td>
<td>Stakeholder Concentrations</td>
</tr>
<tr>
<td>more economically concentrated stakeholders than the UNFCCC.</td>
<td>than the UNFCCC.</td>
<td></td>
</tr>
<tr>
<td>De novo institutions provide limited supplementary functions not handled by</td>
<td>Governments make de novo institutions only on issues outside the mandates of</td>
<td></td>
</tr>
<tr>
<td>treaty processes, either adequately or at all.</td>
<td>existing treaty processes.</td>
<td></td>
</tr>
<tr>
<td>All non-UNFCCC treaty processes used for climate change mitigation have at</td>
<td>Governments select treaty processes with fewer state parties than the</td>
<td>Number of States</td>
</tr>
<tr>
<td>least 170 parties and include the largest economies in the world.</td>
<td>UNFCCC or the Kyoto Protocol.</td>
<td></td>
</tr>
<tr>
<td>De novo institutions include many fewer partner governments than the number</td>
<td>Governments form de novo institutions involving fewer states than the</td>
<td></td>
</tr>
<tr>
<td>of state parties in the UNFCCC.</td>
<td>UNFCCC.</td>
<td></td>
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</tbody>
</table>

The United States has also formed de novo institutions that limit the parties to those that can make technology contributions in mitigating climate change. Only recently has it partnered with other governments and UNEP to launch the CCAC, which has a growing membership but which remains far below the membership sizes of the treaty processes. Under the Bush administration, limiting the number of states in these groups was intended to make the discussions more flexible and productive than possible in the UNFCCC, which enables any party to intervene during formal proceedings to raise an objection. In that respect, the United States has crafted de novo institution in view of the perceived limitations of the UNFCCC process stemming from its inclusive membership.

However, the United States only formed de novo institutions to make progress on limited mitigation issues and encourage win-win technology promotion opportunities among likeminded
governments when existing treaty processes either did not have a mandate that could be extended to provide for these functions or which dealt with more expansive issues, particularly inside the UNFCCC. Governments have only made de novo institutions to complement the treaty processes, not to replace them. They have consistently avoided making alternative treaty processes in part because of the extensive transaction costs and start-up costs that would entail. One Montreal Protocol negotiator remarked that creating a separate convention on HFCs would not have been cost-effective:

“It is a good question because if you created a new convention, you would need all kinds of new institutions. And we already have existing institutions. You have the Ozone Secretariat in Nairobi. You have the Fund Secretariat in Montreal. You have the rules about how those [work]. And then you have the Executive Committee that oversees the Multilateral Fund. There are all kinds of procedures and rules. And the Implementation Committee has developed a kind of a body of operational procedures. All that can be used, rather than creating anything from scratch. It is just smart government, smart international governance. It is cost-effective” (Interview 36, US EPA).

Another negotiator remarked that negotiating a convention on HFCs instead of using the Montreal Protocol to regulate their growth would invite uncertainties. “You may not in the end recreate the same infrastructure twice with as much effectiveness because you are not taking the 20 years of experience that the Montreal Protocol has in those sectors” (Interview 37, Environment Canada). Creating de novo institutions involves uncertainty.

Precisely to economize on transaction costs and start-up costs, governments have sought to avoid investing in de novo institutions when existing treaty process could provide similar functions. When they did create de novo institutions, the investment has been limited and flexible to economize on start-up costs and limit country commitments to non-binding political positions, not legal ones.
More generally, the use of non-UNFCCC institutions was not by design: governments only began using non-UNFCCC institutions for climate change mitigation over a decade after the UNFCCC was negotiated. Even the United States government, which has opposed many aspects of the UNFCCC for over a decade, originally viewed that as the only appropriate and viable institutional setting for addressing climate change issues (Interview 2 & 13, US State Department). Rather than invest in non-UNFCCC treaty processes, the US invested in the UNFCCC process. During the Kyoto conference to negotiate a protocol to the Framework Convention, parties decided to ask the IMO and ICAO to regulate bunker fuels under their mandates not because they had expected to make this request but because it became politically complicated to reach consensus on bunker fuels during the Kyoto negotiations (Interview 3, British Department of Energy and Climate Change). It was a response to political constraints.

The pattern of un-integrated cooperation on climate change has exhibited consistent efforts to limit investments in international governance within political and budgetary constraints. Pursuing un-integrated cooperation was a secondary alternative to the integrated cooperation that originally began in the 1990s.

Although the United States had limited membership in de novo institutions to fewer parties than in the UNFCCC, this was not expected to reduce preference heterogeneity. The de novo institutions were intended to provide a setting for candid dialogue and to facilitate win-win opportunities in technology coordination and promotion (Interviews 11 & 13, US State Department). The limited memberships were not viewed as the most critical features of the de novo institutions. Their limited mitigation goals, the emphasis on win-win projects, and the informal foundations of the processes were collectively more critical features in any success the de novo institutions have had in contributing to climate change mitigation. The inclusiveness of
the CCAC, the most recent of the de novo institutions, has been a source of momentum in that process. Observers view the growing state membership and engagement of non-state groups in the CCAC as important factors in any success it may have presently or in the future in reducing short-lived climate pollutants. Much like in the treaty processes, having more participants contributes to momentum in technological changes by increasingly making older technologies less widely used, producing network externalities that encourage technological shifts on wider and growing scales. This comes from having more participants, not fewer participants.

Recent efforts under the IMO and Montreal Protocol to adopt treaties on climate-warming gases reflected US and European awareness that the concentration of industry stakeholders in these treaty processes made them potentially more viable mechanisms for climate change mitigation than the UNFCCC. Unlike the airline industry involved in the ICAO, the tanker manufacturers and tanker owners in the IMO and the chemical producers and consumer goods producers in the Montreal Protocol have enjoyed less price sensitivity in the downstream consumer markets. Downstream market conditions have enabled them to make investments in innovations and differentiate their products from those of competitors to downstream consumers, enabling a steady flow of innovation and diffusion over several decades. United States and European negotiators involved in the MARPOL and Montreal Protocol negotiations have recognized that these industrial conditions made them viable platforms for action on climate change mitigation (Interview 26, US State Department; Interview 3, British Department of Energy and Climate Change). Diffuse and price sensitive downstream markets in the airline industry have prevented similar opportunities to lower emissions.

The concentrated markets regulated under MARPOL and the Montreal Protocol have contributed to preference convergence in those treaty processes, encouraging the United States and other governments to invest in them for climate change mitigation. The less concentrated downstream consumer markets regulated under the ICAO have prevented similar preference convergence among governments in the ICAO. The European Union now faces opposition from the United States and China on unilaterally imposing efficiency regulations on civil aircraft, as well as inside the ICAO from the aviation sector (Interview 16, European Commission). In the Montreal Protocol, by contrast, the United States and the European Union are aligned in favor of an HFCs amendment – and observers believe that developing countries may switch positions with the right technological conditions and financial incentives for domestic industries (Interview 40, fluoro-product company). Political convergence and divergence in these non-UNFCCC treaty processes have stemmed in part from market conditions in the regulated sectors, making some treaty processes more viable options for climate change mitigation than others while making all of them more viable than the UNFCCC.
CHAPTER SIX

Interdependence Structures and Forms of Regional Water Cooperation

6.1 Introduction

During the Cold War, states along the Danube River remained divided by the politics of the Iron Curtain. Political tensions made the riparian states unwilling to form an international regime to manage the river basin (Linnerooth-Bayer and Murcott 1996). The Danube has been called the most “international” river basin in the world because over a dozen states are in the catchment (Sommerwerk et al. 2010). Despite the mutual interest of Danube riparian states, they only reached a common basin-wide settlement in June 1994 by adopting the Convention for the Protection and Sustainable Development of the Danube River (“Danube River Protection Convention”).

Before 1994, Danube states had made several bilateral and minilateral agreements. In 1948, for example, several Eastern Bloc parties adopted a navigation convention for their portions of the river. Austria and Germany made bilateral agreements on water diversion and dam construction. The Eastern Bloc parties inevitably relied on the actions of Germany and Austria as the upstream parties for the quantity and quality of the river water that reached their territories. All these riparian states adopted a basin-wide information-sharing system in 1985 but it lacked a legal basis. Overall, they continued to independently manage their sections of the river under bilateral or minilateral agreements. In the absence of a common basin-wide regime, they chose to form rules and institutions on narrow issues with few parties. They formed un-integrated cooperation on the Danube River.
The Baltic Sea Area was similarly divided during the Cold War. Several states in the western and southern parts of the Baltic Sea were non-communist states and were involved in the western political, economic, and security institutions. The Soviet Union, Poland, and the German Democratic Republic were solidly in the Eastern Bloc. Despite the tensions among parties, they created an international regime for the Baltic Sea in 1974 under the Convention on the Protection of the Marine Environment of the Baltic Sea Area. When this treaty entered into force, three Eastern Bloc countries, three western alliance members, and Finland were parties to a historic international regime for the Baltic Sea marine environment. The Convention had by that point become a template for the Regional Seas Programme of the United Nations Environment Programme (Hulm 1983, 12).

Why did the Danube River states not make a convention on river-wide management but the Baltic Sea states made a sea-wide convention as early as 1974, exactly twenty years before the Danube states negotiated their convention? In each situation, states had an interest in cooperation because they relied on the water resources for economic reasons but depended on each other to preserve the water resources. In each situation, they were divided by the politics of the Iron Curtain. They were also divided by economic and political philosophies. Yet their histories of regional water cooperation differ considerably.

This chapter explains variation in the form of international cooperation on regional water bodies. It generalizes beyond the Baltic Sea and Danube River cases to explain when states make integrated and un-integrated international cooperation on regional water bodies. Variation in the form of regional water cooperation is puzzling to the extent that un-integrated forms of cooperation are less efficient than integrated ones. Governments harness the efficiency gains of international cooperation when they use existing rules and institutions for further joint gains.
Generally, the literature on water resources management does not compare and contrast different categories of water bodies such as rivers, lakes, and seas. It tends to restrict analyses to a single category of these water bodies. However, I analyze the development of international cooperation across these water bodies over several decades to explain why the Danube River and the Baltic Sea are representative of the international cooperation histories of the wider population of regional rivers, lakes, and seas.

Research on river basin management has outlined when riparian states tend to make asymmetric terms and when they develop symmetric terms for cooperation. In managing international rivers, upstream-downstream conditions encourage side-payments by downstream states to their upstream counterparts when they are wealthier than the upstream parties (Dinar 2008). Side payments are critical for upstream states to implement commitments to reduce their interference with the freshwater. However, border-creating rivers to which riparian states have equal access do not encourage side payments, unless one state is willing to finance regulations by the less wealthy states on the opposite side of the river (Dinar 2008). Upstream states tend to make more bilateral treaties on rivers involving more than two states but states that share similar control over the water resources tend to make multilateral treaties (Zawahri and Mitchell 2011).

This chapter builds on those studies and others. It draws on differences between categories of water bodies to explain how international cooperation varies with interdependence structures. I argue that the structure of interdependence between states in managing regional water bodies affects their incentives in different ways depending on their relative exposure to externalities such as pollution from other states. Thus, I contrast different categories of water bodies (i.e., rivers, lakes, and seas) to explain how their interdependence structures shape when states make integrated regimes or un-integrated regimes on regional water bodies.
Evidence from an original panel dataset and qualitative data shows that states who share symmetrical interdependence in managing the water body tend to form integrated cooperation. In particular, lakes and seas tend to promote more symmetrical interdependence relationships in part because states have similar exposure to externalities from the sea or lake. This promotes integrated rules and institutions. However, rivers with three or more riparian states tend to involve asymmetrical interdependence because at least one of the states has upstream access to the water. This raises the probability of independent agreements on the river insofar as they lack legal or institutional dependence on one another. Thus, regional lakes and seas encourage integrated cooperation but regional rivers encourage un-integrated cooperation. These findings support the interdependence explanation for variation in the form of international environmental cooperation by demonstrating the consequences of different interdependence structures in a setting where they vary considerably – regional water management.

The evidence also qualifies the importance of wealth and geopolitical relations among states bordering a regional water body. Evidence on international cooperation on the Rhine River highlights the value of wealth and close political relations between states in managing a regional water body. However, it also illustrates that having wealth and close political relations does not prevent political disagreements over river management between upstream and downstream states. Rather, states are still inclined to form un-integrated cooperation on long rivers, whether or not the riparian states have relatively close political relations and prosperous economies. Despite significant differences in historical wealth and political relations, states along the Danube River and the Rhine River have each made un-integrated rules and institutions, unlike states along the Baltic Sea.
6.2 Interdependence Structures and the Form of International Water Cooperation

The extent to which states have an interest in cooperating on regional water bodies depends on their relative exposure to externalities from other states bordering the water. Since water is a common-pool resource (CPR), states share interdependence in managing the water because they are mutually exposed to the negative and positive consequences of each other’s actions regarding the water. Elinor Ostrom modeled local water as a CPR because, unless unusual circumstances apply, individuals with access cannot restrict others from accessing it and individual use of the local water can deplete its quality or quantity. This provides a strong incentive for cooperation when individuals have long time horizons with respect to using the water resources and they have relatively similar preferences over immediate or long-term use. Consequently, local water encourages institutionalized cooperation by giving parties an incentive to coordinate actions while also prompting them to create institutions to stabilize cooperation by dis-incentivizing cheating.

The incentives to cooperate vary depending on relative exposure to externalities in using the water. Studies on upstream-downstream rivers highlight this in specific cases (Carel 2011). Theoretical literature on international institutions has also make this point (Mitchell and Keilbach 2001). However, not only do states’ incentives to cooperate vary, their preferences over the form of cooperation also vary. In particular, states become inclined to form un-integrated cooperation when they have divergent interests in regional water management.

6.2.1 Forms of International Cooperation on Rivers
Rivers with three or more riparian states encourage different preferences over the form of cooperation. Downstream states tend to prefer deeper cooperation because their access to the water depends on upstream states. Upstream states have a preponderance of control over the water, undisturbed by downstream states, and prefer to avoid costly adjustments. These structural conditions mean that cooperation will tend to be asymmetrically valued and that financing cooperation will tend not to be evenly distributed among riparian states along rivers with several states.

Upstream states may find mutual benefits in making agreements amongst each other. Downstream states may find mutual benefits in harnessing the water resources amongst each other, despite the limited capacity of their agreements to regulate upstream activities. Without much direct need for cooperation, upstream states will tend to prefer cooperation involving few institutionalized constraints and requirements. Downstream states will tend to settle for making second-best agreements with or without the upstream states. International cooperation on the river will tend not to include highly integrated regimes. Rather, it will consist of independent agreements that meet the narrow interests of states.

Even when the upstream states internalize the costs of regulation because it becomes cost-effective or the public demands environmental protection, states along the river will have different interdependence relationships with neighbors than with states far upstream or downstream relative to their location. They will interact with neighbors more than with other riparian states far upstream or downstream along the river. Local interdependence will tend to have symmetrical characteristics, particularly between states sharing a river stretch that represents a mutual border (Dinar 2008). Local symmetrical interdependence will tend to motivate projects that are of little relevance to states far from each other along the river.
Consequently, in addition to the macro-scale interdependence between states along the full length of the river, states will share local interdependence on specific issues that they will tend not to share with distant riparian states. They will tend to have multifarious incentives for cooperation with neighbors but have fewer incentives for cooperation along the full range of the river, particularly if they are upstream states. Neighbors will find that their interdependence is more intense and sometimes symmetrical. This will incentivize integrated cooperation. Similar incentives will not exist among riparian states that do not share a border or a portion of the river, especially between upstream and downstream states. The asymmetrical structure of interdependence will tend to promote little if any cooperation along the whole river. Thus, international cooperation on the river will consist of un-integrated rules and institutions that are unrelated to each other and cover narrow portions of the river, without much coherence among the different rules and institutions.

6.2.2 Forms of International Cooperation on Lakes and Seas

Seas and lakes with several littoral states do not share the interdependence characteristics of rivers involving several riparian states. Preferences tend to be more homogenous because the states share symmetrical interdependence in managing the water. At the international level, states never have the exact same preferences for exploiting a natural resource. And they certainly tend to have different preferences over water usage because it is essential for many critical personal and societal purposes. However, lakes and seas differ from rivers in the interdependence relationships among states because all states neighboring the water are exposed to each other’s externalities. The same is not true of long rivers involving more than two parties, as some only
receive the water after it passes through other states. Lakes and seas provide all neighboring states with access to potential fisheries, hydrocarbons, or navigable areas. Even if some states chose not to exploit that access at some point in time, they retain the capacity to later exploit it in the event their preferences over the resource (e.g., hydrocarbons development) change. Downstream states along rivers do not have that opportunity. They cannot unilaterally alter the water or its contents when their preferences change.

Because lakes and seas are closer to CPRs than rivers, even the largest exploiters of the water resources must share the water, unless they restrict or heavily disincentive access to the water by taking military action such as setting up a blockade. Along large lakes and seas with multiple littoral states, this often means that interdependence relationships incentivize international cooperation among parties, unlike in some river settings where upstream parties have little if any incentive outside of receiving side payments to take remedial action to protect the river water. Sharing the water space and its resources will tend to make parties sensitive their interdependence along the lake or sea. No party will have a structural or geographic advantage to avoid interference from other littoral states, unlike along rivers with multiple states.

Moreover, there will not be a large difference between local interdependence and macro-interdependence along the lake or sea. For example, nutrient pollution will be a lake-wide or sea-wide issue because it will impact each littoral state bordering the water or using its resources. The same is not true of rivers because states that are not mutual neighbors will not tend to have the same interest in water purification. Similarly, fisheries consumption in the middle of a lake or sea will amount to fewer fisheries for each party neighboring the water. However, fisheries consumption downstream will have more of an impact with downstream states than with upstream states.
Overall, the distinction between local issues and lake-wide or sea-wide issues will tend to be much narrower than the distinction between local issues and river-wide issues. The structure of interdependence between states that share both sides a border-creating river, as Dinar calls them (Dinar 2008), will be similar to the structure of interdependence between states along a lake or sea. States along lakes or seas will tend to have fewer local or bilateral perspectives on key issues compared to riparian states along rivers. The one exception will tend to be territorial zones between neighboring states along a lake or sea, which will often entail demarcating bilateral exclusive zones between neighboring states.

Consequently, states along lakes or seas will have a mutual interest in protecting the shared water and will not have several dimensions of local issues that incentivize independent rules and institutions. Instead, they will tend to prefer integrated agreements covering the whole sea or lake since the issues they cover will tend to reflect the common interests of each state bordering the lake or sea. In other words, while some agreements along rivers will tend to only address local issues among a fraction of riparian states, agreements along lakes or seas will tend to address common issues among all littoral states. They will be integrated to take advantage of efficiency gains from a single international regime for the whole lake or sea. By contrast, a larger fraction of river agreements will not be integrated and will not to take advantage of having other agreements on the river already in place.

6.2.3 Hypothesis

This explanation suggests a hypothesis on the form of regional water cooperation.
**Interdependence Structures Hypothesis.** Lakes and seas encourage states to form integrated cooperation more than rivers. Rivers encourage states to form un-integrated cooperation more than lakes and seas.

### 6.3 Alternative Explanations: Number of Bordering States and Wealth/Geopolitics

Two alternative explanations may explain variation in the form of regional water cooperation. These explanations focus not on the structure of interdependence among states in managing a water body but on the number of states with access to the water and the wealth and political relations of those states. The number of states along a water body may make it harder or easier for governments to form integrated cooperation. Similarly, the wealth and geopolitical relations among countries neighboring a water body may enhance or dampen the prospects of integrated cooperation.

**NUMBER OF STATES.** If the number of states with access to a water body is relatively high, they may have divergent preferences over cooperation because each state has nationals with varying preferences over water use. As the number of states with access to the water grows, the heterogeneity of preferences grows because more groups with different time horizons and needs for water have control over the water. The heterogeneity of preferences makes integrated cooperation less likely as governments are less likely to make successive agreements on new rules and institutions that build upon earlier ones. Having more states with access to the water would instead contribute to un-integrated cooperation because some governments would share convergent preferences over cooperation but others would possess different preferences, stemming from different societal demands for the water resources. I evaluate the hypothesis corresponding to this explanation for the form of regional water cooperation.
**Number of States Hypothesis.** Water bodies with more states bordering the water are less likely to prompt integrated cooperation than water bodies with fewer states bordering the water. Rather, they are more likely to prompt un-integrated cooperation than water bodies with fewer states bordering the water.

**WEALTH AND GEOPOLITICS.** The wealth and political relations among states may also explain variation in the form of regional water cooperation. Collectively managing water resources is costly because it may entail installing wastewater treatment facilities to purify the water for other states. It may also entail constructing dykes or restoring the marine environment or freshwater environment to preserve ecology. Managing water resources to preserve ecology and water quality or quantity levels requires investments, often from public budgets. Cooperation on water resources also implies that actors forego unilateral economic gain for joint gains. Having less wealth in the area where the water body is located may dampen the prospects of integrated cooperation because governments lack the financial wherewithal to protect the water body and avoid unilateral water use or water exploitation.

Similarly, geopolitical relations among governments may affect the politics of water management. Political rivalry between neighboring governments may dampen the prospects of integrated cooperation because water is a politically sensitive issue between neighboring states. Water conflict is a persistent issue in areas of the world lacking adequate water resources or where the water resources provide access to other sources of wealth (Priscoli and Wolf 2009). Hostile political relations make governments less likely to cooperate on managing water resources because the geopolitical implications of water cooperation would trump any interests in mutual water management. The geopolitical relations among states neighboring a water body would penetrate the politics of managing that water body, rendering integrated cooperation unlikely and un-integrated cooperation the only politically feasible option for states. It may even
dampen the prospects of any cooperation altogether. I evaluate two hypotheses corresponding to the wealth and geopolitics explanation for variation in the form of regional water cooperation.

*Wealth Hypothesis.* Wealthier states form integrated cooperation on water bodies; poorer states form un-integrated cooperation on water bodies, if any cooperation at all.

*Geopolitics Hypothesis.* Politically closer states form integrated cooperation on water bodies; political rivals form un-integrated cooperation on water bodies, if any cooperation at all.

### 6.4 Empirical Strategy

Regional water bodies have different interdependence structures. Table 6.1 below summarizes the interdependence structures associated with rivers, lakes, and seas. There is no fundamental difference between lakes and seas in the structure of interdependence between states, regardless of the number of states sharing the water. States share symmetrical interdependence along a lake or sea. However, the interdependence structures along rivers depend on whether there are two or more states sharing the river. When two states share the river, it can have CPR-like characteristics if the river represents a common border separating the two states (Dinar 2008). However, when three or more states share the river, they are asymmetrically exposed to externalities. At least one state is upstream relative to at least one other state.

I leverage this distinction between lakes and seas, on the one hand, and rivers, on the other, in evaluating the consequences of interdependence structures in the form of international environmental cooperation by limiting the empirical analysis to these “multilateral” settings where three or more states share the water. This effectively eliminates the possibility that the
interdependence structure is comparable between rivers, on the one hand, and lakes and seas, on the other, in specific cases.

**Table 6.1** Interdependence Structures by Water Body Category

<table>
<thead>
<tr>
<th>Number of States Bordering the Water Body</th>
<th>Rivers</th>
<th>Lakes and Seas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two states</td>
<td>Symmetric or asymmetric interdependence</td>
<td>Symmetric interdependence</td>
</tr>
<tr>
<td>Three or more states</td>
<td>Asymmetric interdependence</td>
<td>Symmetric interdependence</td>
</tr>
</tbody>
</table>

This empirical strategy depends on the extent to which other characteristics of the water bodies affect international cooperation. The main difference between these water body categories beyond the interdependence structures they entail is that they have different economic uses for individuals and societies. To the extent these differences are minor and economic uses are similar across the water bodies, this would limit the extent to which the economic characteristics of the water body categories undermine making inferences about the importance of interdependence structures in comparing rivers with lakes and seas. It is critical to evaluate how and where these water body categories differ in their economic uses. Table 6.2 lists the main economic uses of the three water body categories.

The table indicates that with the exception of irrigation, drinking water, and energy production, the economic uses of the water bodies are highly similar. However, even these uses do not undermine the research design because lakes and rivers share extremely similar economic and personal uses because both are freshwater resources. The only distinction between them insofar as their economic uses are concerned pertains to the source of energy production. Rivers provide opportunities for hydroelectric power generation but lakes provide opportunities for
hydrocarbons development in some regions. Moreover, lakes and rivers are generally geographically connected because rivers are the source of lakes or lakes are the source of rivers. Instead, seas differ more from lakes and rivers in these respects, largely because most of them are in open water and salination levels prevent their use for drinking water or irrigation without heavy de-salination programs, which tend to be expensive.

Table 6.2 Economic Uses by Water Body Category

<table>
<thead>
<tr>
<th>Rivers</th>
<th>Lakes</th>
<th>Seas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fisheries</td>
<td>Fisheries</td>
<td>Fisheries</td>
</tr>
<tr>
<td>Navigation</td>
<td>Navigation</td>
<td>Navigation</td>
</tr>
<tr>
<td>Hydro-electric energy</td>
<td>Hydrocarbons</td>
<td>Hydrocarbons</td>
</tr>
<tr>
<td>Discharge of waste</td>
<td>Discharge of waste</td>
<td>Discharge of waste</td>
</tr>
<tr>
<td>Discharge of chemicals</td>
<td>Discharge of chemicals</td>
<td>Discharge of chemicals</td>
</tr>
<tr>
<td>Agriculture (irrigation)</td>
<td>Agriculture (irrigation)</td>
<td>Discharge of waste</td>
</tr>
<tr>
<td>Drinking water</td>
<td>Drinking water</td>
<td></td>
</tr>
</tbody>
</table>

Note: For the purposes of this table, inland seas are categorized as lakes (e.g., Caspian Sea, Aral Sea).

From a technical standpoint, these three water bodies pose similar regulatory challenges. A recent study based on an extensive literature review found that the main drivers of degradation across these water body categories stem from human population growth and increases in land use and water changes. The authors concluded,

“A notable finding of our study was the common hierarchy for all four water categories [i.e., rivers, lakes, estuarine, seas] regarding scale of degradation from global and supra-regional scale of primary and secondary drivers from population growth and climate change, respectively. For example, at the catchment level, pressures such as land use, urbanization and industrial development and run-off, alterations in riparian zones, longitudinal profiles and substance flows were often the main drivers again for all four water categories. Likewise, at the local scale
(e.g. a single lake or river stretch), pressures and processes were similar to those found at the catchment scale, but organism composition differed. Commonalities among water categories imply that legislative decisions and management covering broad spatial scales will affect a wide range of water categories” (Verdonschot et al. 2013).

Other studies also highlight similar regulatory challenges posed by the different water categories without explicitly comparing them. Agricultural run-off and nutrient loads in lakes cause similar problems as they do along rivers for downstream states. According to Beeton, “The major impacts on large lakes are diversions, eutrophication, invasive species, land-use change, overexploitation of resources, and pollution” (Beeton 2002, 2). Tropical lakes especially are prone to similar disturbances as rivers from human activities (Lewis 2000). The comparability of regulatory challenges associated with these water body categories supports the research design because it suggests the wider variation comes from the structure of interdependence than from other characteristics of the water bodies. I provide further support in the empirical analysis below.

6.5 Quantitative Data and Measures

The population of interest consists of rivers, lakes, and seas, with variables measured annually. There is one sampling criterion: each water body must have at least three states whose territories border the water. This follows the empirical strategy of distinguishing the water body categories to evaluate the importance of interdependence structures in the development of different forms of cooperation. Recall that having three or more states bordering the regional
water body enables a clean comparison of water bodies involving asymmetrical interdependence with those involving symmetrical interdependence.

The sample consists of 76 water bodies (42 rivers and 34 lakes and seas) and the unit of observation is the water body-year (N = 3,807). Eight lakes and inland seas meet the criterion of three or more bordering states and 26 open-water seas meet that criterion. These 34 lakes and seas represent nearly the full population that meet the criterion. Forty-two rivers also meet the criterion, which is nearly the full population of rivers whose water flow is contiguous with more than two states. Table 6.3 provides information on 14 water bodies in the sample.

**Table 6.3 Select Water Bodies in the Sample**

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Continent</th>
<th>States Bordering the Water Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Chad</td>
<td>Africa</td>
<td>Niger, Nigeria, Cameroon, Chad</td>
</tr>
<tr>
<td>Lake Malawi</td>
<td>Africa</td>
<td>Malawi, Mozambique, Tanzania</td>
</tr>
<tr>
<td>Lake Tanganyika</td>
<td>Africa</td>
<td>Burundi, DR Congo, Tanzania, Zambia</td>
</tr>
<tr>
<td>Lake Victoria</td>
<td>Africa</td>
<td>Tanzania, Uganda, Kenya</td>
</tr>
<tr>
<td>Congo River</td>
<td>Africa</td>
<td>Angola, Burundi, Cameroon, Central African Republic, DR Congo, Gabon, Republic of Congo, Rwanda, Tanzania, Zambia</td>
</tr>
<tr>
<td>Senegal River</td>
<td>Africa</td>
<td>Senegal, Mauritania, Mail, Guinea</td>
</tr>
<tr>
<td>Zambezi River</td>
<td>Africa</td>
<td>Zambia, DR Congo, Angola, Namibia, Botswana, Zimbabwe, Mozambique, Malawi, Tanzania</td>
</tr>
<tr>
<td>Caspian Sea</td>
<td>Asia</td>
<td>Russia, Kazakhstan, Turkmenistan, Azerbaijan, Iran</td>
</tr>
<tr>
<td>Sea of Galilee</td>
<td>Asia</td>
<td>Israel, Syria, Jordan</td>
</tr>
<tr>
<td>Kura-Arks River</td>
<td>Asia</td>
<td>Azerbaijan, Iran, Armenia, Georgia, Turkey</td>
</tr>
<tr>
<td>Indus River</td>
<td>Asia</td>
<td>India, Pakistan, China</td>
</tr>
<tr>
<td>Lake Constance</td>
<td>Europe</td>
<td>Germany, Switzerland, Austria</td>
</tr>
<tr>
<td>Danube River</td>
<td>Europe</td>
<td>Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Bulgaria, Moldova, Ukraine, Romania</td>
</tr>
<tr>
<td>Amazon River</td>
<td>South America</td>
<td>Brazil, Colombia, Peru, Ecuador, Bolivia</td>
</tr>
</tbody>
</table>

Note: The states listed border the corresponding water bodies as of 2010.
For each water body, the annual time series data end in 2010 and begin either in 1945 or the first year when at least three states had independence based on the Correlates of War States System Dataset, making the panel unbalanced (Correlates of War States System 2011). The time series begins in 1945 for most water bodies in Europe and the Americas. However, it begins as late as 1992 for some water bodies in Asia because they had fewer than three independent bordering states. Many states in Africa bordering water bodies in the sample did not gain independence until the early 1960s.

I collected international agreements on the water bodies from various sources.\(^1\) These agreements include provisions on how governments manage a specific water body in the sample, or a part of it. The vast majority of the agreements are legally binding instruments but some are “soft law” arrangements such as memoranda of understanding, action plans, codes of conduct, and political declarations. I include these non-binding agreements to capture the full range of cooperation on the water bodies.

The sample consists of agreements covering each of the economic uses and management problems listed in Table 6.2. The similarity of issues corresponding to these different water bodies is evident from the sample. This supports the premise of the research design: the main difference between these water body categories as they relate to international cooperation comes not from the economic uses they provide but the interdependence structures they entail. The only agreements not included pertain strictly to bilateral boundaries. These are not included because territorial boundaries (e.g., continental shelf, river boundaries) pertaining only to two states do

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not fall within the population of interest because only two states are relevant to the boundary. Only if the boundary agreements also include provisions on water use or management were they included in the sample.

6.5.1 Dependent Variables: Integrated and Independent Agreements

I use two variables that measure the association of subsequent agreements with prior and existing ones on a water body. Each variable is measured based on the two characteristics distinguishing integrated cooperation from un-integrated cooperation: additionality and dependence. Integrated cooperation entails both characteristics; un-integrated cooperation entails only additionality.

The binary variable Integrated Agreement indicates that states completed an agreement that was integrated with an earlier agreement. These follow-up agreements contributed to the provisions of an earlier one, implemented those provisions, or used the provisions in setting forth new rules or institutions. They were subsidiary instruments or otherwise dependent on prior agreements for some of the provisions they established. Protocols and amendments are the clearest examples of integrated agreements. They are legally and operationally dependent on the agreement that parties had made previously. Besides protocols and amendments, other legal and non-binding instruments seeking to modify existing provisions or apply them to another set of issues are integrated as well. More integrated agreements correspond to more integrated cooperation.

To code agreements as integrated, I used a combination of textual and secondary sources. First, I used the text of the agreement to identify whether the governments drafting the agreement
sought to integrate it into an earlier one. The clearest indications are that it is a protocol, amendment, or annex to an existing agreement. Otherwise, phrases in the preamble or an article of the agreement were used to identify its relationship with prior agreements on the water body. The following indicators were used in context if they referred explicitly to another agreement: “implements,” “applies,” “replaces,” “supersedes,” “supports,” “in accordance with,” and “in the spirit of.” Second, I used secondary sources to corroborate the coding where possible by identifying whether secondary accounts are consistent with the indicators from the agreement texts.

The second dependent variable is Independent Agreement. This indicates that states adopted an agreement that was independent of others on a given water body or a specific part of that water body. This is a measure of whether states made an agreement that was independent of earlier agreements and did not contribute to them. These agreements contrast with integrated ones because they were legally and operationally independent and did not share a hierarchical relationship with prior agreements but were made on the same water body as the prior ones, or a portion of that water body. More independent agreements correspond to more un-integrated cooperation.

To code agreements as independent, I used the same combination of textual and secondary sources. First, if the agreement made no mention of earlier agreements on the water body, it was coded as an independent agreement. This is true of over 90 percent of the agreements coded as independent. In the remaining minority of cases, the agreement makes tangential references to an earlier one by “acknowledging” or “taking account of” it, often in the preamble. Neither wording was used as an indicator of integration with an earlier agreement, unless accompanied by other references suggesting otherwise, particularly the indicators of an
integrated agreements. Second, I used secondary sources to corroborate the coding where possible. If no indications of integration with a prior agreement were present in the secondary sources, or if an indication of independence from other agreements was clear from the secondary sources, this corroborated the non-reference in the agreement text.

There are 164 years in the sample with an integrated agreement and 112 years with an independent agreement. According to these measures, states have created more integrated cooperation on the regional water bodies than un-integrated cooperation by nearly a factor of 1.5.

6.5.2 Treatment and Covariates

INTERDEPENDENCE STRUCTURE VARIABLE. The research design enables a clear way to distinguish water bodies involving asymmetrical interdependence structures from those involving symmetrical interdependence structures. All river years are coded as having asymmetrical interdependence (River = 1); all lake and sea years are coded as having symmetrical interdependence (River = 0). Estimates of this variable imply a comparison between rivers, on the one hand, and lakes and seas, on the other, enabling a straightforward comparison of interdependence structure effects on international cooperation patterns. I expect that this variable is positively associated with independent agreements and negatively associated with integrated agreements.

ALTERNATIVE EXPLANATION VARIABLES. According to the Number of States Hypothesis, having more states with direct access to the water body should diminish the prospects of integrated cooperation and make un-integrated cooperation more likely. To test this hypothesis, I include a variable for the total number of states bordering the water body (Number
of States). I relied on maps from various open sources to determine which states were adjacent to which water bodies in the sample.\(^2\) I expect this variable to be negatively associated with integrated agreements and positively associated with independent agreements.

Moreover, the Wealth Hypothesis says that wealthier states will make integrated cooperation on water bodies but less wealthy states will make un-integrated cooperation, if any at all. I evaluate this hypothesis with a variable representing the logged mean GDP per capita of states bordering the water body \((\log(\text{mean GDP per capita}))\). I rely on the World Penn Table (Heston, Summers, and Aten 2012) for this measure.

To test the Geopolitics Hypothesis, I include two variables in the analyses. First, I include the average level of democracy among the states \((\text{Avg Democracy})\) using the POLITY IV dataset (Marshall and Jaggers 2011). This is an average of the polity2 measure across the states bordering the water body. Research has found that democracies maintain more peaceful relations than other dyads (Oneal and Russett 2001). Democracies are also thought to have a greater capacity to make international agreements because their domestic political institutions make their commitments more credible (Leeds 1999). This variable measures these democracy effects. Lower average democracy scores imply a higher probability of discord and conflict among states. I expect the democracy variable to be positively associated with integrated agreements and negatively associated with independent agreements.

Second, I include a variable counting the total number of dyadic rivalries \((\text{Number of Rivalries})\). This measure is largely defined by the number of militarized interstate disputes between two states within a given period. It measures whether a dyad had different types of rivalry relationships in a given year. I use the Klein, Goertz, and Diehl data on enduring and

proto rivalries for this measure (Klein, Goertz, and Diehl 2006). I expect the rivalries variable to be negatively associated with integrated agreements and positively associated with independent agreements.

OTHER VARIABLES. Governments may become less inclined to make additional agreements as the total number of agreements increases, since those prior agreements may address the resource use problem. Further agreements might then become less useful for parties. Thus, I include a lagged count variable for the total number of agreements negotiated or in place on a water body (Total Agreements (t-1)). I expect this variable to be negatively associated with both independent and integrated agreements.

I also include variables pertaining to the location and relative size of the water bodies. Specifically, I coded the continent of the water body (Europe, Africa, South America, Asia). Some water bodies border multiple continents (e.g., Mediterranean Sea) and are coded as bordering each one. I also coded whether the water body is a sub-basin, indicating that it is geographically linked to a larger water body but is smaller than that water body (Sub-Basin).

6.6 Statistical Analysis of Water Agreements

I analyze the relationship between the covariates and agreements on the regional water bodies with time-to-event models. The dependent variables indicate when countries made an independent or integrated agreement following a convention already in place. Some time elapsed between the initial convention and the subsequent agreement. Just as importantly, integrated and independent agreements imply that governments had made earlier agreements on the water body. They added to the rules and institutions already in place to manage the water. Both the temporal
and dependence dimensions of these agreements suggest that a time-to-event analysis should be used to identify how the covariates are associated with the form of regional water cooperation that emerges.

INTEGRATED AGREEMENTS. I estimated the Kaplan-Meier survival functions for rivers and for lakes and seas. These are descriptive nonparametric estimates of the time until an event occurs (Rich et al. 2010). In this analysis, the “event” is an integrated agreement. The x-axis denotes the years until an integrated agreement after the previous one was made. The y-axis denotes the probability of not having had an integrated agreement by that year. Flatter estimates indicate that it is unlikely that states have made an integrated agreement by that year. Steep declines indicate that it becomes more likely that states have made an integrated agreement by that year.

The survival function estimates indicate there is a significant difference between rivers, on the one hand, and lakes and seas, on the other. Figure 6.1 displays no overlap in the confidence intervals of the survival estimates until over four decades after the previous integrated agreement was made. This is consistent with the Interdependence Structures Hypothesis. Lakes and seas experience more frequent integrated agreements than rivers after the previous integrated agreement was made. The difference becomes especially significant in the two decades after the previous integrated agreement was made. The steeper decline of the estimates for lakes and seas than for rivers suggests that states make follow-up integrated agreements sooner on lakes and seas than on rivers.
These are nonparametric estimates that do not account for covariates. I model the relationship between integrated agreements and the covariates with Cox proportional hazards models. These models estimate the hazard ratio corresponding to a variable. Higher estimates correspond to a higher “hazard” of an integrated agreement. Robust standard errors are clustered on the water body. Since states can make a sequence of integrated agreements, this sequence may change the baseline hazard of a water body after each additional agreement is made. I model the potential heterogeneity in the baseline hazards after each new integrated agreement by stratifying the baseline hazards on the sequence of integrated agreements corresponding to a water body. This implies that the baseline hazard varies across the sequence of integrated agreements on a water body. Stratification can model the heterogeneity of baseline hazards associated with repeated events (Box-Steffensmeier and Jones 2004, Chapter 10). In this case, the repeated events are repeated integrated agreements.
Table 6.4 reports the results of four Cox models of the years until an integrated agreement (Appendix 6.1). Rivers are associated with a lower hazard compared to lakes and seas in each of the models including that variable, consistent with the survival function estimates. This supports the Interdependence Structures Hypothesis. *Differing interdependence structures are associated with different prospects for integrated cooperation on regional water bodies.* Lakes and seas are more prone to integrated cooperation than rivers.

The number of states variable has a null estimate in the full model, Model 4, but has a positive and significant estimate in two other models. Having more states bordering the water body is not associated with a lower prospect of integrated cooperation. In two of the models, the estimates actually have the opposite signs of those expected under the Number of States Hypothesis. This is evidence against the Number of States Hypothesis. *Having a large number of states bordering a regional water body does not lower the prospect of integrated cooperation on those water bodies.*

None of the variables corresponding to wealth and geopolitical relations is significant. More wealth is not associated with integrated agreements on regional water bodies, neither is higher average democracy among the states bordering the water body, and neither is having few if any dyadic rivalries among those states. This is strong evidence against the Wealth and Geopolitics Hypotheses.

Predicted hazard ratios based on the estimates from Model 4 are consistent with the negative and significant estimates on the interdependence structures variable. Figure 6.2 below displays the predicted hazard ratios for rivers and for lakes and seas. The left plot displays the means of predicted hazard ratios and the right plot displays the distributions of predicted hazard

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3 A graphical test of the proportional-hazards assumptions for rivers and for lakes and seas indicates that the hazard ratios are parallel for these categories over time. The proportional-hazards assumption of the estimates is supported.
The mean is higher for lakes and seas than for rivers. Moreover, predicted hazard ratios between the 25th and 75th percentiles corresponding to lakes and seas are above the equivalent range of predicted hazard ratios corresponding to rivers. The means of predicted hazard ratios and large shares of those distributions support the Interdependence Structures Hypothesis.

![Predicted Hazard Ratios (Means)](image)

**Fig. 6.2 Predicted Hazard Ratios (Integrated Agreement).** The left plot displays the means of predictions and the right plot displays box plots of the predictions. Outside values – those outside the inter-quartile range, multiplied by 1.5 – are excluded from the box plots. Predictions are based on estimates from Model 4.

**INDEPENDENT AGREEMENTS.** Turning to un-integrated cooperation, Figure 6.3 below plots the Kaplan-Meier survival function estimates for rivers and for lakes and seas. Recall these are descriptive nonparametric estimates of the time until an event occurs. The event in this case is an independent agreement. The x-axis denotes the years until an independent agreement after the previous one was made. The y-axis denotes the probability of not having had an independent agreement by that year. Estimates closer to 1 at \( t \) denote a lower the probability
of having had an independent agreement. Estimates farther from 1 at \( t \) denote a higher the probability of having had an independent agreement.

There is no overlap in the confidence intervals of these survival estimates over the multi-decade timespan. This suggests rivers are prone to more frequent independent agreements than lakes and seas. However, the confidence intervals are close to each other and the difference between the estimates is narrower than the equivalent estimates corresponding to integrated agreements. Lakes and seas are more prone to integrated agreements than rivers to a greater extent than rivers are more prone to independent agreements than lakes and seas. The difference between them is greater with respect to integrated cooperation than un-integrated cooperation.

This may reflect the fact there are more integrated agreements in the sample than independent ones, providing more data for estimating the impact of interdependence structures on integrated cooperation than on un-integrated cooperation.

**Fig. 6.3** Kaplan-Meier Survival Estimates of the Years Until an Independent Agreement. Estimates closer to 1 correspond to a lower probability of an independent agreement by \( t \). Estimates farther from 1 correspond to a higher probability of an independent agreement by \( t \).
I model the relationship between independent agreements and the covariates with Cox proportional hazards models. Robust standard errors are clustered on the water body. Since states can make a sequence of independent agreements, this sequence may change the baseline hazard of a water body after each additional agreement is made. I model potential heterogeneity in the baseline hazards after each new independent agreement by stratifying the baseline hazards on the sequence of independent agreements corresponding to a water body. This implies the baseline hazard varies across the sequence of independent agreements on a water body. In these respects, the estimation strategy parallels the one for integrated cooperation.

Table 6.5 reports the coefficient estimates of four Cox models of the years until an independent agreement (Appendix 6.1). *There is stronger support for the Number of States Hypothesis than the Interdependence Structures Hypothesis.* In each of three models featuring the number of states variable, it is positive and significant. Having more states bordering the water body contributes to independent agreements. In two of the three models featuring the interdependence variable, it is positive and significant. However, in the full model, it is not significant.\(^4\) This suggests that the structure of interdependence among states in managing a water body is less important than the number of those states in the prospects of forming un-integrated cooperation on the water body.

There is no support for the Wealth and Geopolitics Hypotheses. The logged mean GDP variable is not statistically significant in each of the three models in which it is included. In only one of the three models featuring the average democracy variable is it negative and significant. And in all three models featuring the number of rivalries variable, it is significant but the sign is contrary to expectations under the Geopolitics Hypothesis. Instead of being positive, the number

\(^4\) A graphical test of the proportional-hazards assumptions for rivers and for lakes and seas indicates that the hazard ratios are parallel for these categories over time. The proportional-hazards assumption of the estimates is supported.
of the rivalries variable is negative, suggesting more rivalries is associated with a lower hazard of an independent agreement. The results do not support the Wealth and Geopolitics Hypotheses.

Although the coefficient estimates do not consistently support the Interdependence Structures Hypothesis, estimates of predicted hazards provide more support. Figure 6.4 below displays the distributions of predicted hazard ratios based on Model 8. The left plot displays the means of predicted hazard ratios and the right plot displays the distributions of predicted hazard ratios. Rivers have a higher mean than lakes and seas. The overall distributions are consistent with the higher mean for rivers. These predicted hazard ratios support the Interdependence Structures Hypothesis and qualify the null estimate on that variable in Model 8, which based on the p values is not significant at the 0.05 level but is significant at the 0.1 level. Overall, however, there is stronger support for the Number of States Hypothesis than for the Interdependence Structures Hypothesis in explaining un-integrated cooperation on regional water bodies.

Fig. 6.4 *Predicted Hazard Ratios (Independent Agreement)*. The left plot displays the means of predictions and the right plot displays box plots of the predictions. Outside values – those outside the inter-quartile range, multiplied by 1.5 – are excluded from the box plots. Predictions are based on estimates from Model 8.
6.6.1 Are Some Water Body Categories More Prone to Agreements than Others?

Making an integrated or independent agreement implies that governments have at least one agreement in place on a water body because both agreement types are additional to those already in place. Table 6.6 shows that some water bodies in the sample have never had an agreement – and the share of lakes and seas that never had one is much larger than the share of rivers that never had one. It is important therefore to consider the initial decision to have an agreement on the water body because that decision may be systematically more associated with rivers than with lakes and seas and because having either integrated or un-integrated cooperation implies the existence of some cooperation already in place. To what extent are some water body categories more prone to agreements in general than other water body categories?

**Table 6.6 Water Body Categories With and Without an Agreement**

<table>
<thead>
<tr>
<th>No agreement</th>
<th>Rivers</th>
<th>Lakes and Seas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>One or more agreements</td>
<td>35</td>
<td>20</td>
</tr>
</tbody>
</table>

To assess whether some water body categories are more prone to agreements in general than other categories, I apply the same estimation strategy as I used in analyzing integrated and un-integrated cooperation on the water bodies. Specifically, I model the relationship between agreements and the covariates. The analyses do not distinguish among agreements. All are included in these analyses, regardless of how they relate to prior agreements. I employ Cox proportional hazards models of the years until the next agreement, regardless of type. Robust
standard errors are clustered on the water body. Since states can make a sequence of agreements, this sequence may change the baseline hazard of a water body after each additional one is made. I model potential heterogeneity in the baseline hazards after each new agreement by stratifying the baseline hazards on the sequence of agreements corresponding to a water body. This implies the baseline hazard varies across the sequence of agreements on a water body. In these respects, the estimation strategy parallels that adopted to analyze the forms of regional water cooperation.

Table 6.7 reports the coefficient estimates from Cox proportional hazards models of the years until an agreement (Appendix 6.1). It is clear from the results that rivers are not more prone to agreements than lakes and seas. In each of the models, the interdependence structures variable is not significant. This suggests that the patterns of integrated and un-integrated cooperation on regional water bodies are not simply reflections of more cooperation on rivers than on lakes and seas. Governments are not more prone to pursuing cooperation on lakes and seas than on rivers; they are more prone to forming integrated cooperation on lakes and seas than on rivers. Likewise, governments are not more prone to pursuing cooperation on rivers than on lakes and seas; they are prone to forming un-integrated cooperation on rivers compared to lakes and seas. The structure of interdependence shapes the form of cooperation, not whether it exists.

6.7 Danube River and Baltic Sea: Impact of Interdependence Structures

The research design leverages variation in interdependence structures across the water body categories but relies on similarities in their economic uses and their regulatory challenges. To the extent these other characteristics are relevant to international cooperation decisions, they may undermine the statistical inferences on interdependence. I analyze the forms of international
cooperation that emerge across water body categories to identify whether interdependence structures drive the divergent patterns of cooperation, and not other characteristics of the water bodies. This helps to evaluate the relative importance of interdependence structures and other variables.

In particular, I analyze the extent to which interdependence structures have shaped the form of international cooperation using an in-depth focused comparison of international cooperation on the Danube River and the Baltic Sea. The focused comparison enables a closer evaluation of the Interdependence Structures Hypothesis because it can identify the impact of varying interdependence structures on how states along these regional water bodies have collectively managed them. Thus, I return to the comparison made in the Introduction to evaluate the Interdependence Structures Hypothesis and either support or problematize the quantitative results.

This focused comparison relies on similarities in the political relations and wealth of countries along each of these two water bodies to identify the impact of different interdependence structures. Studies of transboundary water conflicts highlight the politicized characteristics of regulating international rivers (Priscoli and Wolf 2009). And although wealth was not significant in the statistical models, it is considered important for cost-effectively reducing environmental externalities and in the prospects of environmental regulation (Grossman and Krueger 1995, Ekins 2000).

In this respect, the Baltic Sea area and the Danube River Basin have shared similar political and economic conditions over 50 years. In the eastern half of each water body, former communist countries in the Eastern Bloc have become economies in transition and several have entered the European Union. Their economies have been transformed in the process – and
undergo continuing transformation. Some states in each water basin are former communist
countries but are not in the European Union. Moreover, states in the western portions of each
water basin were in the western alliance and had capitalist economies. They have provided
economic and political support for economic changes in the eastern countries of each basin. *The political and economic histories of these water bodies are similar enough over 50 years to limit the extent to which these variables can explain variation in the form of cooperation that governments have created for each water body.*

6.7.1 Consequences of Interdependence Structure Differences

Figure 6.5 shows that the Baltic Sea has had more integrated agreements in place on
average since 1945 than the Danube River (p value = 0.006). It also shows that the Danube River
has had more independent agreements in place on average since 1945 than the Baltic Sea (p
value = 0.000). These distributions are consistent with the Interdependence Structures
Hypothesis.

BALTIC SEA. International cooperation on the Baltic Sea became a template for other
European and UN programs on regional seas. The industrialized countries that surround the
Baltic Sea had during the 1960s and early 1970s discharged waste and chemicals into the sea
from land and commercial vessels, including oil tankers. In 1974, states with direct access to the
water signed a convention to address the pollution problem. Previously, they had made several
fisheries agreements and the 1974 convention was independent of those prior agreements insofar
as it did not rely on their legal authority or institutional resources.
Fig. 6.5 Integrated Agreements and Independent Agreements in Place (Baltic Sea and Danube River). These values are derived from the same sources used in the quantitative data analysis.

When the convention entered into force in 1980, it became a platform for protecting the Baltic Sea from oil spills, waste discharges, and chemical pollution. The Soviet Union had not maintained the environmental positions of Sweden, Denmark, or the Federal Republic of Germany, but it and other Eastern Bloc parties signed and then ratified the convention for both political and environmental reasons (Hjorth 1994, 21). It began as a weak agreement without specific limitations or obligations on load reductions from the parties. The convention’s entry
into force established the Helsinki Commission (HELCOM) to serve as a permanent international organization for facilitating cooperation on the marine environment.

Parties subsequently made amendments and protocols to the convention, adopting at least one new agreement each year from 1980 through 1985 that was integrated into the preexisting set of rules and institutions established under the Baltic Sea Convention. They held ministerial meetings and issued declarations from 1988-90 under the auspices of the Convention to improve the status of the Baltic Sea (Elofsson 2010, 1043). In 1992, they created a more comprehensive system for managing and protecting the Baltic Sea with the post-communist states. This convention covered the whole basin, in contrast to the previous convention, which only covered the sea surface (Interview 19, HELCOM Secretariat). Instead of terminating the original convention, they replaced it with the new Baltic Sea Convention, building the new convention on top of the existing rules and institutions that had evolved over the previous decade.

The Baltic Sea area has seen a growth of bilateral and sub-regional initiatives to implement specific regulations under the 1992 Convention or other relevant marine conventions adopted under the International Maritime Organization. Hydrocarbons development projects have prompted the most vulnerable of states in the area to undertake special initiatives with other concerned parties bordering the sea (Hassler 2010, 500). However, parties have not formalized these initiatives as independent agreements and they have institutionalized them under HELCOM. They have focused on four main objectives recently, identified as the critical areas for cooperation in protecting the Baltic Sea: nutrient pollution, hazardous substances and wastes, biodiversity, and maritime shipping (HELCOM Baltic Sea Action Plan). Countries have invested in HELCOM as the international mechanism for facilitating improvements in these core areas.
DANUBE RIVER. International cooperation on the Danube River has taken a different path before and after the collapse of the Soviet Union and the integration of several former Eastern Bloc countries into the European Union. Largely, the un-integrated characteristics of international cooperation on the Danube River have reflected the local interests of parties. Germany and Austria have made agreements, including a critical one in 1987, because they share the Inn River, a tributary of the Danube River (Interview 2, Austrian Ministry). The Inn River flows from Austria through Bavaria in Germany and the water than flows through Bavaria into another part of Austria. Thus, Austria is upstream to Germany and Germany is upstream to Austria along different parts of the Danube River Basin. This geographic condition has contributed to the mutual reciprocity of relations between the two governments in managing the river (Interview 10, Austrian Ministry). Moreover, both Germany and Austria are upstream parties along the Danube and they have long exploited that position because it has provided considerable opportunity for developing hydroelectric power plants along the upstream portions of the river. In fact, Austria relies on hydroelectric power for two-thirds of its national energy consumption and a large fraction of that hydroelectric power comes from the Danube River (Interview 10, Austrian Ministry).

Unlike cooperation on the Baltic Sea, cooperation on the Danube River Basin involves an independent multilateral convention, the Framework Convention on the Sava River Basin. The Sava is the longest tributary of the Danube Basin and the second largest in terms of square kilometers of area. The Sava River flows through four Balkan republics. Following the Balkan Wars of the late 1990s, western countries, the European Union, and the United Nations found an interest in formalizing greater cooperation in the Balkans under a river convention (Interview 6, ICPDR). Thus, the motivation for the convention was largely political. It has operated
independently of the Danube Commission and manages smaller portions of the Sava basin than the ICPDR parties believe is relevant to their convention (Interview 5, ICPDR Secretariat).

The Sava Convention handles some issues with treaties that the International Commission for the Protection of the Danube River (ICPDR) does not handle, particularly navigation (Interview 5, ICPDR Secretariat). Although it relies on the information systems of the ICPDR, it also has protocols on flood management and navigation that are meant for implementation under the Sava Commission. Moreover, the Sava Commission is responsible for tributaries of the river with smaller areas than covered by the Danube Commission. The Danube Commission does not have responsibility for rivers in the catchment area below 5,000 square kilometers because those are considered local issues and irrelevant to all the 15 contracting parties of the Danube River Convention (Interview 12, ICPDR Secretariat). By contrast, the Sava parties manage issues at smaller levels of detail under the Sava Commission than the Danube parties manage under the Danube Commission. Riparian states along the largest tributary of the Danube Basin, the Tisza River, are also working towards sub-basin cooperation that would focus on rivers of 1,000 square kilometers or more, in contrast to the Danube Commission (Interview 4, ICPDR Secretariat).

Critically, cooperation on the Danube River has depended in part on the unique political circumstances of the area and the timing of political changes in the region. Germany and Austria had a strong political interest in helping the downstream former Eastern Bloc countries learn to protect and better manage the Danube waters (Interview 9, Global Environmental Facility). Instead of exploiting their positions as upstream parties and avoiding commitments, Austria and Germany have had the wealth and political incentives to facilitate changes in downstream countries like Romania, Bulgaria, Ukraine, and Moldova to implement reforms and install
wastewater treatment facilities (Interview 10, ICPDR Secretariat). River management was viewed as economically important for growth and economic development in these economically depressed states. It was also viewed as a potential stepping-stone towards membership in the European Union, under which water laws would need to be implemented to meet the *acquis communautaire* of EU law (Interview 15, Austrian Environment Agency). Without these unique political incentives and the economic wealth of the upstream parties to facilitate changes in downstream areas of the basin, the Danube Commission probably would not have achieved all of its historic successes since the Convention entered into force in 1998 (Interview 6, ICPDR Secretariat).

### 6.8 Danube River and Rhine River: Impact of Geopolitics and Wealth

The Danube riparian states have continued to rely on bilateral agreements, sub-basin multilateral agreements, and other sub-basin initiatives to handle the specific issues relevant to neighbors. They have continued to use and make independent commissions on different sections of the Danube River Basin. The asymmetrical interdependence relationships among Danube riparian states have not promoted integrated cooperation on the river as the symmetrical interdependence relationships have along the Baltic Sea for several decades.

International cooperation on the Danube River in recent decades has depended in part on the improved political relations between states along the Upper, Middle, and Lower Danube and the wealth and political incentives of Germany and Austria, the upstream states. To what extent are the economic and political circumstances that contributed to basin-wide cooperation on the Danube River more important than the interdependence structures between the Danube states? If
wealth in the upstream states, strong support by the upstream states for basin-wide cooperation, and improved geopolitical relationships among the Danube states explain the emergence of basin-wide cooperation following the end of the Cold War, this would indicate that wealth and geopolitical conditions are critical for explaining the form of international cooperation on the Danube Basin. It would significantly qualify the relevance of interdependence structures in the un-integrated form of Danube basin management.

Since the Baltic Sea area and the Danube River Basin have undergone similar economic and political transformations since the 1970s, they do not vary enough along those variables to assess the extent to which economic and political variables mitigate the consequences of varying interdependence structures. That focused comparison does not provide an opportunity to assess whether varying economic and political variables can mitigate the potential for conflict between upstream and downstream states along a long multi-party river. There is not enough variation in the economic and geopolitical histories of the two areas to leverage for an empirical analysis.

To evaluate whether economic and political conditions effectively contribute more to the form of regional water cooperation that emerges, I rely on another focused comparison between two large rivers in Europe: the Danube River and the Rhine River. These two water bodies have strong upstream-downstream properties because downstream states depend heavily on upstream states for good quality water and for reasonable quantities of water. However, they vary considerably with respect to the political and economic conditions since 1945. To what extent have those variables mitigated the tendency to form un-integrated international cooperation on these river basins?

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5 Plots of mean per capita GDP, mean democracy score, and dyadic rivalries over 1945-2010 show that the Danube countries have had lower scores on the democracy and wealth variables and have had more dyadic rivalries in recent decades than the Rhine countries.
6.8.1 Consequences of Political and Wealth Disparities

The Rhine River has a longer history of international cooperation among riparian states than the Danube River. As early as the 1870s, states along the Rhine had a navigation agreement to provide for the passage of commercial vessels (Interview 18, Dutch Embassy-Berlin). The Rhine states had made attempts to form a common framework for cooperation on the river before World War II. After the war, those efforts resumed by focusing on minor issues that did not involve considerable policy changes or costly regulations, similar to the beginning of Baltic Sea cooperation under the 1974 Baltic Sea Convention. In 1963, the Rhine states adopted a convention to begin basin-wide cooperation. At that point, they were among the wealthiest and most politically connected in Europe. France, Luxembourg, the Netherlands, and the Federal Republic of Germany were member states of the European Economic Community and Switzerland had close political and economic ties with these countries (Interview 18, Dutch Embassy-Berlin).

Despite the close connections and post-war economic growth, the interdependence relationships among the Rhine states limited the extent to which upstream states would clean and protect the river water for the Netherlands. Since 1931, a French potassium mining company had dumped salt into the Rhine River, which would then flow downstream to the Netherlands, which relied on the Rhine for much of its freshwater because it is a low-lying country bordering the North Sea (Carel 2011). Political disagreement between the Netherlands and France eventually prompted the Dutch government to withdraw its ambassador to Paris in 1979 after the French Prime Minister decided not to submit the Chloride Convention, adopted by the Rhine parties in
1976, for ratification in the French parliament. Cost-sharing arrangements between the Rhine parties resulted in a violation of the “polluter pays” principle, according to which France would have internalized the costs of reducing salt discharges into the Rhine water (Interview 17, ICPR Secretariat). Parties only resolved this issue in the 1990s, by which time chemicals pollution, ecology, and flood protection had become more pressing concerns under the Rhine Commission (Interview 19, Dutch Embassy-Berlin).

Since a chemical spill in 1986 from a Swiss chemical plant, the Rhine states have undertaken transformative regulations to restore the ecology of the Rhine River Basin, improve water quality, and create flood protection measures (Interview 17, ICPR Secretariat). The wealth of Rhine states has enabled them to self-finance these improvements and regulatory changes. Unlike in the Danube Basin, where international donors ranging from the Global Environmental Facility to the European Union have contributed funds to improve water quality in the Lower Danube, the Rhine River has benefited from the technical capacities and economic prosperity of the riparian states (Interview 16, ICPR Secretariat). Wealth helped them make large improvements.

Nonetheless, states along sub-basin tributaries of the Rhine River have maintained independent agreements. Germany, France, and Luxembourg have an international commission for the Moselle River. The Netherlands and Switzerland have not had a stake in the operations and decisions taken by parties to the Moselle River Convention because it has not interfered with their water quality and has not interfered with the achievement of goals under the Rhine Commission (Interview 19, Dutch Embassy-Berlin). As in the Danube Basin, states have maintained local perspectives and basin-wide perspectives on transboundary river management because interdependence relationships have existed at both levels. The Moselle and Saar Rivers
have independent conventions that rely on the methodologies and data collection institutions of
the Rhine Commission because the Rhine Commission has responsibility for the full catchment,
which includes the Saar and Moselle tributaries (Interview 18, ICPR). Similar information-
sharing has occurred between the Danube Commission and the Sava River Commission, but in
each case the basin-wide commission has provided more institutional support to the sub-basin
commission than vice versa.

Overall, despite the economic and political differences between the Rhine and Danube
basins, both have had independent agreements in place for decades but the Rhine states have
developed a more integrated international regime for their river. Figure 6.6 below shows that the
Rhine River states have had more integrated agreements in place on average than the Danube
River states over the 1945-2010 period (p value = 0.000). However, it also shows that the Rhine
River has had nearly as many independent agreements in place in a given year since 1990 as the
Danube River, although the difference is statistically significant if we consider the full 1945-
2010 period (p value = 0.000). Political and wealth conditions have helped the Rhine River states
form integrated and deep international cooperation involving monitoring, information-sharing,
and mutual water protection. These conditions have not yet existed in the Danube Basin,
preventing similar accomplishments despite major progress on the Danube since 1998.

States in both basins have formed un-integrated cooperation to address bilateral issues
and local concerns in addition to participating in a basin-wide commission to address basin-wide
issues. Interdependence structures have prompted states in each basin to have both a local and
basin-wide perspective. Different interdependence relationships among parties have also meant
that environmental cooperation in river management has required political and economic support
because the exposure to environmental degradation has varied among states in each basin.
Fig. 6.6 Integrated Agreements and Independent Agreements in Place (Danube River and Rhine River). These values are derived from the same sources used in the quantitative data analysis.

Relying on common exposure to environmental externalities could not have prompted states in each basin to form basin-wide conventions. Overarching political and economic changes spanning decades have been critical in each river basin in promoting a basin-wide perspective on river management, which had not been internalized until recent decades and remains problematic along the Danube River (Interview 7, Austrian Ministry). Favorable political conditions were
needed for a common basin-wide perspective to emerge in the Danube basin. Nonetheless, local perspectives have remained central throughout decades in the form of cooperation that emerged in each basin. States have viewed each river as both a basin-wide management problem and a local management problem with neighbors.

6.9 Conclusion

This chapter has evaluated the importance of interdependence structures in the form of international environmental cooperation by analyzing the development of cooperation on different categories of water bodies. Water bodies such as the Danube River or the Baltic Sea involve different interdependence structures among states. Symmetrical interdependence and asymmetrical interdependence do not take ideal type forms in regional water management. No river has the same set of interdependence relationships as another river basin because riparian states share different time horizons in exploiting the water resources. The same is true of lakes and seas. Preferences over water exploitation are never identical between states.

Nonetheless, these water body categories have different interdependence structures because states bordering the water are not similarly exposed to externalities from other states bordering the water. The economic and regulatory challenges associated with rivers, lakes, and seas are close enough to limit the extent to which these other characteristics of water bodies can explain strong variation in the form of international cooperation that develops over decades-long time scales. I leveraged the interdependence disparities and economic similarities across rivers, lakes, and seas to evaluate how well interdependence structures explain when states create integrated international cooperation and when they create un-integrated cooperation.
Using a combination of new quantitative and qualitative data, I find that rivers are associated with un-integrated international cooperation involving agreements without legal or institutional links to each other. The form of international cooperation on rivers remains un-integrated because riparian parties have local and bilateral issues whose resolution may affect downstream states but which they nonetheless settle outside a basin-wide framework. In more assertive situations, upstream states only selectively make agreements without making a common agreement for the basin. By contrast, lakes and seas are associated with agreements that are legally and institutionally linked, contributing to integrated regimes for these water bodies. Common exposure to pollution and other externalities gives states bordering lakes and seas more incentives to make a common international cooperation framework involving integrated rules and institutions. Overall, disparities in the interdependence structures across these water bodies generate divergent preferences over international cooperation, affecting the form of cooperation takes shape. Preferences over the form of regional water cooperation depend on the structure of interdependence among states with access to the water.

Wealth and political relations can sometimes encourage integrated international cooperation on river basins, as the example of Rhine River cooperation has demonstrated since at least 1986. Nonetheless, even in these “most likely” cases of integrated cooperation, preferences diverge because of varying interdependence among states. More wealth and closer political ties do not contribute to integrated cooperation on their own. They can be mediating factors. Disputes still arise and reach high political levels, even among politically close states, along rivers. Interdependence at the local level and at the basin-wide level encourage a different form of international cooperation than that which generally evolves on lakes and seas. Riparian states have different perspectives on managing the water because of geographic proximity to some
states as opposed to others and because of upstream-downstream properties along the river.

States along lakes and seas do not share this perspective, at least not to the same extent, because they are mutually exposed to each other’s interference with the water.
Appendix 6.1

Table 6.4 Cox Proportional Hazards Models of Years Until an Integrated Agreement

<table>
<thead>
<tr>
<th>Model Number</th>
<th>1</th>
<th>2</th>
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<th>4</th>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>River</td>
<td>−1.168</td>
<td>−1.134</td>
<td>−1.540</td>
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</tr>
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<td></td>
<td>(0.299)</td>
<td>(0.386)</td>
<td>(0.445)</td>
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</tr>
<tr>
<td><strong>Wealth and Geopolitics</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>−0.300</td>
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<td></td>
<td>(0.194)</td>
<td>(0.231)</td>
<td>(0.215)</td>
<td></td>
</tr>
<tr>
<td>mean Democracy</td>
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<td>−0.014</td>
<td>−0.009</td>
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</tr>
<tr>
<td></td>
<td>(0.044)</td>
<td>(0.049)</td>
<td>(0.046)</td>
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<td>−0.039</td>
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</tr>
<tr>
<td></td>
<td>(0.134)</td>
<td>(0.159)</td>
<td>(0.126)</td>
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</tr>
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<td><strong>Number of States</strong></td>
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<td>(0.577)</td>
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<td>(0.392)</td>
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<td>(0.340)</td>
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<td>Asia</td>
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<td>(0.371)</td>
<td>(0.242)</td>
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<td>−0.990</td>
<td>−1.230</td>
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<td>(0.690)</td>
<td>(0.650)</td>
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<td>Total Agreements (t-1)</td>
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Note: The dependent variable is years until the next integrated agreement. Coefficient estimates are reported, not hazard ratios. Robust standard errors (in parentheses) are clustered on the water body. Baseline hazards are stratified on the sequence of integrated agreements. The Efron method of ties is used. Bold estimates: p value ≤ 0.05.
### Table 6.5 Cox Proportional Hazards Models of Years Until an Independent Agreement

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<td><strong>Interdependence</strong></td>
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<td>(0.629)</td>
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</tr>
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<td>(0.169)</td>
<td>(0.187)</td>
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<td>mean Democracy</td>
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<td>–0.062</td>
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<td>(0.114)</td>
<td>(0.156)</td>
<td>(0.202)</td>
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Note: The dependent variable is years until the next independent agreement. Coefficient estimates are reported, not hazard ratios. Robust standard errors (in parentheses) are clustered on the water body. Baseline hazards are stratified on the sequence of independent agreements. The Efron method of ties is used. Bold estimates: p value ≤ 0.05.
Table 6.7 Cox Proportional Hazards Models of Years Until an Agreement

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<td><strong>Interdependence</strong></td>
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<td>River</td>
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<td>(0.321)</td>
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<td>Europe</td>
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<td>0.202</td>
<td>(0.381)</td>
<td>(0.379)</td>
</tr>
<tr>
<td>Asia</td>
<td>–0.142</td>
<td>–0.092</td>
<td>(0.346)</td>
<td>(0.406)</td>
</tr>
<tr>
<td>South America</td>
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<td>–0.566</td>
<td>(0.651)</td>
<td>(0.650)</td>
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<tr>
<td>Total Agreements (t-1)</td>
<td>0.027</td>
<td>0.023</td>
<td>(0.053)</td>
<td>(0.052)</td>
</tr>
<tr>
<td>N</td>
<td>3807</td>
<td>2882</td>
<td>2847</td>
<td>2847</td>
</tr>
<tr>
<td>Water Bodies</td>
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<td>74</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>0.06</td>
<td>26.05</td>
<td>49.91</td>
<td>52.41</td>
</tr>
</tbody>
</table>

Note: The dependent variable is years until the next agreement, regardless of its relation to earlier ones. Coefficient estimates are reported, not hazard ratios. Robust standard errors (in parentheses) are clustered on the water body. Baseline hazards are stratified on the sequence of agreements. The Efron method of ties is used. Bold estimates: p value ≤ 0.05.
Chapter Seven

Interdependence Structures and the Breadth of Regional Water Cooperation

7.1 Introduction

States along the Danube River have made agreements on different segments of the river basin. They have established new institutions and rules for basin-wide management in recent decades, but that followed a longer period in which they made agreements with bilateral or sub-basin objectives. Following entry into force of the 1994 Danube Convention, the International Commission for the Protection of the Danube River (ICPDR) became the main mechanism for encouraging basin-wide cooperation. The Convention established a basin-wide management framework that had not been in place because of the earlier focus on bilateral and sub-regional commissions. Even following the adoption of the Danube Convention and the formation of the ICPDR, several states in the Danube basin have made sub-basin treaties and have pursued sub-basin programs on tributaries of the river. Over 60 years, the Danube riparian states have made bilateral commissions, followed by the basin-wide commission, followed by a sub-basin commission, with a potential second sub-basin commission to follow in the future. The river is managed at bilateral, sub-basin, and basin-wide levels with treaties and soft law instruments.

Governments along the Baltic Sea have pursued greater cooperation on the whole sea than at the bilateral or sub-basin level, although they have created sub-basin and bilateral initiatives on specific issues. Since the 1974 Convention for Protection of the Marine Environment of the Baltic Sea Area, Baltic governments have devoted resources to encourage sea-wide rules and institutions through the Helsinki Commission (HELCOM). They extended the
objectives of cooperation to the whole basin in 1992 with a new convention that replaced the earlier one. There are several sub-regional initiatives, particularly in responding to oil spills and developing research collaboration or wastewater treatment plants. Nonetheless, the legal instruments and rules began with a sea-wide mandate and then were extended to the whole basin, not just the sea surface. Over 45 years, the Baltic coastal states have formed a commission and corresponding legal instruments and institutions with sea-wide mandates. Largely, cooperation is coordinated at the sea-wide level, even when sub-regional and bilateral actions are taken to implement the centrally coordinated goals.

Why have the Danube states made agreements at different levels of the river but the Baltic states have made agreements that focus primarily on the sea level? Over the same timespan, the Baltic states have made far more agreements on the sea with all the Baltic states participating than the Danube states have made agreements on the river with all Danube states participating. Chapter Six described the similar geopolitical and economic histories of these regions. To the extent that political and economic disparities are critical factors in water cooperation, they cannot account for the divergent pattern of agreements on the Danube River and the Baltic Sea. Both basins have experienced similar political, social, and economic transformations in recent decades. Yet the breadth of cooperation has varied. Cooperation on the Danube basin is multi-layered, consisting of institutions and rules at bilateral, sub-regional, and regional levels. Cooperation on the Baltic basin is more strongly consolidated at the regional level.

In this chapter, I document the pattern of regional water cooperation with a different analytical focus than in the previous chapter. Instead of analyzing the form of regional water cooperation – the subject of the previous chapter – I study the breadth of regional water
cooperation. Specifically, I analyze when governments make agreements that include all states along a water body and when they make agreements that include a fraction of states along the water body. I generalize beyond the Baltic-Danube comparison to analyze general patterns in the scope of cooperation on regional water bodies. *Under what conditions do governments form regional water cooperation consisting of all states bordering the water body? Under what conditions do governments form cooperation that includes a fraction of states along the water body?*

The analysis so far has sought to explain patterns of integrated and un-integrated international environmental cooperation. Whether cooperation had broad participation or narrow participation was not the problem addressed in earlier chapters. The form of international cooperation is defined by whether governments have made cooperation integrated or un-integrated – whether new rules and institutions depend on earlier rules and institutions. Integrated and un-integrated cooperation are not defined by whether all states relevant to managing a natural resource participate in cooperation or only a fraction of them participate. It is not defined by the breadth of cooperation.

This chapter differs from the earlier ones precisely because it documents patterns of cooperation defined by the breadth of participation and not the development of cooperation into either integrated or un-integrated forms. Having studied the form of cooperation on regional water bodies in the preceding chapter, I study the breadth of cooperation by analyzing patterns in the scope of participation in regional water cooperation.

I study the breadth of regional water cooperation because, like the form of cooperation, it may depend on interdependence structures. *Breadth is another dimension of cooperation in which interdependence structures may play an important role.* Symmetrical interdependence
should not only prompt integrated cooperation by encouraging preference convergence among governments but should also prompt broader participation in regional water cooperation. When states share a water body that entails symmetrical interdependence, their mutual participation affects how much governments can mitigate environmental externalities. They rely on each other to mitigate externalities. And they are each conscious of the political consequences of non-participation by some relevant states. Non-participation may contribute to a breakdown of cooperation by raising concerns over competitiveness distortions.

Similarly, asymmetrical interdependence should not only prompt un-integrated cooperation by encouraging preference divergence but should also prompt narrower participation. When states share a water body entailing asymmetrical interdependence, some states do not believe that cooperation is mutually beneficial. They prefer to abstain from cooperation. Moreover, governments may find that the asymmetrical structure of interdependence makes it useful to have cooperation with narrower participation. *The form of regional water cooperation is one of two variables that should depend on interdependence structures. The breadth of cooperation is the second variable that should depend on interdependence structures.*

Besides the interdependence structures of water bodies, the number of states bordering a water body should affect the breadth of cooperation. Having more states along the water entails greater preference heterogeneity to the extent that the states each hold different preferences over water management than other states. Water bodies with many parties are more prone to encouraging a narrow or localized perspective on the need for water management. With more states, having cooperation that includes all of them would require overcoming different preferences to achieve a broad scope of participation in cooperation. Under this expectation,
there is a trade-off between the breadth of regional water cooperation and the number of states bordering the water body.

Statistical analysis of panel data on 76 rivers, lakes, and seas provides support for the argument that having more states bordering a water body encourages agreements that do not include all states bordering the water body. Having more states with direct access to a water body encourages agreements with narrow participation. This finding is robust to different models of narrow participation. However, the number of states is not associated with agreements that include all states bordering the water body. Having fewer states along the water body does not encourage agreements with broad participation. Overall, the statistical analysis provides support for the view that water bodies involving many parties are prone to narrow cooperation.

The statistical analysis also provides some support for the argument that differences in interdependence structures across water bodies contribute to divergent patterns in the breadth of cooperation. Agreements on rivers with participation by all states bordering the rivers are neither more likely nor less likely than agreements on lakes and seas with participation by all states bordering lakes or seas. This null finding is robust to different models of broad participation. However, agreements on rivers with narrow participation are more likely than agreements with narrow participation on lakes and seas, a finding that is robust to different models. Statistical evidence for the importance of interdependence structures is equally consistent as evidence for the importance of the number of states in explaining narrow regional water cooperation. Neither variable helps to explain broad cooperation, however.

A focused comparison of cooperation on the Danube River and the Baltic Sea provides stronger support for the Interdependence Structures Hypothesis than the Number of States Hypothesis. Despite having only one less state bordering the Baltic Sea than bordering the
Danube River, Baltic states have made far more agreements and institutions at the sea-wide level than states along the Danube. Although the Baltic Sea has an unusual shape as a marine body, states acknowledge their mutual interdependence in managing the water and preventing pollution. The circular movement of water in the Baltic Sea and the common space in the sea make participation by all the Baltic Sea states critical in protecting the water against pollution and ecological stresses. Baltic Sea cooperation is broad as a result.

The lack of common space and the unidirectional movement of water along the Danube River mitigate the extent to which successive basin-wide agreements are useful. Danube interdependence is asymmetric at the basin level but local interdependence between two or three neighboring states encourages multi-layered cooperation. Local interdependence along the Danube River is sometimes symmetric but river-wide interdependence is asymmetric. By contrast, local interdependence along the Baltic Sea is not structurally different from sea-wide interdependence. All Baltic states may experience environmental changes in the Baltic Sea but not all Danube states may experience environmental changes along the Danube River. The breadth of cooperation on the two water bodies reflects this difference.

7.2 Explaining the Breadth of Regional Water Cooperation

Water bodies generate incentives for international cooperation by exposing states to externalities, which may come in the form of pollution, resource depletion, or limitations on navigation. Governments recognize that they can only reduce externalities by cooperating and that a refusal to cooperate would make sustainable management unlikely. Governments are
unlikely to take costly actions and impose economic costs on domestic constituencies unless other governments make comparable commitments.

The breadth of regional water cooperation should depend on the same interdependence variable contributing to integrated and un-integrated cooperation. Interdependence structures shape the incentives of states along regional water bodies to cooperate. Preferences over cooperation converge more along lakes and seas than along rivers because of interdependence structures. The preceding chapter demonstrated that rivers are prone to encouraging un-integrated cooperation compared to lakes and seas. Similarly, lakes and seas are prone to encouraging integrated cooperation compared to rivers.

Interdependence structures should also affect the breadth of regional water cooperation. By breadth, I refer to the extent to which cooperation involves states that contribute externalities. Broad cooperation involves all states contributing externalities. Narrow cooperation involves a fraction of those states. Interdependence structures affect the breadth of regional water cooperation, just as they affect the form of cooperation that develops, by encouraging convergent or divergent preferences over cooperation. When states along a water body are exposed to each other’s externalities, interdependence has a symmetrical structure. All states have an interest in cooperation. When some states along a water body are not exposed to others’ externalities, interdependence has an asymmetrical structure. Only a fraction of states have an interest in cooperation.

Under symmetrical interdependence, the breadth of cooperation is likely to include all states with direct access to the water body. We should expect broad cooperation: all states with access to the water should participate in cooperation. Under asymmetrical interdependence, cooperation is likely to include smaller groupings with more aligned preferences and interests.
We should expect narrow cooperation: a fraction of states with access to the water should participate in cooperation.

7.2.1 Interdependence and the Breadth of Lake and Sea Cooperation

To the extent that lakes and seas encourage preference convergence over cooperation, the breadth of participation should include all littoral states. There are two incentives for having cooperation on a wide scope. First, states cannot mitigate the externalities without participation by states that generate externalities or could generate them in the future. Mutual access to the water means that anybody along the water body can pollute it and that pollution may drift to a variety of coastal areas. Anybody along the lake or sea can exploit the economic resources of the water and that resource depletion has consequences for all states. Without participation by all states contributing externalities, they cannot ensure sustainable management for the future. Symmetrical interdependence along lakes and seas makes participation by all states necessary for sustainable water management.

Second, non-participation by some states creates competitiveness imbalances between industries by placing them under different regulatory regimes. By accepting environmental regulations, governments impose limitations on what domestic economic actors can and cannot do. They change the incentives of those domestic economic actors. Governments are unlikely to adopt such regulations unilaterally in most cases, particularly in managing water because water is essential to a variety of sectors. To the extent that governments want to mitigate externalities, they prefer that others make comparable commitments as they make. Sustaining cooperation
depends on avoiding artificial competitiveness imbalances caused by free-riding by some littoral states.

Both the symmetrical structure of interdependence and the reluctance to avoid competitive imbalances encourage participation in cooperation on lakes and seas by all states bordering these water bodies. Each state has an interest in broad cooperation comparable to other states. They seek to encourage more participation in the cooperation rather than narrower participation. They may have incentives to form bilateral or sub-basin initiatives to cooperate with neighbors more intensively on specific issues. However, these are unlikely to become legalized and institutionalized platforms for cooperation among different combinations of states along the lake or sea. More extensive and institutionalized cooperation is likely to occur at the sea or lake level than at the local level.

7.2.2 Interdependence and the Breadth of River Cooperation

To the extent that rivers encourage divergent preferences over cooperation, the breadth of participation should be limited to a fraction of the riparian states. There are two incentives for having cooperation on a local or sub-regional level along a river. First, upstream states can mitigate their externalities without the participation of downstream states. They have privileged access to the freshwater resources and are not exposed to externalities generated downstream, at least outside of navigation. The need to incentivize upstream states to cooperate with side-payments gives downstream states an incentive to avoid relying on the upstream states and form cooperation at local and sub-regional levels amongst themselves. Asymmetrical interdependence
generates divergent preferences between upstream and downstream states along rivers, making participation by all states unlikely.

Second, neighboring states along the river have more symmetrical interdependence with each other than with more distant states. Upstream states have more incentives to cooperate with each other on projects to create hydropower plants or prevent flooding than to cooperate with distant downstream states on these issues. Downstream states likewise have more incentives to cooperate on flood protection, irrigation, and dykes with each other than with the upstream states. Although along the whole river, upstream-downstream situations involve asymmetric interdependence relations, local interdependence between neighboring states has a more symmetrical structure.

Both the divergence of preferences between upstream and downstream states and the convergence of preferences between neighboring states are likely to prompt narrow cooperation on rivers. Broad participation by riparian states is unlikely. Cooperation along rivers will tend to be narrower than cooperation along lakes and seas.

7.2.3 Interdependence Structures Hypothesis

The interdependence structures associated with lakes and seas, on the one hand, and rivers, on the other, are likely to encourage cooperation of varying breadth. By shaping incentives for cooperation in symmetrical ways, lakes and seas are likely to encourage broad cooperation. Rivers are likely to encourage narrow cooperation. I evaluate the following hypothesis stemming from the interdependence structures argument.
**Interdependence Structures Hypothesis:** Lakes and seas are more likely to encourage agreements that have broad participation than rivers. Rivers are more likely to encourage agreements that have narrow participation than lakes and seas.

7.2.4 **Alternative Explanation: Number or Bordering States**

The breadth of regional water cooperation may also depend on the number of states bordering the water body. Participation by all states should become less likely as more states border the water body because each one has different interests in using the water. In this view, having more states diminishes the possibility of converging on rules and institutions for managing water resources. It becomes increasingly difficult to find common interests among a larger group of states in managing the water body. There is an inverse relationship between the number of states with access to a water body and the breadth of cooperation they achieve. Consequently, more states make broad cooperation unlikely and make narrow cooperation likely. I evaluate the hypothesis stemming from this explanation.

**Number of States Hypothesis:** Water bodies with more states bordering the water are more likely to encourage agreements with narrow participation than water bodies with fewer states bordering the water.

7.3 **Quantitative Data and Measures**

The population of interest for evaluating these hypotheses consists of rivers, lakes, and seas, with variables measured annually. There is one sampling criterion: each water body must have at least three states whose territories are adjacent to the water body. If only two states border a water body, then any agreement they make would necessarily be a broad-participation
agreement. Narrow participation would be impossible. All water bodies with at least three bordering states give them opportunities to make agreements of broad participation or narrow participation.

The sample is the one analyzed in Chapter Six. Recall that it consists of 76 water bodies (42 rivers and 34 lakes and seas) and the unit of observation is the water body-year (N = 3,841). Eight lakes and inland seas meet the criterion of three or more bordering states and 26 open-water seas meet that criterion. These 34 lakes and seas represent nearly the full population that meet the criterion. Forty-two rivers also meet the criterion, which is nearly the full population of rivers whose water flow is adjacent to more than two states.

For each water body, the annual time series data end in 2010 and begin either in 1945 or the first year when at least three bordering states had independence based on the Correlates of War States System Dataset (Correlates of War States System 2011). The time series begins in 1945 for most water bodies in Europe and the Americas. It begins as late as 1992 for some water bodies in Asia because they had fewer than three independent bordering states. Many states in Africa adjacent to water bodies in the sample did not gain independence until the early 1960s.

I recorded international agreements on the water bodies. These agreements contain provisions on how governments manage a specific water body, or a segment of the water body. Nearly all of the agreements are legally binding but some are “soft law” instruments such as memoranda of understanding, action plans, codes of conduct, and political declarations. I include non-binding instruments to cover the full range of cooperation on the water bodies.

Recall that the sample consists of agreements covering diverse issues. The similarity of issues corresponding to the different water bodies supports the premise of the research design: the different types of water body categories present similar regulatory challenges and share
similar economic importance for states. The only agreements not included pertain strictly to
bilateral boundaries. These are not included because territorial boundaries (e.g., continental shelf,
river boundaries) pertaining only to two parties do not fall within the population of interest
because only two states are relevant to the boundary. If the boundary agreements also include
provisions on water use or management, they were included in the sample.

7.3.1 Dependent Variables: Broad-Participation and Narrow-Participation Agreements

I measure the breadth of cooperation on the water bodies according to participation in
agreements on the water bodies. Broad cooperation implies that all states bordering a water body
were participating in the agreement. Narrow cooperation implies that some states bordering the
water body were not participating in the agreement. This means the threshold for broad
cooperation is high: all states that border the water body must participate for the agreement to
have broad participation. Anything short of that means the agreement contributes to narrow
cooperation.

I coded each agreement as either Broad-Participation or Narrow-Participation based on
whether all the states bordering the water body signed the agreement or became a contracting
party before the end of the time series for that water body – or before the agreement expired. For
example, the 1987 Treaty of Regensburg between Germany and Austria on the Danube River is
coded as a Narrow-Participation Agreement because fewer than all the states bordering the
Danube River signed the agreement and because fewer than all bordering states have been
contracting parties to the agreement by the end of 2010, the last year of the dataset. By contrast,
the 1994 Danube River Protection Convention is coded as a Broad-Participation Agreement
because it qualifies under one of two coding criteria: each bordering state as of 2010 is a contracting party. If all bordering states as of 1994 had signed the agreement, then it would have qualified as broad-participation based on that coding criterion.

Signing an agreement and becoming a contracting party to an agreement are not legally equivalent. Becoming a contracting party to a legal instrument obliges a state to observe the instrument under international law. Signing the instrument does not carry such an obligation. However, signing a legal instrument is often considered an expression of the intention to become a contracting party, although that does not happen on rare occasions. Moreover, the signing period for agreements has generally been limited to one or two years after the agreement was completed. The contracting period for agreements has no such limitation. Only termination or expiration of the agreement brings an end to the opportunity to become a contracting party.

I use signatures and formal adoption through ratification, accession, or other equivalent procedures to measure participation because it helps to avoid mis-measurement. Signatures sometimes make countries parties to an agreement. Several agreements in the sample stipulate that signing implies that a country becomes a legal party. Moreover, since some of the agreements in the sample are not legally binding, countries cannot become contracting parties to them. The most they can do to commit in a formal sense is to sign the non-binding instrument. However, since the signing period is not indefinite and some countries may choose to become parties later, having never signed the agreement, I do not limit the measure of participation to signatures. Becoming a contracting party without having signed the agreement also indicates that a country participates in the agreement. Thus, I measure participation in an agreement based on whether a given country bordering a water body signed the agreement or became a contracting party. Relying exclusively either on signatures, on the one hand, or on ratifications, accessions,
or other formal adoption procedures, on the other, would lead to mis-measurement of participation.

Data on the status of parties to the agreements in the sample come from several sources, including the agreement names. Often, a narrow-participation agreement is clear from the name: the agreement name lists the parties to the agreement, which provides a direct way to measure whether it has broad participation or narrow participation based the states bordering the water body. The names of broad-participation agreements do not list parties, making it necessary to use a variety of data sources of parties to the agreement.¹

7.3.2 Treatment and Covariates

INTERDEPENDENCE STRUCTURES VARIABLE. The research design enables a clear way to distinguish water bodies with asymmetrical interdependence structures from those with symmetrical interdependence structures. All river years are coded as involving asymmetrical interdependence (River = 1); all lake and sea years are coded as involving symmetrical interdependence (River = 0). Estimates of this variable imply a comparison between rivers, on the one hand, and lakes and seas, on the other, enabling a straightforward comparison of interdependence structure effects. The Interdependence Structures Hypothesis indicates that rivers should be positively associated with narrow-participation agreements and negatively associated with broad-participation agreements relative to lakes and seas. River should be

¹ Transboundary Freshwater Dispute Database, Oregon State University (http://www.transboundarywaters.orst.edu/database/index.html); ECOLEX (www.ecolex.org/); UN Treaty Collection (http://treaties.un.org/Home.aspx); International Environmental Agreements Database Project (http://iea.uoregon.edu/page.php?file=home.htm&query=static). Treaty secretariat webpages were also used to identify parties to some agreements.
positively associated with narrow cooperation; it should be negatively associated with broad cooperation.

NUMBER OF STATES VARIABLE. According to the Number of States Hypothesis, having more states with direct access to the water body should make broad cooperation unlikely and should make narrow cooperation more likely. To test this hypothesis, I constructed a variable for the total number of states bordering the water body (Number of States). I relied on maps from various open sources to determine which states were adjacent to which water bodies in the sample. This variable is expected to be negatively associated with broad participation and positively associated with narrow participation.

OTHER VARIABLES. I do not evaluate a specific hypothesis pertaining to the importance of wealth or geopolitical relations in explaining the breadth of regional water cooperation. Chapter Six evaluated hypotheses on the relevance of wealth and geopolitics in the development of international cooperation on regional water bodies. Nonetheless, I include variables pertaining to wealth and geopolitics among states bordering the water body in modeling broad participation and narrow participation to estimate potentially significant relationships. I include the logged mean GDP per capita of bordering states (log(mean GDP per capita)) to measure the wealth of countries with access to the water body. I rely on the World Penn Table (Heston, Summers, and Aten 2012) for this measure. More wealth should encourage broad cooperation and discourage narrow cooperation.

I constructed two variables associated with political relationships among countries. First, I include the average level of democracy among the bordering states (Avg Democracy) using the POLITY IV dataset (Marshall and Jaggers 2011). This is an average of the polity2 measure

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across the states bordering the water body. Research has found that democracies maintain more peaceful relations than other dyads (Oneal and Russett 2001). Democracies are also thought to have a greater capacity to form international cooperation because their domestic political institutions make commitments more credible (Leeds 1999). This variable measures these democracy effects. Lower average democracy scores imply a higher probability of discord and conflict among states. I expect the democracy variable to be positively associated with broad participation and negatively associated with narrow participation. More democracy should encourage broad cooperation.

Second, I constructed a variable counting the total number of dyadic rivalries (Number of Rivalries). This measure is defined by the number of militarized interstate disputes between two states within a given period. It measures whether a dyad had different types of rivalry relationships in a given year. I use the Klein, Goertz, and Diehl data on enduring and proto rivalries for this measure (Klein, Goertz, and Diehl 2006). I expect the rivalries variable to be negatively associated with broad participation and positively associated with narrow participation. More rivalries should diminish the prospects of broad cooperation.

Governments may become less inclined to make additional agreements as the total number of agreements increases because further agreements might then become less useful for parties. I include a lagged count variable for the total agreements (Total Agreements (t-1)) in place on a water body and expect that this variable is negatively associated with both broad and narrow participation agreements.

I also include variables pertaining to the geography of the water bodies. I include variables indicating the continent of the water body (Europe, Africa, South America, Asia). Some water bodies border multiple continents (e.g., Mediterranean Sea) and are coded as bordering
each one. I also include whether the water body is a sub-basin, indicating that it is geographically linked to a larger water body but is smaller than that water body (Sub-Basin).

7.4 Statistical Analysis of Water Agreements

Unlike the statistical models used to analyze the form of international environmental cooperation in earlier chapters, there are at least two ways to model the breadth of cooperation. Breadth is not defined by a relationship with earlier agreements, unlike integrated and un-integrated cooperation, which are defined by a relationship with the rules and institutions created earlier on an environmental issue. Integrated and un-integrated cooperation each imply a relationship between newer rules and institutions and older ones. Therefore, they each imply the passage of time between older rules and institutions and newer ones. They also imply dependence or independence relative to earlier institutions and rules. This made time-to-event analysis the appropriate tool for modeling the conditions affecting integrated and un-integrated cooperation.

The breadth of cooperation is not defined by a relationship with rules or institutions that came earlier in the history of cooperation on an environmental issue. It is defined by the extent to which states with control over an environmental issue participate in cooperation. This does not imply the passage of time between earlier rules and institutions and newer ones on an issue. In that respect, time-to-event models are not the clearest way to model the breadth of cooperation, as they were in modeling the form of cooperation. Binary-outcome models of broad participation and narrow participation may be just as appropriate.
Nevertheless, agreements of narrow and broad participation are made over time. There is a timespan separating some narrow agreements from others on a specific water body. The same is true of broad participation: states may make a broad-participation agreement at t0 and then follow with another one at t1. Although time-to-event models are not clearly the most appropriate way to model the breadth of cooperation as they are in modeling its form, they are able to model the temporal dimension associated with successive agreements.

As a compromise, I use a combination of time-to-event models and binary-outcome models to evaluate the hypotheses. Using both types of models to evaluate the hypotheses provides a robustness check. In case a variable is significant in one type of model but not significant in the other, it is not consistently significant across different models of the breadth of participation. In case the variable is significant in both types of models, however, it is robust to different modeling approaches. And in case it is not significant in either type of model, it is clearly insignificant regardless of the modeling approach. I begin first with time-to-event analysis and then turn to binary-outcome analysis.

7.4.1 Time-to-Event Analysis

BROAD PARTICIPATION. Figure 7.1 below plots the Kaplan-Meier survival function estimates for rivers and for lakes and seas. These are descriptive nonparametric estimates of the time until an event occurs. In this analysis, the “event” is an agreement that includes all states bordering the water body (“broad participation”). Flat estimates denote that states are no more likely to have made a broad-participation agreement than before. Vertical declines correspond to a higher probability that states had made a broad-participation agreement. A broad-participation
agreement was more likely to have been made. Steep vertical declines denote a sharp increase in the probability that states had made a broad-participation agreement by that point in time.

The estimates suggest there is no significant difference between rivers, on the one hand, and lakes and seas, one the other. There is considerable overlap in the confidence intervals of these survival estimates, suggesting no significant difference.

**Fig. 7.1** Kaplan-Meier Survival Estimates of the Years Until a Broad-Participation Agreement. Estimates closer to 1 correspond to a lower probability of a broad-participation agreement by $t$. Estimates farther from 1 correspond to a higher probability of a broad-participation agreement by $t$.

Since these are nonparametric estimates, they do not account for covariates. I model the relationship between broad-participation agreements and the interdependence variable, the number of states variable, and other covariates with Cox proportional hazard models. These models estimate the hazard ratio corresponding to a variable. Higher estimates correspond to a higher “hazard” of a broad-participation agreement. Robust standard errors are clustered on the water body. Since states can make a sequence of broad-participation agreements, this sequence
may change the baseline hazard of a water body after each additional agreement is made. I model the potential heterogeneity in the baseline hazards after each new broad-participation agreement by stratifying the baseline hazards on the sequence of broad-participation agreements corresponding to a water body. Stratification can model the heterogeneity of baseline hazards associated with repeated events (Box-Steffensmeier and Jones 2004, Chapter 10). In this case, the repeated events are repeated broad-participation agreements.

Table 7.1 reports the results of four Cox models of the years until a broad-participation agreement (Appendix 7.1). Rivers are not associated with a higher hazard compared to lakes and seas in each of the models, consistent with the survival function estimates and contrary to the Interdependence Structures Hypothesis.3 Differing interdependence structures are not associated with different prospects for broad participation. The number of states bordering a water body also has a null estimate in each of the models. Having more states bordering the water body is not associated with a lower prospect of broad participation. Neither interdependence structures nor the number of states bordering the water body have a significant relationship with broad cooperation on regional water bodies. These null findings may reflect the high threshold for broad participation. Recall that the measure of broad participation requires that all states that border the water body participate in the agreement.

Predicted hazard ratios based on the estimates from Model 4 are consistent with the null estimate on the interdependence structures variable. Figure 7.2 displays the predicted hazards for rivers and for lakes and seas. The left plot displays the means of predicted hazard ratios and the right plot displays the distributions of predicted hazard ratios. There is no significant difference

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3 A graphical test of the proportional-hazards assumptions for rivers and for lakes and seas indicates that the hazard ratios are parallel for these categories over time. The proportional-hazards assumption of the estimates is supported.
between rivers, on the one hand, and lakes and seas, on the other, in relation to broad-participation agreements.

![Graph showing predicted hazard ratios (means) for lakes and seas versus rivers.](image)

**Fig. 7.2 Predicted Hazard Ratios (Broad-Participation Agreement).** The left plot displays the means of predictions and the right plot displays box plots of the predictions. Outside values – those outside the inter-quartile range, multiplied by 1.5 – are excluded from the box plots. Predictions are based on estimates from Model 4.

NARROW PARTICIPATION. Turning to narrow cooperation, Figure 7.3 plots the Kaplan-Meier survival estimates for the different water body categories. Recall these are nonparametric estimates of the time until an event occurs. In this case, the event is a narrow-participation agreement. Vertical declines in the estimates correspond to a higher probability that states had made a narrow-participation agreement by that year, denoted along the x-axis. Steep vertical declines denote a significantly higher probability that states had made a narrow-participation agreement. Flat estimates denote the probability of a narrow-participation agreement is no higher than before.
The estimates suggest there is a difference between rivers, on the one hand, and lakes and seas, on the other. There is no overlap in the confidence intervals of these survival estimates, suggesting a difference between water bodies with asymmetrical interdependence and those with symmetrical interdependence. This supports the Interdependence Structures Hypothesis.

Fig. 7.3 Kaplan-Meier Survival Estimates of the Years Until a Narrow-Participation Agreement. Estimates closer to 1 correspond to a lower probability of a narrow-participation agreement by $t$. Estimates farther from 1 correspond to a higher probability of a narrow-participation agreement by $t$.

As before, I model the relationship between narrow-participation agreements and the covariates with Cox proportional hazards models. Robust standard errors are clustered on the water body. Since states can make repeated narrow-participation agreements, this repetition may change the baseline hazard of a water body after each additional agreement is made. I model potential heterogeneity in the baseline hazards after each new narrow-participation agreement by stratifying the baseline hazards on the sequence of narrow-participation agreements corresponding to a water body. This implies the baseline hazard varies across the sequence of
narrow-participation agreements. In these respects, the estimation strategy for narrow-participation agreements is practically identical to the one used to model broad-participation agreements.

Table 7.2 reports the coefficient estimates of four Cox models of the years until a narrow-participation agreement (Appendix 7.1). There is no stronger support for the Number of States Hypothesis than for the Interdependence Structures Hypothesis. In two of the three models featuring the number of states variable, it is positive and significant. And in two of the three models featuring the interdependence structures variables it is positive and significant. Above all, there is strong support for the argument that less wealthy groups of states make narrow-participation agreements on regional water bodies. In each of the three models featuring the logged mean per capita GDP variable, it is negative and significant.

The coefficient estimates provide some support the Interdependence Structures Hypothesis and estimates of predicted hazard ratios provide one indication of the different effect sizes. Figure 7.4 displays statistics on the predicted hazard ratios corresponding to Model 8. The left plot displays the means of predicted hazard ratios and the right plot displays the distributions of predicted hazard ratios. Rivers have a much higher mean predicted hazard than lakes and seas. And the overall distributions are consistent with the higher mean for rivers. These predicted hazards support the Interdependence Structures Hypothesis.

Overall, there is equally strong support for the Number of States Hypothesis as for the Interdependence Structures Hypothesis in explaining narrow participation. Neither hypothesis, however, explains broad participation.

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4 A graphical test of the proportional-hazards assumptions for rivers and for lakes and seas indicates that the hazard ratios are parallel for these categories over time. The proportional-hazards assumption of the estimates is supported.
Fig. 7.4 Predicted Hazard Ratios (Narrow-Participation Agreement). The left plot displays the means of predictions and the right plot displays box plots of the predictions. Outside values – those outside the inter-quartile range, multiplied by 1.5 – are excluded from the box plots. Predictions are based on estimates from Model 8.

7.4.2 Binary-Outcome Analysis

The time-to-event models are useful for modeling the time elapsed between repeated broad-participation agreements or repeated narrow-participation agreements. However, unlike the integration of international environmental cooperation analyzed in earlier chapters, there is no implied temporal relationship between agreements of varying breadth. There is no implied dependency relationship either. The breadth of cooperation is defined by whether all states controlling an environmental resource are parties to cooperation – not whether subsequent agreements are independent of or integrated with earlier ones. Integrated and un-integrated cooperation imply the passage of time since cooperation first began; the breadth of cooperation implies no such temporal relationship.
Therefore, I complement the time-to-event analysis with binary-outcome analysis to determine whether they produce consistent findings. To the extent they produce a consistent finding on a variable, it demonstrates the robustness of that finding. I include the same covariates in the binary-outcome models as I included in the time-to-event models, except for adding a cubic polynomial approximation ($t, t^2, t^3$) to model time dependence in the binary-outcome analysis (Carter and Signorino 2010).

BROAD PARTICIPATION. I model the occurrence of broad-participation agreements using population-averaged logistic regression models, with robust standard errors clustered on the water body. These models return estimates of the variables at the population level and not the subject-specific level. I tested the assumption that the findings do not differ when modeling random heterogeneity among the water bodies and found that using random-effects specifications instead of population-averaged specifications does not produce substantively different results on the main explanatory variables. The correlation structure of the logistic models is specified as “exchangeable,” which assumes no autoregressive structure in the covariates.

Table 7.3 reports the coefficient estimates from four logistic models of broad-participation agreements (Appendix 7.1). The results indicate no difference between rivers, on the one hand, and lakes and seas, on the other, in their relationships with broad participation. Lakes and seas are not more positively associated with broad cooperation than rivers, contrary to the Interdependence Structures Hypothesis. Table 7.4 below shows that the predicted probability of a broad-participation agreement on a river is not statistically different from the predicted probability of a broad-participation agreement on a lake or sea. The confidence intervals of the
estimates overlap. This null result is consistent with the null result from the time-to-event analysis of the relationship between broad cooperation and interdependence structures.

Table 7.5 Predicted Probabilities of a Broad-Participation Agreement

<table>
<thead>
<tr>
<th>Water Body Category</th>
<th>Pr(Broad Participation)</th>
<th>Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>0.043</td>
<td>[0.025, 0.061]</td>
</tr>
<tr>
<td>Lake or Sea</td>
<td>0.049</td>
<td>[0.017, 0.081]</td>
</tr>
</tbody>
</table>

Note: Estimates based on output from Model 12. All covariates were fixed at their observed values for these estimates.

However, the results also indicate that having more states bordering a water body is positively associated with broad participation, contrary to the Number of States Hypothesis. According to this hypothesis, having more states along a water body makes broad cooperation unlikely. Yet there is a positive and significant relationship between the number of bordering states and broad-participation agreements in each of the models including this variable, not negative and significant, as expected under the hypothesis. This surprising finding is inconsistent with the null finding from the time-to-event analysis of the relationship between broad participation and the number of states. Therefore, unlike the consistent null results on the relationship between interdependence structures and broad participation, there are inconsistent results on the relationship between the number of states bordering a water body and broad participation.

NARROW PARTICIPATION. I model the occurrence of narrow-participation agreements using a comparable set of population-averaged logistic regression models with robust standard errors clustered on water body. I tested the assumption that the findings do not differ
when modeling random heterogeneity among the water bodies with random-effects specifications in place of population-averaged models and found no substantive difference in the results on the main explanatory variables. The correlation structure of the logistic models is specified as “exchangeable,” which assumes no autoregressive structure in the covariates.

Table 7.5 reports estimates from four logistic models of narrow-participation agreements (Appendix 7.1). The results indicate that rivers are positively associated with narrow-participation agreements compared to lakes and seas. This supports the Interdependence Structures Hypothesis and is consistent with the time-to-event models of narrow-participation agreements, insofar as they produced estimates suggesting that rivers are prone to narrow-participation agreements more than lakes and seas. Table 7.6 shows that the predicted probability of a narrow-participation agreement on a river is statistically different from the predicted probability of such an agreement on a lake or sea. The confidence intervals of the estimates do not overlap. The estimates suggest that narrow-participation agreements are slightly more than seven times more likely on rivers than on lakes and seas, controlling for other variables.

<table>
<thead>
<tr>
<th>Water Body Category</th>
<th>Predicted Pr(Narrow Participation)</th>
<th>Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>0.076</td>
<td>[0.040, 0.112]</td>
</tr>
<tr>
<td>Lake or Sea</td>
<td>0.01</td>
<td>[–0.000, 0.020]</td>
</tr>
</tbody>
</table>

Notes: Estimates based on output from Model 16. All covariates were fixed at their observed values for these estimates.

Having more states bordering the water body is also positively associated with narrow participation, according to estimates from two of the three models featuring this variable. This
finding that there is a positive relationship between water bodies with more states and narrow participation is consistent with the results on this relationship from the time-to-event analysis. There is consistent support, therefore, for the hypothesized positive relationship between having more states bordering a water body and participation by a fraction of those states in cooperation. The binary-outcome models and the time-to-event models provide support for the Number of States Hypothesis in this respect. This support is consistent across the different models, much like support for the Interdependence Structures Hypothesis, which finds similar support based on the time-to-event models and the binary-outcome models.

7.4.3 Discussion

The statistical analysis provides relatively consistent support for the expectation that having more states bordering a water body contributes to narrow cooperation. It provides consistent support for the expectation that differences in interdependence structures make rivers more prone to encouraging narrow cooperation than lakes and seas. In particular, support for the Interdependence Structures Hypothesis is robust to modeling approaches, much like support for the Number of States Hypothesis, in explaining narrow cooperation.

Neither hypothesis, however, accounts for broad cooperation by states bordering a water body. Regardless of whether broad-participation agreements on regional water bodies are analyzed using time-to-event models or binary-outcome models, interdependence structures are not significant factors. The same is true of the number of states bordering a water body. In that respect, the Interdependence Structures Hypothesis and the Number of States Hypothesis are each better at explaining narrow cooperation than they are at explaining broad cooperation.
7.5 Danube River Basin and Baltic Sea Basin: Interdependence or Number of States?

The statistical analysis provides mixed support for the Interdependence Structures Hypothesis and for the Number of States Hypothesis. Neither one receives overwhelming support. The statistical results are inconclusive. This may reflect the high threshold for measuring broad participation (and the low one for measuring narrow participation). Recall that the measure of broad participation requires that all states that border the water body participate in the agreement. Anything short of that is defined as narrow participation.

To further assess the relative importance of interdependence structures and the number of states in the breadth of cooperation, I return to the contrasting histories of international cooperation on the Baltic Sea and the Danube River. This comparison is useful because the Baltic Sea and the Danube River each have had relatively many states bordering them. As of 2012, the Danube River had 10 bordering states and the Baltic Sea had nine bordering states.

Equally as important, the numbers of states bordering the Danube River and the Baltic Sea have each increased since 1991. Five states that border the Danube became independent between 1991 and 1993 (Ukraine, Moldova, Serbia, Croatia, Slovak Republic) and three states collapsed (Union of Soviet Socialist Republics, Czechoslovakia, Socialist Federal Republic of Yugoslavia), resulting in a net addition of two states bordering the Danube. Similarly, four states became independent along the Baltic Sea (Russia, Latvia, Lithuania, Estonia) and one state collapsed (Union of Soviet Socialist Republics), resulting in a net addition of three states bordering the Baltic. Changes in the number of states bordering these two European water bodies
have paralleled each other since the end of the World War Two, as the only other state to gain independence along each water body since 1945 is adjacent to each one of them (Germany).

Table 7.7 below summarizes the expectations from each hypothesis. As a preview of the findings, it highlights that the evidence strongly supports the Interdependence Structures Hypothesis. The Danube states have made bilateral and sub-regional commissions much more than the Baltic Sea states. They have also institutionalized sub-regional programs to a greater extent than the Baltic Sea states, giving responsibilities to sub-basin organizations. In these dimensions, there is comparatively weak support for the Number of States Hypothesis. Although the statistical analysis was inconclusive, the qualitative comparison of these water bodies provides strong support for the interdependence structures argument and much less support for the number of states argument.

**Table 7.7** Summary of Findings from Focused Comparison of Danube River and Baltic Sea

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Expectations</th>
<th>Support for Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interdependence Structures</strong></td>
<td>(1) Danube River has far more bilateral and sub-regional commissions than the Baltic Sea. (2) Programs focused on local or sub-regional issues are more institutionalized in the Danube basin than the Baltic Sea area.</td>
<td>Strong support.</td>
</tr>
<tr>
<td><strong>Number of States</strong></td>
<td>(1) Danube River has about the same number of bilateral and sub-regional commissions as the Baltic Sea. (2) Programs focused on local or sub-regional issues are institutionalized to about the same extent in the Danube basin as in the Baltic Sea area.</td>
<td>No support.</td>
</tr>
</tbody>
</table>

7.5.1 Water Cooperation at Different Levels
BALTIC SEA. Cooperation on the Baltic Sea is largely coordinated under HELCOM. Sea-wide institutions are in HELCOM and contracting parties to the 1992 Helsinki Convention rely on their activities in HELCOM for the majority of coordination they undertake to protect the marine environment of the Baltic Sea. Activities and programs at different levels of the Baltic Sea – sub-basin and basin-wide – are coordinated to varying extents within HELCOM.

Baltic Sea states use HELCOM in large part because all states bordering the sea are contracting parties. HELCOM was established in 1980 after the 1974 Convention on the Protection of the Marine Environment of the Baltic Sea Area entered into force. Each state adjacent to the Baltic Sea became a contracting party to the 1974 Convention. After Estonia, Latvia, Lithuania, and Russia became independent states, they adopted the new 1992 Convention. That convention achieved full participation by the Baltic Sea states. Given the importance of the 1974 and 1992 conventions in protecting the Baltic Sea, the vast share of international cooperation on the marine environment has received the consent of all states bordering the sea under HELCOM rules for over 30 years.

HELCOM is not only a tool of cooperation by the Baltic Sea states but also a tool of policy implementation by the European Commission. The Baltic Sea Strategy and the Marine Strategy Framework Directive of the European Union both rely to varying extents on HELCOM for their implementation (Interview 22, HELCOM Secretariat; interview 24, Baltic Sea expert). From the European Commission’s perspective, investing in HELCOM amounts to investing in the implementation of policy goals targeting the newly independent states and the former communist states in the Baltic Sea basin (interview 24, Baltic Sea expert). By using HELCOM for policy implementation, the EU is able to rely on existing institutions that have participation by all the new EU member states bordering the Baltic Sea and Russia as well. HELCOM has
become an important mechanism for engaging Russia on marine policy issues in part because Russia prefers to negotiate with the EU because it has the same status as the eight EU member states in HELCOM (Interview 24, Baltic Sea expert). Therefore, full participation in HELCOM is useful for the EU from a policy implementation standpoint and is useful for Russia’s engagement with the EU from a political standpoint.

Even sub-regional initiatives are coordinated under HELCOM. The main sub-regional initiatives on the surface water are intended to enhance readiness in case of oil spills. The Baltic Sea is one of the most commercially trafficked seas in the world (Interview 22, HELCOM Secretariat). Oil shipments from Russia pass through the Baltic Sea proper to Germany, Denmark, and other states beyond the Baltic area. Consequently, oil spills and illegal discharges of oil into the Baltic Sea have long been a concern for the sea-bordering states. It was one of the top priorities of Baltic states in establishing cooperation under the 1974 Helsinki Convention (Interview 12, HELCOM Secretariat). Oil spills remain one of the main priorities, largely because of the growth of Russian oil shipments through the Danish Straits in the recent decade.

*Oil spill response occurs at the sub-basin level but is coordinated at the HELCOM level.* Groups of states numbering fewer than those in HELCOM participate in annual exercises to enhance readiness in the event they undertake emergency responses to oil spills (Interview 22, HELCOM Secretariat). Russia, Finland, and Estonia take part in these activities in the Gulf of Finland, located in the far east of the Baltic Sea. Denmark, Germany, and Sweden take part in them in the western Baltic region, near the Danish Straits (Interview 19, HELCOM Secretariat). Despite their narrow participation, the exercises and media coverage of the exercises are coordinated and managed under HELCOM, which has a working group set up to handle pollution from commercial shipping.
Unlike sub-regional initiatives, bilateral initiatives on the Baltic Sea are far less institutionalized and have more limited goals. For example, there has been a bilateral project between Sweden and Russia to create a management plan for salmon in the Volga River (Interview 20, HELCOM Secretariat). These projects exist outside the HELCOM framework and involve relatively less funding. However, they are largely complementary to work under HELCOM. Bilateral initiatives on the Baltic Sea have limited goals because most of the main activities and programs receive full participation by all Baltic Sea states under the Helsinki Convention.

DANUBE RIVER. In contrast to international cooperation on the Baltic Sea, cooperation on the Danube River is shared among treaties covering different portions of the watershed. With the entry into force of the 1994 Danube River Protection Convention, Danube states established the ICPDR to serve as the coordinating mechanism for cooperation on the whole river basin. This was the first treaty and commission to encourage river-wide cooperation by the states bordering the Danube River. As parties to the Convention, states not bordering the Danube River itself but in the basin area also participate in cooperation through the ICPDR. However, unlike HELCOM’s role in the Baltic Sea, the ICPDR is one of several commissions established to manage portions of the basin. Other commissions exist to encourage cooperation on more limited stretches of the Danube River proper and sub-basins.

Like HELCOM’s role in the EU Baltic Sea Strategy and the Marine Strategy Framework Directive, the ICPDR serves as an implementing instrument of the EU Danube Basin Strategy and the EU Water Framework Directive. Danube states use the ICPDR to implement the river basin approach of the Water Framework Directive, which calls on states to adopt wider perspectives on rivers than narrow ones defined by the formation of bilateral commissions.
(Interview 2, Austrian Ministry). Therefore, both HELCOM and the ICPDR are entrusted to help implement policy goals and legal obligations adopted in Brussels to facilitate environmental improvements and economic transition in each basin area.

From an institutional perspective, what separates international cooperation on Danube River from cooperation on the Baltic Sea is that bilateral commissions play a critical role in managing the Danube River but do not exist in the Baltic Sea area. Bilateral commissions predated the ICPDR – and remain critical institutions in the overall management of the river basin. In that respect, the ICPDR was formed independently of the bilateral commissions but exists in addition to bilateral commissions (Interviews 2 & 10, Austrian Ministry). The Baltic Sea states have not formed bilateral commissions; they have worked within HELCOM as the international organization established to manage the sea.

Bilateral commissions are important in managing the Danube River because states can handle issues of bilateral relevance in which other states along the Danube do not have a stake. The reason bilateral commissions do not exist in managing the Baltic Sea is precisely because issues of bilateral relevance are issues of Baltic-wide relevance, making them HELCOM issues. The same is not true of management issues along the Danube River – or at least states along the river do not acknowledge their river-wide relevance. For example, flood protection is a problem in upper and middle portions of the river more than for lower portions of the river (Interviews 4 & 5, ICPDR Secretariat; Interview 2, Austrian Ministry). However, ecological conditions and eutrophication is a problem for the lower Danube, near the Danube Delta, where the mouth of the Danube connects to the Black Sea (Interview 8, Global Environmental Facility). By contrast, ecological issues and eutrophication are widely acknowledged as Baltic-wide problems for each state along the sea (HELCOM, Baltic Sea Action Plan).
In terms of the whole Danube basin, states along different tributaries have particular interests in cooperating outside the context of the ICPDR. Only river basins 5,000 square kilometers or greater are considered to be of basin-wide relevance and are subject to consideration and management under the ICPDR. Smaller sub-basins within the Danube basin are not managed within the ICPDR. States along two tributaries have undertaken cooperation at the sub-basin level, although one of the initiatives is institutionalized within the ICPDR to provide steering and institutional support for the participating sub-basin states. In particular, states along the Tisza River, which is the largest sub-basin of the Danube in square kilometers, have pursued cooperation on that tributary and rivers of 1,000 square kilometers, but their coordination occurs within the ICPDR with the help of staff at the ICPDR Secretariat (Interview 4, ICPDR Secretariat). States along the Sava River, which is the second largest sub-basin in square kilometers in the Danube basin, formed an international commission to manage the river under the 2002 Framework Agreement on the Sava River Basin. Both the Sava River Commission and the Tisza Group under the ICPDR have the participation of all states in those sub-basins. The institutionalization of sub-basin cooperation in the Danube basin contrasts with the coordination on sub-basin activities on the Baltic Sea under HELCOM.

7.5.2 Impact of the Number of States

Contrary to the Number of States Hypothesis, having more states along the Baltic Sea after the collapse of the Soviet Union increased sea-wide cooperation and efforts under HELCOM to aid the newly independent states. It did not prompt narrow agreements and institutions among two or three states bordering the sea. It gave more impetus to efforts under
HELCOM to take on new responsibilities related to the challenges facing the Baltic Sea following the expansion in the number of states bordering the sea. Baltic states placed more emphasis on sea-wide cooperation and added projects to HELCOM’s work program after the new convention was adopted in 1992 and more states entered the picture.

To illustrate, the Baltic states have used HELCOM to encourage reforms in Russia, Estonia, Latvia, Lithuania, and Poland because these states had less environmental regulation, especially in the area of wastewater treatment. In 2009, following negotiations between the HELCOM Secretariat and the European Commission, the EU funded a project called BALTHAZAR to reduce pollution from Russia. The project focused on pollution from agriculture and inputs of hazardous substances. Instead of creating a new international institution to manage funding resources, the EU relied on HELCOM to manage the funds and encourage reforms in the two parts of Russia bordering the Baltic: the Leningrad Oblast, where St. Petersburg is located, and in Kaliningrad Oblast, which is separate from Russia proper and borders Belarus and Poland. After the BALTHAZAR Project ended in 2012, its successor was formed under the name BASE.

States along the Baltic have viewed these Russia-centric BALTHAZAR and BASE Projects as Baltic-wide programs because improvements in Russia’s reporting and changes in the pollution loads from Russia have sea-wide relevance to the Baltic states. This contrasts with the focus on bilateral commissions by states like Austria along the Danube River in the overall management strategy they have for the river. The Baltic states cannot have a full understanding of ecological and environmental stresses on the Baltic Sea without having verifiable and comparable data from Russia, which has major inputs from St. Petersburg and, to a lesser extent, from Kaliningrad into the Baltic water. Not having data from Russia that is comparable to the
data from other Baltic Sea states would leave a “black spot” in the overall picture that the Baltic states have of the sea’s status (Interview 24, Baltic Sea expert). Moreover, not engaging Russia on pollution issues would also lead to imbalanced efforts by the Baltic states in reducing pollution loads into the sea. Although Russian territory is located on the eastern and central portions of the sea, its contributions have sea-wide relevance, providing rationale for having BALTHAZAR and BASE under HELCOM’s responsibility (Interviews 20 & 26, HELCOM Secretariat).

The newly independent states and Poland have presented a challenge in recent years because their agricultural production has steadily resumed after a period of decline following the aftermath of communism (Interview 24, Baltic Sea expert). EU funds for the Common Agricultural Policy and cohesion funds have gone to the three Baltic republics and Poland. Growth in their agricultural sectors has meant an increase in nutrient loading from these states into the Baltic Sea, which contributes to eutrophication in the sea and ecological problems in the coastal areas and the off-shore areas. This has made eutrophication and nutrient pollution the main problem motivating Baltic Sea cooperation in recent years (Interviews 19 & 25, HELCOM Secretariat). However, this was not merely a result of the addition of new states along the border. Finnish agriculture has also released nutrient inputs into the Archipelago Sea (Interview 23, Finnish Environment Institute).

Rather than contributing to narrow cooperation, the increased number of states along the Baltic Sea has driven parties under the Helsinki Convention to adopt the Baltic Sea Action Plan prepared through HELCOM. More states along the Baltic gave impetus for a new convention in 1992. The issues associated with economic transitions and pollution from those states have prompted not bilateral commissions or sub-regional agreements but more emphasis on
HELCOM work as the solution. Reinforced after several ministerial meetings, this decision reflected a sea-wide perspective on the importance of having regulatory changes and other transitions in those newly independent states.

DANUBE RIVER. The increased number of states along the Danube River has contributed more emphasis to provision by the EU to the former communist states and added to work inside the ICPDR. However, the disintegration of Yugoslavia prompted the former Yugoslav republics to form a sub-basin commission independent of the ICPDR (Interview 6, ICPDR Secretariat). States along the Danube and the EU have sought to use the ICPDR to facilitate reforms in the former communist states and the newly independent states bordering the river and in the basin. They have also recognized that basin-wide cooperation would not address issues at local levels and along specific tributaries or portions of the Danube River Basin. Having more states along the Danube River and in the basin has contributed, therefore, to greater emphasis on the ICPDR in coordinating activities in the former communist countries. It has also led to more efforts to cooperate outside the basin-wide framework established through the ICPDR. In that respect, the larger number of states along the Danube River and in the basin has contributed to cooperation along segments of the river basin and along the whole river basin all at once, in contrast to the increased number of states along the Baltic Sea, which contributed to greater reliance on HELCOM and relatively minor bilateral or sub-regional initiatives.

Professionals working on management of the Danube River recognize that one challenge is overcoming parochial views of the river. One slogan of water professionals working on the river has been, “We share one basin; everybody lives downstream!” (Interview 13, Danube River consultant). The addition of new states bordering the Danube River has enhanced the need for public outreach and public communication to have individuals in the basin understand their
contributions to pollution in the river. Cultural perspectives and historical uses vary considerably among countries in the basin (Interview 10, Austrian Ministry). Disparities among the states bordering what is often called the “most international river basin in the world” has made it difficult to infuse a basin-wide perspective on individual contributions to the river. The same has been true in the case of Baltic Sea cooperation. In the aftermath of communism in Eastern Europe, the former communist states were mainly focused on economic transition and rebuilding efforts. Over time, they have been drawn more into HELCOM work.

Unlike HELCOM, however, the ICPDR has established institutions for raising public awareness across the basin, including in the former communist states and the newly independent states. HELCOM does not have a comparable public communications and public outreach system in place as the ICPDR. This difference reflects the greater effort needed to infuse a basin-wide perspective along the Danube River than along the Baltic Sea. However, it may also reflect institutional path-dependence within HELCOM, which according to one researcher has grown since 1980 (Valman 2013). The relative newness of the ICPDR may have rendered it more flexible in handling new challenges related to public awareness in a diverse basin.

The large size of the Danube River has made general basin-wide strategies more limiting than in the case of the Baltic Sea. The Danube catchment has a size of 817,000 square kilometers with a current population of about 83 million. The Baltic catchment has a size of 1.7 million square kilometers with a current population of about 85 million. The length of the Danube River and of its main tributaries has presented a diversity of challenges in the basin to a greater extent than along the Baltic Sea. In both water bodies, there is considerable ecological and environmental diversity. However, the main challenges vary more considerably along the Danube River to a greater extent than along the Baltic Sea. For example, although water
availability is not a problem in upstream portions of the river, drought is a problem in middle and downstream portions of the river (Interview 5, ICPDR Secretariat). This difference in the diversity of challenges is unrelated to differences or changes in the number of states between them. They are geographical characteristics.

7.5.3 Impact of Interdependence Structures

BALTIC SEA. Interdependence in the Baltic Sea is defined by the exposure of Baltic states to pollution and other distortions of the marine environment. Circulation in the Baltic Sea follows dominating patterns. The circulation is counter-clockwise: water in the Baltic Sea proper flows into the Gulf of Finland, where the flow from the Neva River in Russia and near Finland pushes water back into the Baltic proper and the Archipelago Sea between Finland and Sweden (Interview 25, HELCOM Secretariat). Pollution from Poland can reach as far as Finland and pollution from St. Petersburg can reach as far as Sweden. Although there are dominating patterns, circulations can change and pollution can begin to infiltrate areas that had not been exposed as much, such as the Bothnia Bay, which borders Finland and Sweden.

Some of the currents are more immediate and directly affect the coastal areas of a state and its neighbors. Pollution from Finland reaches the Archipelago Sea, which is adjacent to Finland and Sweden (Interview 23, Finnish Environment Institute). Similarly, pollution from St. Petersburg can reach Helsinki. Consequently, the exposure to pollution in the gulfs and coastal areas is always possible. A state that pollutes the water cannot guarantee, first, that it will not be exposed to its own pollution and, second, that it will not be exposed to others’ pollution. This is true even among countries that do not directly neighbor each other along the Baltic Sea. Only
states at the western end of the Baltic Sea can avoid the consequences of some forms of pollution at the eastern end of the Sea – and vice versa. However, even they are exposed to the consequences of nutrient pollution because it contributes to eutrophication in the Sea, which is a general sea-wide problem (Interview 23, Finnish Environment Institute). Therefore, no state bordering the sea can safely avoid all the consequences of pollution from other states, even relatively distant ones, along the sea. They are exposed to sea-wide pollution and ecological problems.

Interdependence at the sea-wide level has a similar structure as interdependence in the specific gulfs or seas within the Baltic Sea. For example, pollution within the Gulf of Finland exposes Estonia, Russia, and Finland to environmental and ecological consequences. Pollution in the Archipelago Sea exposes Finland and Sweden to the consequences. Exposure within the gulfs or sub-basins is greater than at the sea-wide level (Interview 23, Finnish Environment Institute; interview 25, HELCOM Secretariat). At both sea-wide and sub-basin levels, exposure to pollution is mutual: all parties can experience some of the consequences of pollution. However, the intensity of symmetrical interdependence is greater within the sub-basins (e.g., Gulf of Riga, the Bothnia Bay, or the Gulf of Finland) than the whole sea.

Nutrient loading in the sea can also lead to self-exposure depending on the physical characteristics of a country’s coastal areas. Nutrient loading from farmland along the Finnish coast contributes to eutrophication in the Archipelago Sea. Because of natural boundaries created by the archipelago, the loading is largely retained in the coastal areas of Finland. This contributes to algae blooms in areas near the summer cottages of Finnish farmers (Interview 21, Finnish Environment Institute). Moreover, because Finland has many lakes, much of the pollution is retained before it reaches the sea. The pollution has direct consequences for the coastal areas of
Finland and within Finland itself (Interview 21, Finnish Environment Institute). More generally, the coastal areas are most affected by pollution into the sea, giving states a direct stake in reducing their own pollution, in addition to the need for similar efforts by neighboring and distant states with influence over the ecological status of the sea.

There are upstream-downstream characteristics in the Baltic Sea area, just as there are in the Danube River, because the rivers contributing nutrient loading to the Sea span states in upstream locations. For example, Norway and Belarus are in the Baltic Sea catchment but are not contracting parties to the Helsinki Convention. They participate as observers. In the case of Belarus, it is the upstream state along the Daugava River, which discharges into the Baltic Sea. However, since Belarus does not have a direct stake in Baltic Sea cooperation, it has decided not to join the Helsinki Convention and participate as a contracting party in HELCOM. Its observer status places no obligations on Belarus in Baltic Sea cooperation, despite the fact that more of Belarus’ territory is in the Baltic catchment than Latvia’s territory, with Latvia being a contracting party to the Helsinki Convention. *A country’s distance from the Baltic Sea affects its perspective on the need for cooperation, with states not bordering the sea deciding against adopting the convention and states bordering the states accepting the convention as contracting parties (Interview 22, HELCOM Secretariat)*. Therefore, among states bordering the Baltic Sea, there are no upstream-downstream characteristics. However, when including upstream states not bordering the sea, there are upstream-downstream characteristics with non-participation by upstream states as contracting parties.

**DANUBE RIVER.** Water movement along the Danube does not have the circulation that water movement within the Baltic Sea has. The source of the Danube is in the Black Forest of Germany. The river discharges into the Black Sea but the current receives strength from the
elevated upstream portions and small tributaries at different areas along the river. In sections of the basin where states are upstream and downstream to each other, they share symmetrical interdependence and their cooperation reflects a mutual interest in river management. For example, there is a section of the Danube River Basin where Austria is upstream to Germany because the Inn River flows into Germany from its source in Austria. However, at another section of the basin, Germany is upstream to Austria because the Danube proper flows from Germany into Austria. Since each state is upstream relative to the other at different sections of the river basin, this has contributed to reciprocal cooperation (Interview 10, Austrian Ministry). Particularly under the 1987 Treaty of Regensburg between Austria and Germany, both states work through issues on local water management within their bilateral commission.

Bilateral commissions have proliferated along the Danube in part because of these local issues highlighted by the relationship between Austria and Germany in managing their sections of the river basin. Yugoslavia had numerous bilateral commissions with states along the river to coordinate on specific issues (Interview 10, Austrian Ministry; interview 6, ICPDR Secretariat). For example, it constructed the Iron Gates dam with Romania for joint hydroelectric power production. Bilateral dam construction has downstream consequences by affecting water quantity and raising flood potential. One water professional who worked on the Danube remarked, “You are going to turn it into a lake instead of a flowing river [with hydropower plants].” (Interview 6, ICPDR Secretariat). But Romania and Yugoslavia shared opposite sides of the middle Danube and undertook a bilateral project.

Since the formation of the ICPDR, states along tributaries of the Danube have increasingly focused on cooperation at sub-basin levels. The Balkan republics, along with the European Union, viewed the formation of an international commission for the Sava River Basin
as a political instrument for reconciliation following a decade of war among the former Yugoslav republics (Interview 5, ICPDR Secretariat). Since the mid-2000s, Hungary has advanced the idea of creating a commission for the Tisza River, which connects with the middle Danube. Romania has been reluctant to form a sub-basin commission. Overall, countries have been reluctant to form many sub-basin commissions along the Danube to avoid investing more resources in commissions (Interview 5, ICPDR Secretariat; interview 2, Austrian Ministry). Generally, the upstream states within these sub-basins have been opposed to commissions.

International governance of the Danube River Basin has reflected asymmetrical interdependence at the basin level and symmetrical interdependence between specific pairs of countries at portions of the basin. States along the river have created multi-layered governance, dividing responsibilities among bilateral commissions, sub-basin commissions and initiatives, and the basin-wide ICPDR. Instead of investing in the ICPDR as the mechanism for resolving all major issues, they have reserved ICPDR issues and activities for those with basin-wide relevance, which from a technical standpoint means that sub-basins of under 5,000 square kilometers are not issues subject to action through the ICPDR. Governance is multilayered precisely because the structure of interdependence varies with the section of the river and whether one considers the whole river.

7.5.4 Discussion

Overall, the evidence provides more support for the Interdependence Structures Hypothesis than the Number of States Hypothesis in explaining the breadth of cooperation on the Baltic Sea and the Danube River. Danube states have made bilateral commissions and sub-
regional commissions and initiatives to manage specific portions of the basin. By contrast, sub-regional initiatives on the Baltic Sea are generally coordinated within HELCOM and have sea-wide relevance. While activities in bilateral commissions and sub-basin commissions or initiatives are generally regarded as having limited basin-wide relevance in the Danube Basin, bilateral and sub-basin initiatives on the Baltic Sea are often regarded as having broad relevance.

The institutionalization and legalization of institutions outside the basin-wide commissions demonstrate the emphasis on local issues and sub-regional issues in the Danube Basin relative to the Baltic Sea. International institutions and organizations on the Danube Basin outside the ICPDR are legalized and institutionalized. Some bilateral commissions predate the ICPDR by several decades. By contrast, sub-regional and bilateral initiatives on Baltic Sea are complementary to activities under HELCOM and are not legalized or institutionalized to comparable extents as those in place for the Danube Basin. Those that are institutionalized and possess a legal foundation are linked to HELCOM.

Baltic states have reacted to more states adjacent to the Sea since 1991 by not moving towards bilateral commissions or sub-regional treaties. Rather, they have placed more responsibility on HELCOM and invested more in HELCOM to facilitate transitions in the programs and capacities of the newly independent state along the Baltic Sea to reduce their pollution loads into the Sea. Far from creating multi-layered cooperation, they have invested greater resources in HELCOM, with financial support from the European Union, which has sought to engage Russia in the Baltic Sea on marine issues. The addition of newly independent states along the Danube Basin has had two consequences. First, the EU and Danube states have placed more emphasis on the ICPDR to facilitate changes in the Eastern European states in their water management facilities and programs. But second, the independence of the Balkan republics
has prompted a sub-basin commission in the Danube basin and more attention to sub-regional issues in other sub-basins involving former communist states.

Figure 7.5 below indicates that the period following 1991-1993 has involved more broad-participation agreements among Baltic Sea states but more narrow-participation agreements among Danube River states. Changes in the number of states along each water body have corresponded to a more sea-wide focus along the Baltic and a more local or sub-regional focus along the Danube, even as the ICPDR has worked to infuse a strong basin-wide perspective on the river.

Finally, interdependence along the Baltic Sea has prompted a stronger focus on the impacts of pollution within specific gulfs on the whole Baltic Sea and more focus on having sea-wide programs on issues that may be locally concentrated, such as oil spills. The status of the sea is viewed holistically in part because eutrophication – regarded as the main challenge facing the Baltic Sea – has sea-wide consequences. By contrast, interdependence along the Danube River varies across portions of the river, despite having an underlying upstream-downstream property. There are points where states are upstream and downstream relative to each other and have no cooperation. There are also points where states are neither upstream nor downstream to each other and have institutionalized cooperation. *The breadth of cooperation has reflected this difference in the interdependence structures at the basin-wide level and at local or bilateral levels of the river.*
Fig. 7.5 Number of Bordering States, Broad-Participation Agreements, Narrow-Participation Agreements (top to bottom). These data are sourced from the panel data of 76 water bodies.
7.6 Conclusion

The breadth of international environmental cooperation was not the subject of earlier chapters. They focused on the conditions for integrated and un-integrated cooperation. Breadth refers to the extent to which states with control over the issue participate in cooperation on that issue. The breadth of cooperation does not imply a relationship between newer rules and institutions and older ones. The form of cooperation is precisely defined by how governments choose to manage an environmental issue: do they build on existing rules and institutions or create independent rules and institutions? By analyzing patterns in the breadth of cooperation, this chapter has studied another dimension of international environmental cooperation.

Despite this difference, the breadth of cooperation provides a dimension for further evaluating the interdependence structures argument and the number of states argument. It is another variable for evaluating the importance of interdependence structures relative to the importance of the number of states in the development of international environmental cooperation. As in Chapter Six, I evaluate the importance of interdependence in patterns of international environmental cooperation by focusing on regional water bodies. This research design leverages the wide variation in interdependence structures between rivers, on the one hand, and lakes and seas, on the other hand. This chapter evaluates another set of expectations stemming from the interdependence structures argument relating not to the form of cooperation but the breadth of cooperation. Thus, it evaluates the importance of interdependence structures within the same empirical domain as explored in Chapter Six but with a focus on a different dimension of international cooperation.
Statistical analysis of panel data on 76 rivers, lakes, and seas provides tentative support for the Interdependence Structures Hypothesis, according to which rivers should encourage narrow cooperation but lakes and seas should encourage broad cooperation. There is statistical support for the expectation that rivers encourage narrow cooperation – support that is robust to different modeling approaches. Binary-outcome analysis provides only slightly more support for this expectation than time-to-event analysis. There is no support that varying interdependence structures account for broad cooperation.

Statistical evidence is equally mixed for the Number of States Hypothesis, according to which having more states bordering a water body encourages narrow cooperation. Whether the analysis is conducted with time-to-event models or binary-outcome models, the evidence indicates that having more states bordering a water body is associated with narrow-participation agreements. However, having fewer states is not associated with broad cooperation. *The evidence consistently supports the number of states argument and the interdependence structures argument in explaining narrow cooperation. However, neither argument helps explain broad cooperation.*

Overall, the statistical results are inconclusive. This may reflect the high threshold for measuring broad participation (and the low one for measuring narrow participation). Recall that the measure of broad participation requires that all states that border the water body participate in the agreement. Anything short of that was defined as narrow participation. A different threshold would probably produce different findings.

A focused comparison of international cooperation on the Baltic Sea area and the Danube River Basin provides stronger support for the Interdependence Structures Hypothesis than the Number of States Hypothesis. Symmetrical interdependence along the Baltic Sea and in the
interior portions of the Baltic Sea have prompted a holistic management perspective on the sea by states bordering it. Instead of investing resources in bilateral or sub-regional agreements and institutions, states bordering the sea have invested in HELCOM, the basin-wide organization for managing the sea. By contrast, the Danube River involves asymmetrical interdependence along the river and more symmetrical interdependence at specific portions of the river separating two neighboring states. This has prompted multi-layered governance. States have invested in bilateral, sub-regional, and basin-wide institutions with legal auspices and independent budgets.

Patterns of cooperation on both water bodies suggest that, contrary to the Number of States Hypothesis, Baltic states have invested more resources and placed greater responsibilities on HELCOM after more states were added to the Baltic Sea area. Rather than creating bilateral commissions and placing more resources in sub-regional programs separating states by geographical proximity, the EU and Baltic states have focused on using HELCOM resources and institutions to enhance environmental programs and mitigation capacities in the newly independent states and Poland. Despite the net addition of states bordering the Danube River that nearly equals the net addition of states bordering the Baltic Sea, Danube states have reacted to the addition of states differently than the Baltic countries. They have used the ICPDR to infuse a stronger basin-wide perspective in the newly independent states and support efforts in those states at river management. However, they have also invested in sub-regional initiatives and a sub-regional commission, while maintaining the importance of bilateral commissions.

Overall, the statistical evidence provides equal support for the argument that having more or fewer states along a water body is a critical variable in the breadth of cooperation and the argument that interdependence structures are a critical variable. Evidence from the focused comparison of Baltic Sea and Danube River cooperation provides stronger support for the
interdependence structures argument than for the number of states argument. On balance and in aggregate, the evidence provides marginally more support for the importance of interdependence structures than the number of states in explaining patterns in the breadth of regional water cooperation.
Appendix 7.1

Table 7.1 Cox Proportional Hazards Models of Years Until a Broad-Participation Agreement

<table>
<thead>
<tr>
<th></th>
<th>Model Number</th>
<th>1</th>
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<th>3</th>
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<td><strong>Interdependence</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>River</td>
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<td>–0.310</td>
<td>–0.202</td>
<td>–0.336</td>
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<tr>
<td></td>
<td></td>
<td>(0.325)</td>
<td>(0.349)</td>
<td>(0.422)</td>
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</tr>
<tr>
<td><strong>Wealth and Geopolitics</strong></td>
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<tr>
<td>log(mean GDP per capita)</td>
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<td>0.097</td>
<td>0.022</td>
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<td></td>
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<td>(0.169)</td>
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<td>–0.081</td>
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<td>(0.127)</td>
<td>(0.130)</td>
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<td>(0.427)</td>
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<td>(0.499)</td>
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<td>(0.369)</td>
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<tr>
<td>Asia</td>
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<td>–0.216</td>
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</tr>
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<td>(0.506)</td>
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<td>–1.537</td>
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<td>(0.761)</td>
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<td>(0.034)</td>
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</tr>
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<td>5.76</td>
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Table 7.2 Cox Proportional Hazards Models of Years Until a Narrow-Participation Agreement

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<tr>
<td><strong>Interdependence</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>River</td>
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<td>1.635</td>
<td>1.877</td>
<td>(0.595)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(mean GDP per capita)</td>
<td>–0.465</td>
<td>–0.618</td>
<td>–0.593</td>
<td>(0.173)</td>
</tr>
<tr>
<td>mean Democracy</td>
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<td>–0.023</td>
<td>–0.001</td>
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<td>Number of States</td>
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<td>0.079</td>
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<td>0.335</td>
<td>0.495</td>
<td>(0.498)</td>
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</table>

Note: The dependent variable is the years until the next narrow-participation agreement. Coefficient estimates are reported, not hazard ratios. Robust standard errors (in parentheses) are clustered on the water body. Baseline hazards are stratified on the sequence of narrow-participation agreements. The Efron method of ties is used. Bold estimates: p value ≤ 0.05.
Table 7.3 Population-Averaged Logistic Regression Models of Broad-Participation Agreement

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</tr>
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<td>River</td>
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<td></td>
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<td>(0.447)</td>
<td>(0.513)</td>
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<td><strong>Wealth and Geopolitics</strong></td>
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<td>(0.147)</td>
<td>(0.141)</td>
<td>(0.144)</td>
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<td>−0.055</td>
<td>−0.056</td>
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<td>(0.033)</td>
<td>(0.032)</td>
<td>(0.031)</td>
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<td>−0.170</td>
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<td>(0.116)</td>
<td>(0.109)</td>
<td>(0.110)</td>
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<td>(0.387)</td>
<td>(0.398)</td>
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<tr>
<td>Asia</td>
<td>0.133</td>
<td>0.086</td>
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<td></td>
<td>(0.389)</td>
<td>(0.491)</td>
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</tr>
<tr>
<td>South America</td>
<td>−0.589</td>
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<tr>
<td></td>
<td>(0.568)</td>
<td>(0.580)</td>
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</tr>
<tr>
<td>Total Agreements (t-1)</td>
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<td>(0.034)</td>
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</tr>
<tr>
<td>t</td>
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<td>0.005</td>
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<tr>
<td>t³</td>
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<tr>
<td>Water Bodies</td>
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<td>74</td>
<td>74</td>
<td>74</td>
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</table>

Note: The dependent variable is a year in which states made a broad-participation agreement on the water body. Coefficient estimates are reported, not odds ratios. Robust standard errors (in parentheses) are clustered on the water body. The correlation structure is set to exchangeable. Bold estimates: p value ≤ 0.05.
Table 7.5 Population-Averaged Logistic Regression Models of Narrow-Participation Agreement

<table>
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Note: The dependent variable is a year in which states made a narrow-participation agreement on the water body. Coefficient estimates are reported, not odds ratios. Robust standard errors (in parentheses) are clustered on the water body. The correlation structure is set to exchangeable. Bold estimates: p value ≤ 0.05.
CHAPTER EIGHT

Conclusion: Markets and Exposure in International Environmental Cooperation

8.1 Complexity under Constraints

Governments prefer efficient international environmental cooperation. They prefer to have cooperation that consists of rules and institutions that build on each other. They prefer to avoid investing in institutions and rules with superfluous functions to economize on the costs of cooperation. They prefer rules and institutions that are efficient to create and maintain and that provide them with tools for managing the environmental issue.

In the course of cooperation, governments sometimes find that their international rules and institutions are not able to provide them with adequate benefits. They sometimes find their rules and institutions are not able to meet new challenges or even the original goals for which they were created. At this point, governments decide individually and sometimes collectively whether to continue cooperation with the current set of rules and institutions or create new ones. Creating new ones is costly. Governments must invest in negotiating the new rules and institutions. They often must finance their maintenance and any further actions they imply.

In a world without politics, governments could expand cooperation with efficient tools. They could use the existing rules and institutions as a platform for creating new ones. This would enable governments to economize on the costs of negotiating and maintaining the cooperation they had established. They could economize on “transaction costs” while pursuing new policy goals or implementing earlier ones.
However, governments are not always able to economize on transaction costs in pursuing cooperation because of political constraints. They sometimes cannot create efficient systems for collectively managing an environmental issue. These constraints cannot always be obvious at the outset. Governments may not anticipate that they will arise in the future. Governments are forward-looking in designing cooperation – but they cannot anticipate all the large constraints to cooperation that will arise. In some cases, they may prefer to simply deal with those constraints as they arise in the future rather than invest in dealing with them before they become limitations.

What starts out as efficient and cost-effective cooperation can sometimes become inefficient and less cost-effective. Governments sometimes find that they cannot economize on the costs of cooperation to the extent they had wanted in the beginning. Under this recognition, they are more likely to select less efficient systems for managing the environmental issue than had previously existed. By adapting or adjusting to constraints, governments find it more useful to create rules and institutions that do not entail efficient cooperation. In pursuit of mutual and individual benefits from collective action, they create institutions and rules that are not integrated with preexisting ones. *Faced with constraints, they settle for complexity.*

Governments settle for complexity because their preferences over cooperation diverge. They do not share the same interests in cooperation. Some governments want deeper cooperation than others. Some do not want it at all because they do not want to make adjustments to the status quo. Governments do not create efficient institutions for managing transboundary environmental issues when they lack common interests in cooperation. They are much more likely to create integrated institutions when they share common interests. They settle for un-integrated ones when they lack common interests.
In this dissertation, I explained when governments have convergent and divergent preferences over international environmental cooperation. One constraint comes from the individuals, businesses, and communities that generate the environmental problem that prompted international action – the “stakeholders.” When these actors are in concentrated economic markets, governments have more opportunity to economize on international regulation after it begins. Although stakeholders in concentrated economic markets have stronger lobbying power, they make it simpler for governments to create relatively efficient forms of international environmental cooperation. However, when the stakeholders are in diffuse economic markets, governments have less opportunity to economize on international regulation after it begins. They may have ambitious goals at the beginning. Yet the diffuseness of stakeholders makes it infeasible from a political standpoint and impractical from a regulatory standpoint to create international regulation with as much efficiency as when the stakeholders are in concentrated markets.

Diffuse markets contribute to preference divergence between national governments by raising the costs of mitigating the environmental problem and by encouraging disputes over how those costs are distributed. Stakeholders in diffuse markets are unlikely to lower the costs of mitigating the environmental problem over time; the costs remain steady and persistent. In addition to remaining persistent, the costs are diffuse across economic actors. They are borne on large markets with many consumers. This makes it difficult for governments to lower “negative externalities” – the social costs of individual economic activities. Governments cannot pass off the function of reducing mitigation costs to stakeholders because they are unlikely to have the
incentives or capacities to accomplish that goal. Governments face a larger share of the cost burden. The cost burden remains persistent and governments are reluctant to finance adjustments. Internationally, they are likely to have more distributive disputes over financing. “Who pays?” becomes a greater limitation to convergent preferences when stakeholders operate in diffuse markets.

Moreover, diffuse stakeholders make general regulations unlikely to have the environmental consequences governments would prefer. General regulations cannot adequately incentivize stakeholders in diffuse markets to create innovations that mitigate the environmental problem cost-effectively. They are ineffective from an environmental protection standpoint. Governments would prefer otherwise: they would prefer to have general regulations that incentivize stakeholders to change their practices and technologies to lower their externalities. This lowers the burden on governments to make multiple and potentially superfluous rules and institutions to perform similar and overlapping functions. General regulations are cost-effective and governments prefer them to specific regulations.

Diffuse stakeholders place limitations on what general regulations can accomplish and therefore induce governments to develop specific and tailored regulations aimed at specific portions of the stakeholders. These are costly. Governments must create specific regulations to “get the incentives right” for stakeholders to change their practices or technologies. Specific and tailored regulations and programs imply not the top-down strategy of providing stakeholders with new incentives. They entail a bottom-up strategy that concentrates on specific groups of stakeholders to alter their incentives and add to their capacities. Such a strategy is not conducive to efficient governance. It is a reaction to stakeholder diffuseness.
GLOBAL ENVIRONMENTAL ISSUES. Concentrated sectors provide conditions for integrated cooperation on global environmental issues but diffuse sectors impose constraints on integrated cooperation. Original panel data on 18 global environmental treaty processes and qualitative data on the governance of climate change and ozone layer depletion demonstrate that diffuse sectors like agriculture and energy are associated with un-integrated international rules and institutions. Governments are unable to overcome interest divergence and settle for tailored rules and institutions because diffuse stakeholders are unwilling or unable to respond to general obligations. They cannot adjust quickly to produce innovations that lower environmental externalities. Governments react to these stakeholder conditions by seeking to target specific markets and specific issues on which mutual interests exist. But this drives them away from integrated cooperation. Concentrated sectors like commercial shipping, waste management, and chemicals enable governments to avoid making un-integrated rules and institutions to lower externalities. Governments can achieve policy goals of lowering externalities cost-effectively with integrated regimes. Their interests converge more when sectors are concentrated because the mitigation costs decline or remain localized. There are fewer distributive disputes or those disputes are relatively less intense. Governments decide to economize by forming integrated regimes.

MERCURY AND BIODIVERSITY. Specifically, governments expect to govern chemicals and land use differently because of differences in stakeholder concentrations, technological innovation possibilities, and political interests between governments. Responses to field surveys at global environmental negotiations and supporting data show that negotiators and stakeholders expect integrated cooperation on a concentrated issue like mercury pollution but un-integrated cooperation on a diffuse issue like biodiversity loss. Chemicals issues stem from
concentrated industries with the technological, human, and financial resources to lower their externalities cost-effectively. Negotiators and stakeholders believe these conditions are conducive to integrated cooperation. Biodiversity loss stems from diffuse industries like agriculture and forestry. It also stems from national industries and businesses. This makes the instruments of integrated cooperation unlikely to have much impact on the problem. In managing mercury, governments and stakeholders have a clear vision for the value of international financing in managing the problem and they have a clear understanding of where efforts are most needed. In managing biodiversity loss, governments and stakeholders do not have as clear a vision for the value of international financing in managing the problem and do not have as clear an understanding of where efforts are most needed. When regulating concentrated upstream producer markets, governments have more precise ideas of what actions need to take place to mitigate the problem. When regulating diffuse upstream markets, they do not have precise ideas on mitigation needs.

CLIMATE CHANGE. In pursuing un-integrated cooperation on climate change, governments have sought to economize on transaction costs by making de novo institutions in the absence of existing ones that did not have the mandate to handle a specific climate change mitigation issue or had demonstrated an inability to handle such an issue. The United States made new institutions flexible by keeping them informal and un-legalized. These de novo institutions have had limited goals and limited resources for achieving them. When governments pursued legal agreements outside the UN climate change regime, they relied on existing treaty processes. Specifically, they relied on the Montreal Protocol, the International Maritime Organization (IMO), and the International Civil Aviation Organization (ICAO) to make legal agreements on climate-warming gases. Each of these treaty processes has had more concentrated
stakeholders than the UN climate change process. However, more progress towards a legal agreement has occurred in those treaty processes that have concentrated downstream consumer markets. Specifically, there has been more political progress among governments in the Montreal Protocol and the IMO than in the ICAO in part because of more diffuse consumer markets for civil aviation than for refrigeration products or commercial tankers. These market conditions have prompted more preference convergence in the IMO than the ICAO – and potentially more convergence in the Montreal Protocol – on climate change mitigation.

8.3 Exposure and Patterns of Regional Water Cooperation

Convergent and divergent preferences over international environmental cooperation depend not only on stakeholder concentrations, but also on the relative exposure of nationals from one state to the externalities of nationals from another state. The relative exposure to externalities between states encourages or discourages governments to form integrated international environmental cooperation. Interdependence reflects the relative control of each state over the environmental conditions of other states. When interdependence is relatively symmetrical, governments find more common ground and view the environmental problem as an issue of mutual concern. They become more inclined to create new rules and institutions that are built into the existing framework of rules and institutions. However, when interdependence is relatively asymmetrical, governments find less common ground and tend not to view the environmental problem as an issue of mutual concern. In the event they create new rules and institutions, they make the rules and institutions independent of the preexisting framework for cooperation on the issue. They form un-integrated cooperation because preferences diverge.
Interdependence structures are not as important in the breadth of international environmental cooperation as they are in its form. Unlike the form of cooperation, the breadth of cooperation reflects the extent to which states whose nationals contribute to the environmental problem participate in cooperation. Symmetrical interdependence was expected to be associated with broad cooperation – that which includes all states contributing to the environmental pollution or other externalities. Asymmetrical interdependence was expected to be associated with narrow cooperation – that which includes a fraction of states contributing to the environmental pollution or other externalities. The evidence provides tentative support for the expectation that asymmetrical interdependence is associated with narrow cooperation but no support for the expectation that symmetrical interdependence is associated with broad cooperation.

REGIONAL WATER BODIES. Interdependence structures are especially important in studying international cooperation on regional rivers, lakes, and seas. The exposure to externalities varies across those categories of water bodies. Rivers with three or more states bordering the river involve asymmetric exposure to externalities like fisheries depletion, flooding, pollution, or hydro-morphological alterations. Lakes and seas with three or more states border the water involve symmetric exposure to externalities like fisheries depletion and pollution. Although these categories of water bodies do not possess perfectly symmetrical or perfectly asymmetrical interdependence, they provided a contrast useful for analyzing the importance of different interdependence structures in the form and breadth of regional water cooperation. They also share comparable economic uses and involve similar regulatory challenges along important dimensions, limiting the extent to which other characteristics could undermine inferences on interdependence.
The agreement histories of 76 regional rivers, lakes, and seas demonstrate the importance of interdependence structures in the form of regional water cooperation. Lakes and seas are far more likely to encourage integrated cooperation than rivers. Rivers are more likely to encourage un-integrated cooperation than lakes and seas. The structure of interdependence between states contributes to convergent preferences among states bordering lakes and seas. It contributes to divergent preferences among states bordering rivers. However, these interdependence structures are not as important in the breadth of cooperation on regional water bodies. Lakes and seas are not more likely than rivers to prompt broad cooperation by all states bordering the water. Rivers are more likely to prompt narrow cooperation than lakes and seas. Overall, at high thresholds for broad participation (and low thresholds for narrow participation), interdependence structures across rivers, lakes, and seas are not as critical as they are in the form of cooperation. They are a far more critical variable in the form of regional water cooperation that emerges.

**BALTIC SEA AND DANUBE RIVER.** The contrasting histories of cooperation on the Baltic Sea and the Danube River highlight the importance of interdependence structures along rivers and seas. The Baltic Sea has a long history of integrated cooperation involving all states bordering the sea. They have long recognized that their mutual exposure to pollution in the Sea provides an incentive to have deep cooperation. They have chosen to economize on the transaction costs of cooperation by making integrated rules and institutions. When they replaced the 1974 Baltic Sea Convention, they built new rules and institutions on the older ones, but expanded institutional responsibilities and goals. They have also acknowledged the importance of including all states bordering the sea to participate because they each contribute to issues like eutrophication and these have impacts across of the whole sea. Other pollution also has these
generalized properties. Cooperation has been integrated to economize on the costs of governance and has been broad to lower externalities and harmonize standards.

However, upstream states not bordering the Baltic Sea but contributing pollution through rivers have not chosen to cooperate as contracting parties. Even in the Baltic Sea catchment, there are some upstream-downstream properties contributing to non-participation by some important states with a lower stake in cooperation. Symmetrical interdependence along the Sea itself has contributed to integrated and broad cooperation. But upstream-downstream properties in the whole Baltic Sea basin have not led to broader cooperation involving all basin countries.

The Danube River has had a more checkered history of international cooperation. After decades of narrow and un-integrated cooperation on the Danube River, states came together to form a basin-wide commission to handle pollution and sustainable development issues through the river basin. This reflected auspicious political conditions and a recognition that the end of communism and the Cold War provided new challenges and opportunities in Eastern Europe. Basin-wide cooperation has depended on positive engagement by Germany and Austria, both of which have sought to help the former communist countries in the east to make improvements in wastewater treatment and in their practices towards the river. In part, this reflected the political decision to help those states make post-communist reforms and perhaps enable them to become full members of the European Union.

Despite these auspicious political conditions for basin-wide cooperation, Danube Basin management has remained un-integrated and narrow. Instead of having a basin-wide focus with less attention to bilateral or local issues, as in the Baltic Sea, the Danube Basin states have continued to invest in bilateral commissions and have formed a sub-basin commission for a tributary, with the possibility that another one will form along a different tributary. Unlike the
sea-wide focus of Baltic Sea cooperation, Danube River cooperation has been multi-layered: institutions and rules exist at bilateral, sub-regional, and basin-wide levels. Asymmetrical interdependence along the entire river and symmetrical interdependence along specific stretches have contributed to un-integrated and narrow cooperation.

8.4 Wealth, Geopolitics, and the Breadth-Depth Trade-Off

WEALTH AND GEOPOLITICS. Wealth and geopolitics are often assumed to be important “background” variables in cooperation. Whether governments are willing to cooperate on issues is often assumed to depend partly on whether they are political friends or allies. This assumption sometimes warrants investigation (Gartzke and Weisiger 2013). Moreover, reducing pollution is often linked to technical capacities (Jaffe, Newell, and Stavins 2002). These capacities in turn are linked to economic growth (Grossman and Krueger 1995, Ekins 2000). Having more wealth and closer political relations should play critical roles in integrated and broad cooperation on environmental issues.

Changes in global wealth and geopolitics have not been critical in the divergent forms of global environmental governance. Despite changes in the distribution of global wealth and political influence in recent decades, some global environmental regimes have remained integrated and others have become un-integrated during that period of transformative global change. Whether large countries share divergent preferences has varied across issues: those involving diffuse stakeholders have seen the most preference divergence. They have prompted un-integrated global governance on issues like climate change and biodiversity. Even in treaty regimes featuring disputes between wealthy countries and lower-income countries, concentrated
stakeholders have given those governments reason not to form un-integrated rules and institutions. The Montreal Protocol parties have relied on the stakeholders to enable them to overcome disputes in the past. There is a similar reliance on the stakeholder industries to do the same in regulating a new challenge for the climate, hydrofluorocarbons. Economic and geopolitical changes may have exacerbated disputes and contributed to interest divergence, but they have not prompted fissures in global environmental governance. Diffuse markets and stakeholders have done that.

Moreover, the perceived importance of these background variables in regional water cooperation should be qualified. Wealth and close political relations helped the Rhine River states form deeper and more integrated international cooperation to protect the Rhine River from pollution. However, major efforts in this direction only followed an accidental chemical spill in 1986. Previously, there were strong disputes between the Netherlands and France over potassium deposits in the river water. The polluter pays principle was violated. And the dispute only ended after the potassium mine closed and other issues became higher agenda items. Moreover, although the Rhine states have achieved relatively integrated cooperation, there are multiple sub-regional commissions on tributaries. It took decades before the Rhine states established effective cooperation in the post-War era, despite having become among the wealthiest and politically closest states in Europe in the 1950s and 1960s. Only relatively recently have the upstream-downstream properties of the river not generated political disputes and disagreements.

BREADTH AND DEPTH. International environmental affairs have reflected a stronger tradeoff between the breadth and depth of cooperation on regional water bodies than on global environmental issues. Many global environmental treaty processes with universal or near-universal membership have maintained their status as integrated regimes over several decades.
Contrary to the expectation that the depth of global environmental governance would suffer if more states were involved in cooperation, having more states involved diminishes concerns over competitive imbalances. It enables governments to avoid placing domestic businesses in competitive disadvantages by accepting obligations that other countries have not adopted. Governments have sought more states to join global environmental treaties, not fewer. This enables preferences to converge between national governments. It also expands the potential environmental effectiveness of the regime by having more states accept obligations. Global environmental treaty regimes that encourage deep cooperation, measured by the integration of rules and institutions, also have universal or near-universal membership. This follows recent research that shows the tradeoff between the depth and breadth of the global environmental governance is contingent on institutional characteristics of the regimes (Bernauer et al. 2013).

*Including more states in global environmental governance reduces preference divergence.*

The presumed tradeoff between breadth and depth is more accurate in characterizing regional water cooperation. Water bodies with more states are prone to narrow cooperation. They do not encourage broad cooperation among states bordering the water body. They also encourage un-integrated cooperation. States are prone to making independent agreements unconnected to others on the water body, or a part of it. The presumed trade-off is contingent: it is more apparent in regional water management than in global environmental governance, where the contrary view that regimes involving broad cooperation also encourage deep cooperation seems more valid.

*The tradeoff perspective is more accurate at the regional level than the global level.*

### 8.5 International Policy for the Environment
Governments cooperate on international environmental issues because un-coordinated actions by individuals, communities, and businesses create social costs. Cooperation is intended to mitigate these costs. Governments make rules and institutions to encourage mutual adjustments that lower the social costs of economic activities. To the extent that governments can cooperate on mitigating these social costs, they can preserve a natural resource such as the global atmosphere or regional water quality. Cooperation enables governments to encourage the sustainable consumption of natural resources so that they do not expose populations to human health and environmental costs associated with unsustainable resource consumption. Institutions and rules enable governments to avoid the “tragedy of the commons” (Hardin 1968).

The form of cooperation is linked to the extent that governments achieve their environmental protection goals. Examples of integrated global cooperation on atmospheric issues or the marine environment illustrate that international processes involving integrated rules and institutions are generally more effective in mitigating externalities than un-integrated global cooperation. Integrated cooperation on water basins is often associated with more rules and institutions covering a larger portion of the water basin. It is widely believed that the form of cooperation and the extent to which governments mitigate the environmental problem are correlated. Integrated cooperation is valued in part because it is associated with deeper cooperation and more environmental protection than un-integrated cooperation.

In this dissertation, I have documented how un-integrated cooperation reflects obstacles to integrated cooperation. It is a response to obstacles preventing efficient governance. It is a response to divergent political interests. Un-integrated cooperation reflects government efforts to make rules or institutions when barriers to integrated cooperation make that approach infeasible or ineffective. Un-integrated cooperation is the response to divergent preferences. Without
efforts to form un-integrated cooperation in the face of political obstacles or governance limitations, the landscape of cooperation would have fewer rules and institutions.

If governments only ever sought to pursue integrated cooperation no matter the obstacles, they would have fewer rules or institutions on the environment. Governments have made integrated rules and institutions where feasible but have settled for un-integrated rules and institutions where realistic. Governments should craft international environmental cooperation in view of stakeholder concentrations and interdependence relationships. Pursuing integrated cooperation is not productive when stakeholders are diffuse or interdependence is asymmetrical.

Second, cooperation on global environmental issues is tailored to stakeholders and the markets in which they operate. Governments seek to harness the opportunities that stakeholders provide because of their resources and capacities. They seek to create incentives for stakeholders in their markets. Governments prefer to rely on businesses to effectively solve the pollution problem without investing significantly with public resources in the solutions. When stakeholders operate in economic markets involving concentrated suppliers and producers, with consumers operating in diverse and narrow markets, these conditions enable governments to pursue policy goals without needing to tailor regulations as much as when the stakeholders do not possess these characteristics.

Stakeholder concentrations shape the investments governments must make to mitigate the environmental problem because they make more regulation necessary in some circumstances but not others. Providing markets for innovation to capital-intensive producers with high information and technical capacities makes intrusive and costly policies unnecessary. When upstream producers do not possess these characteristics, generalized policies are unlikely to generate reliable markets for innovation. Costly policies and more regulation are essential for making
progress in mitigating environmental problems caused by diffuse stakeholders. Stakeholder concentrations affect how much governments must invest in environmental protection and how much they can rely on businesses to make those investments for them.

To the extent that diffuse stakeholders make integrated cooperation unlikely, this places greater burden on national governments to craft tailored international policies. Governments shoulder a comparatively higher burden in tackling diffuse problems because relying on diffuse stakeholders to solve the environmental problem by creating appropriate incentives is costlier than when stakeholders are in concentrated markets. And since governments are reluctant to waste public resources on ineffective international regulation, the diffuseness of stakeholders places a higher burden to tailor international policies and institutions to the information, technical capacities, and economic opportunities of stakeholders. *Governments should not reapply pre-established templates for international governance when stakeholders are diffuse.*

Finally, following the view that broad cooperation is incompatible with deep cooperation can be self-defeating in international environmental cooperation. Economic actors are reluctant to accept costly regulations if their competitors overseas do not accept similar regulations. Only when they know foreign competitors will face similar standards can these competitiveness concerns dissipate. If governments apply the view that deeper cooperation requires narrower membership in cooperation, this may undo efforts at deeper cooperation by raising competitiveness concerns in domestic industries. Domestic industries prefer broader membership to harmonize regulations across all markets in which they operate (DeSombre 2000b). Pursuing narrow cooperation to have deeper cooperation can incentivize individual states to avoid making adjustments because of competitiveness imbalances created by narrow participation.
Following the view that broad cooperation is incompatible with deep cooperation can be self-defeating not only because of domestic pressures to harmonize standards across competitors but also because it limits the effectiveness of environmental measures. Limiting participation in cooperation constrains the environmental effectiveness of response measures. It not only raises competitiveness concerns but also limits the environmental effectiveness of collective efforts to mitigate the problem. Narrowing the breadth of cooperation to pursue deeper cooperation may prove to be an ineffective strategy. It may reduce the capacity of states to reduce the environmental externalities by narrowing the range of participants while leaving some that contribute to the externalities uninvolved in cooperation. This can reduce the inclination of governments to undertake costly measures – not only because that would expose domestic industries to competitive disadvantages but also because it would have limited environmental benefits. Governments should not exclusively pursue narrow cooperation to ensure deep cooperation when many states contribute to the environmental problem.

8.6 Contributions to the Theory of International Organization

This dissertation makes a contribution to research on international organization by clarifying when governments make varying forms of international cooperation. In particular, the un-integrated development of international environmental cooperation raises a general puzzle. Why do governments make integrated institutions on some environmental issues but make un-integrated institutions on other environmental issues? Why wouldn’t they harness the potential efficiency gains of integrated cooperation across all environmental issues? This puzzle parallels debates on changes in the global trade regime (Mansfield and Reinhardt 2003), the nuclear non-
proliferation regime (Verdier 2008), and international law (Koskenniemi and Leino 2002). This dissertation engages this puzzle by focusing specifically on international environmental affairs.

Efficient international environmental cooperation requires favorable conditions. Efficient cooperation entails relying on rules and institutions as a platform for furthering cooperation. On issues such as climate change and biodiversity, stakeholders are too economically diffuse to enable governments to harness a single international regime to provide the right incentives for stakeholders to alter practices or technologies. Stakeholder diffuseness is a constraint on efficient international environmental governance. On issues with strong upstream-downstream properties, efficient cooperation is also unlikely. Asymmetric interdependence is a constraint on having an integrated set of rules and institutions to manage these issues. Market concentrations and relative exposure condition the prospects of integrated international environmental institutions.

This dissertation highlights another reason why stakeholders are important in international environmental cooperation, besides their lobbying efforts. Stakeholders can influence the form of environmental cooperation because of the markets in which they operate. Stakeholders operating in concentrated markets enable governments to form integrated regimes; stakeholders operating in diffuse markets force governments to settle for un-integrated regimes. Research has long argued that group concentration is critical to whether individuals are able to overcome barriers to collective action and secure the policies they prefer (Lowi 1964, Olson 1965). This is consistent with the pattern of global environmental governance: concentrated interests have been able to narrow the scope of regulation or weaken provisions in regulations more effectively than diffuse interests. However, stakeholder concentration can also promote integrated regimes after the initial terms of cooperation are established. Stakeholder concentration sets the conditions for new regulations by governments that seek to cost-
effectively mitigate an environmental problem. Diffuse stakeholders may not have the lobbying power of concentrated stakeholders but they also do not enable governments to make new regulations that cost-effectively mitigate an environmental problem. Stakeholder concentrations affect the form of environmental cooperation, not only the extent of regulation.
Summary of Interviews and Field Research

All interviewees are listed anonymously in this appendix and in the text to ensure non-attribution. In most cases, the institutional affiliation is included. The institutional affiliation is either the current or former affiliation of the interviewee. It is the affiliation most relevant to their experience working on international environmental policy. Some interviewees asked not to have their institutional affiliation listed. Accordingly, the text and the list below provide a generic moniker. Some interviewees asked not to be listed at all. I provide no generic moniker and denote these interviewees with a number. Each interviewee was assigned an arbitrary number.

Interviews Overseas and in the United States (Chapters Three through Five)

Interview 1, former UNFCCC Secretariat official, by phone, 14 September 2011

Interview 2, former State Department negotiator, in person, Washington, DC, 23 August 2011.


Interview 4, UNFCCC Secretariat, in person, Bonn, Germany, 11 August 2011.

Interview 5, State Department negotiator, by phone, 22 July 2011.

Interview 6, UNFCCC Secretariat, in person, Bonn, Germany, 12 August 2011.

Interview 7, former British diplomat, by phone, 24 August 2011.

Interview 8, European Commission official (DG Climate Action), in person, Brussels, Belgium, 7 November 2011.

Interview 9, former White House official, in person, Cambridge, MA, 11 July 2011.

Interview 10, former UNFCCC Secretariat official, by phone, 10 November 2011.
Interview 11, by phone, 2 August 2011.

Interview 12, former State Department negotiator, in person, Washington, DC, 21 July 2011.


Interview 14, NGO official, by phone, 24 August 2011.

Interview 15, UNFCCC staff member, in person, Bonn, Germany, 10 August 2011.

Interview 16, European Commission negotiator (DG Climate Action), in person, Brussels, Belgium, 8 November 2011.

Interview 17, State Department legal adviser, by phone, 29 August 2011.

Interview 18, former State Department official, by phone, 13 September 2011.

Interview 19, UNFCCC Secretariat official, in person, Bonn, Germany, 12 August 2011.

Interview 20, former White House official, in person, Washington DC, 19 January 2012.

Interview 21, NGO official, in person, Bali, Indonesia, 21 November 2011.

Interview 22, State Department official, in person, Bali, Indonesia, 23 November 2011.

Interview 23, European Commission official (DG Climate Action), in person, Brussels, Belgium, 4 November 2011.

Interview 24, UNFCCC Secretariat official, by phone, 1 August 2011.

Interview 25, former State Department official, in person, Princeton, NJ, 22 March 2011.

Interview 26, former State Department negotiator, by phone, 7 October 2011.

Interview 27, State Department official, in person, Washington DC, 20 July 2011.


Interview 29, NGO official, by phone, 19 September 2011.

Interview 30, former State Department legal adviser, by phone, 31 August 2011.

Interview 32, Danish Ministry of Climate and Energy negotiator, by phone, 10 November 2011.

Interview 33, European Commission official (DG Climate Action), by phone, 11 November 2011.

Interview 34, international organization senior official, by phone, 8 October 2011.

Interview 35, former Energy Department official, in person, Princeton, NJ, 10 February 2012.


Interview 37, Environment Canada negotiator, by phone, 14 February 2012.

Interview 38, fluorocarbon industry representative, in person, Bangkok, Thailand, 24 July 2012.


Interview 40, fluorocarbon industry representative, in person, Bangkok, Thailand, 24 July 2012.

Interview 41, fluorocarbon industry representative, in person, Bangkok, Thailand, 24 July 2012.

Interview 42, natural refrigerants industry representative, in person, Bangkok, Thailand, 23-5 July 2012.

Interview 43, fluorocarbon industry representative, in person, Bangkok, Thailand, 23 July 2012.

Interview 44, Global Environmental Facility official, by phone, 31 August 2012.

Interview 45, fertilizer expert, by phone, 15 March 2013.

Interview 46, Global Environmental Facility official, in person, Geneva, Switzerland, 13 January 2013.


Interview 50, World Alliance for Alliance-Free Dentistry, by phone, 6 February 2013.

Interview 51, Liaison, World Chlorine Council, by Skype, 8 February 2013.


Interview 53, State Department official, in person, Bonn, Germany.

Interview 54, Swiss negotiator, by Skype, 5 March 2013.

Interview 55, fertilizer industry expert, in person, Princeton, NJ.

**Interviews Overseas and in the United States (Chapters Six and Seven)**

Interview 1, former water technician in the Lake Victoria Basin, Doctors without Borders, by phone, 19 September 2012.


Interview 13, Water Management Outreach Consultant, by phone, 18 January 2013.

Interview 14, Senior Water Industry Official, by phone, 28 December 2012.


Interview 19, Secretariat Staff, HELCOM, in person, Helsinki, Finland, 24 April 2013.

Interview 20, Secretariat Staff, HELCOM, in person, Helsinki, Finland, 24 April 2013.
Interview 21, Senior Scientist, Finnish Environment Institute, in person, Helsinki, Finland, 25 April 2013.

Interview 22, Secretariat Staff, HELCOM, in person, Helsinki, Finland, 29 April 2013.

Interview 23, Senior Scientist, Finnish Environment Institute, by phone, Helsinki, Finland, 29 April 2013.

Interview 24, Baltic Sea expert, in person, Helsinki, Finland, 29 April 2013.

Interview 25, Secretariat Staff, HELCOM, in person, Helsinki, Finland, 29 April 2013.

Interview 26, Secretariat Staff, HELCOM, in person, Helsinki, Finland, 24 April 2013.

**Overseas Global Environmental Meetings Attended**

I attended four meetings where global environmental negotiations took place. In three of the meetings, I was a delegate from Princeton University. In one of the meetings, I was a delegate from the Princeton Environmental Institute.

Meeting 1, 5\textsuperscript{th} Session of the Intergovernmental Negotiating Committee to prepare a legally binding instrument on mercury, 13-18 January 2013, Geneva, Switzerland.

Meeting 2, 1\textsuperscript{st} Plenary Session of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services and Stakeholders Meeting, 20-26 January 2013, Bonn, Germany.

Meeting 3, 32\textsuperscript{nd} Open-Ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, Bangkok, Thailand, 21-25 July 2012.

Meeting 4, Joint 9\textsuperscript{th} Conference of the Parties to the Vienna Convention and 23\textsuperscript{rd} Meeting of the Parties to the Montreal Protocol, Bali, Indonesia, 21-25 November 2011.
Bibliography


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