Doctoral Thesis

Explaining the dynamics of international legal commitment in the area of air pollution

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Explaining the Dynamics of International Legal Commitment in the Area of Air Pollution

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Abstract
A better understanding of the dynamics of voluntary action that aims at solving global public
good problems are of high relevance to explain successful international environment
cooperation. This dissertation sheds light on the driving factors of international environmental
cooperation and improves current explanations of international commitment behaviour by
complementing collective action and two-level game explanations with insights from
diffusion studies.

So far, scholarly work has mainly focused on collective action problems and two-level game
approaches to explain states’ ratification behaviour and has neglected to take into account
contingent factors in a systematic way. I argue that it is important to take into account
temporal dynamics and diffusion mechanisms in order to better understand the drivers of
international cooperation. Learning processes, as well as mechanisms of emulation, coercion
and competition can influence a country’s ratification behaviour.

Empirically, I focus on the nine agreements of the regime on long-range transboundary air
pollution (LRTAP), one of the most important environmental regimes in Europe. In 1979, 33
countries joined the Convention on Long-Range Transboundary Air Pollution (C-LRTAP).
Today, the Convention comprises of 51 parties, and eight additional agreements related to
different air pollutants have so far been agreed upon. These agreements differ considerably in
scope and there is strong variation in ratification behaviour. The empirical research strategy
follows a mixed-methods agenda. In the first two chapters, I apply advanced statistical
methods (binary times series cross sectional and survival models), whereas primarily
qualitative methods are used in the third chapter.

Overall the results of this inquiry confirm that interdependencies matter. Thus, this research
project provides qualitative as well as quantitative evidence for the effects of diffusion
processes on ratification dynamics. The analysis clearly demonstrates that not only domestic
factors such as capacity and costs associated with cooperation but international factors, in
particular learning and emulation mechanisms, have an effect on the ratification behaviour of
states. Especially new knowledge and information related to health risks of air pollution are
effective as they provide incentives to reduce emissions for large emitters. In contrast,
competition and coercion mechanisms do not seem to have a similar impact on the ratification
behaviour of states.

Thus, this dissertation has shown that it is important to take into account temporal dynamics
and diffusion mechanisms in order to better understand ratification behaviour of countries.
Moreover it has improved the current literature in at least three ways: First, with regard to the international relations and ratification literature in general, it represents a unique attempt to explicitly join the three relevant theoretical approaches in a comprehensive manner. Second, compared to the current scholarly work on international environmental cooperation, it represents a significant methodological improvement given its use of advanced quantitative methods of inference as well as qualitative ones. Finally, with regard to the existing LRTAP literature, it sheds light on aspects that have not yet been analysed so far.

**Zusammenfassung**


Bisherige wissenschaftliche Arbeiten zum Ratifizierungsverhalten von Staaten haben sich vor allem auf nationale Faktoren konzentriert und systemische Interdependenzen unberücksichtigt gelassen. Ich argumentiere, dass zeitliche Dynamik und Diffusionsmechanismen für das Verständnis internationaler Zusammenarbeit im Umweltbereich (oder im Bereich der grenzüberschreitenden Luftverschmutzung) eine wichtige Rolle spielen. Lernprozesse sowie Emulations-, Zwang- und Wettbewerbsmechanismen beeinflussen das Ratifizierungsverhalten eines Landes massgeblich.


In den ersten beiden Kapiteln, wird diese Varianz hauptsächlich mit der Anwendung fortgeschrittener statistischer Methoden erklärt, während im dritten Kapitel der
Forschungsfrage vorwiegend mit qualitativen Methoden begegnet wird.


Diese Dissertation hat gezeigt, dass es wichtig ist Diffusionsmechanismen zu berücksichtigen, um die Dynamik internationaler Kooperation im Umweltbereich besser zu verstehen. Ausserdem wurde die aktuelle Literatur in mindestens dreierlei Hinsicht verbessert: Zum einen, im Hinblick auf die Literatur im Bereich der internationalen Beziehungen und der Kooperation im Allgemeinen, stellt dies einen einzigartigen Versuch dar, die oben erwähnten theoretischen Ansätze zu kombinieren. Zweitens, ist in Bezug auf die methodologische Herangehensweise die Kombination von fortgeschrittenen statistischen Methoden mit vergleichenden qualitativen Fallstudien innovativ. Schließlich beleuchtet diese Arbeit inhaltliche Aspekte, die bisher in der bestehenden Literatur über das LRTAP Regime vernachlässigt wurden.
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**Introduction**

Various dramatic environmental issues with which the world is confronted today like for instance global warming, overfishing of the seas, air pollution and toxic waste trade require international cooperation and coordination as they cannot be solved unilaterally. Over the last decades, we have observed a significant increase in international environmental agreements that deal with many of these global goods problems (Barrett, 2003). This growth in international treaties was facilitated after the Second World War by multilateral institutions like the UN and its numerous agencies. However, multilateral cooperation efforts have not always been crowned with success and their effects have often been limited. For instance, there is a strong variation in the ratification behaviour of states. Full participation is an exception and often, prominent “polluters” stay out, as they generally have few incentives to participate. This affects negatively the success of agreements, as broad participation, including both, polluters and victims, is a necessary condition to achieve an effective outcome.

In light of the challenges the world is facing today, it is therefore crucial to better understand what affects the willingness of countries to cooperate internationally. This dissertation project hence aims to shed light on the driving factors of international environmental cooperation, and more precisely, to better understand why some countries make a legal commitment earlier or later than others and some still refrain from joining.

A better understanding of the dynamics of voluntary action that aims at solving global public good problems are of high relevance for the understanding of successful international environment cooperation. So far, scholarly work mainly focused on collective action problems and two-level game approaches to explain states’ ratification behaviour (e.g. Barrett, 1998; Putnam, 1988; König and Hug 2000). They offer rather pessimistic expectations with respect to the success of effective successful cooperation. Generally, free-rider problems and domestic interests hamper optimal solutions.

While these theoretical approaches provide valuable insights into the general incentives and disincentives of countries to take voluntary measures that alleviate certain global problems, they cannot offer a satisfactory explanation of the observed prevalence of delayed ratification. Moreover, we know that successful international cooperation in difficult contexts is possible. A prominent example is the Montreal protocol on substances that deplete the ozone layer (Barrett, 2003).

A shortcoming of these approaches is that they rely on static models. In fact, until now, most
scholarly work neglected to take into account contingent factors in a systematic way that could better account for the dynamics of ratification processes. This project therefore, by complementing collective action and two-level game explanations with insights from diffusion studies, improves current explanations of international commitment behaviour.

I argue that diffusion processes can also be drivers of international cooperation and that learning processes, as well as mechanisms of emulation, coercion and competition can influence a country’s ratification behaviour. Availability of new information from other countries about environmental risks, the ratification behaviour of other countries and external pressure can change the incentives to participate even many years after the treaty was opened for ratification and thus positively influence the likelihood of cooperation.

Empirically, I focus on the area of air pollution. Dramatic changes in air quality have taken place in Europe over the past decades. Due to the increasingly visible damages caused by acid rain, air pollution became a salient international environmental issue in the seventies. In 1979, governments of 33 countries joined the Convention on Long-Range Transboundary Air Pollution (C-LRTAP) with the explicit aim to limit and gradually reduce air pollution (article 3) with the best available technology that is economically feasible. Although air pollution was recognized as a serious threat to the environment and public health when the LRTAP convention was signed, concrete emission reduction goals were considered unrealistic. However, by 2010, 51 countries have ratified the convention and more than 20 countries ratified eight of the follow-up agreements from the LRTAP regime, each of which includes deeper commitments regarding abatement goals and the implementation of cleaner technologies. Interestingly, some countries made a legal commitment later than others and some still refrain from signing long-range transboundary air pollution treaties.

To explain this variation in the ratification behavior, I chose a mixed methodological approach and use quantitative as well as qualitative methods in the different parts of my dissertation. In the first two papers, I mainly apply advanced statistical methods (binary times series cross sectional and survival models), whereas primarily qualitative methods are used in the third paper.

The first paper, co-authored with Thomas Bernauer, analyses the ratification behaviour with the conceptual framework of diffusion analysis. The results clearly demonstrate that not only domestic factors like capacity and costs and benefits of cooperation but international factors like the ratification behaviour of specific other countries also affect cooperation behaviour. The second paper looks more specifically at the effect that learning through involvement in
the regime has on cooperation behaviour and account for information exposure in the regime institutions. Finally, the last paper seeks to validate previous findings with comparative cases studies of the ratification debates of the four most recent LRTAP protocol in three countries whose interests to ratify are to some extent ambiguous, namely Austria, Switzerland and Estonia.

This dissertation project improves the current literature in at least three ways: Firstly, with regard to the international relations and ratification literature in general, it represents a unique attempt to explicitly join the three relevant theoretical approaches in a comprehensive manner. Secondly, Compared to the current scholarly work on international environmental cooperation, it represents a significant methodological improvement given its use of advanced quantitative methods of inference as well as qualitative ones. Finally, with regard to the existing LRTAP literature, it sheds light on aspects that have not yet been analysed so far. Most of the existing literature focuses on the first SO2 protocol (Levy, 1993; Murdoch et al. 1997; Ringquist and Kostadinova, 2005). The few quantitative studies done by econometricians exclusively argue from a collective action perspective (Murdoch et al. 1997; Ringquist and Kostadinova, 2005) and there are few studies that look at the follow up treaties. Regarding qualitative research, existing case study work so far almost exclusively analysed Western European countries. Traditional laggard countries and Eastern European countries have been neglected (exceptions are Hanf and Underdal, 2000 as well as VanDeever, 2005).

**Theoretical approaches to explain ratification**

In the ratification literature, the prevalent interest based (Olsen, 1965; Sandler, 1997; Barett, 2003) and domestic explanations (Putnam, 1988) offer rather pessimistic expectations with regard to the possibilities to effectively solve international environmental problems. On the one hand, environmental problems that endanger a global public good like air quality need international cooperation to achieve an effective solution. But on the other hand, exactly the characteristics of such a public good make voluntary efforts to alleviate the problem extremely difficult.

Air quality is a typical “common pool resource”, characterized by non-excludability and rivalry in consumption. It typically has negative externalities. This means that producers of a public bad, reducing the quality of the collective good, can impose costs on third parties, which are less involved in the action producing the externality. For instance, countries bear

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1 This point differentiates the common pool resource from a pure public good, which is defined not only by non-excludability but also by non-rivalry in consumption.
the costs of transboundary pollution caused by upwind countries, which do not pay for the public bad they produce (Sandler, 1997). These externalities can be quite large and thus make cooperation necessary, but also difficult.

Countries are often reluctant to implement costly policies unless other concerned states credibly commit to act similarly (Sandler, 1997, Barrett, 2003, Schaffer and Bernauer, 2011). Indeed, free-riders that do not participate to the reduction efforts could benefit without any cost, or even worse, they could cancel out the unilateral efforts of a few willing countries with an increase in their emissions. That is why collective action problems lead to the underprovision of public goods (e.g. Olson, 1965): Individuals have an incentive to freeride on the efforts of others when having to decide whether to participate in collective action that aims at public good provision (Ward, 1996).

Large externalities often necessitate public intervention, e.g. contractual agreements, to solve the public good problem. That is one of the reasons why IEA use mechanisms of reciprocity to avoid free riding. The requirement of ratification by a certain number of countries before an agreement enters into force is typical (Schaffer and Bernauer, 2011) and intends to partly deter free riding. It creates incentives to join as non-participation only delays the entry into force while the global benefits only emanate after the entry into force. But often treaties do not offer enough strong incentive to convince the biggest polluter to join. For instance, the Kyoto Protocol to the UNFCCC required the ratification of 55 countries that represent 55% of global emissions before its entry into force yet a major emitter - the USA - has not yet ratified it. In fact, on the international level, an independent polluter-country cannot be forced to internalize the external costs arising from its emissions and will generally be reluctant to do so as long as the gains from internalizing these costs are smaller than the utility from doing nothing.

There are also domestic hurdles to cooperation. Once a treaty is negotiated, it needs to be ratified, generally by domestic parliament, in order to be incorporated in the domestic law. International politics can be seen as a two-level game according to Putnam (1988). Governments negotiate on the international level (first level) knowing that the result has later to be approved by their domestic constituents (second level). Thus, it is not only the preferences of governments, but also those of the key domestic actors that matter. This two-level nature of international politics reduces the domestic set of possible agreements that all relevant actors are willing to accept.

Therefore the composition of parliament plays a central role in the ratification decision.
Beside political parties represented in the parliament, other relevant players include governmental agencies and interest groups, which can exert pressure on their government.

However, notwithstanding the pessimistic expectations derived from predominant collective action and two-level game theoretical approaches, the history of environmental cooperation also includes surprisingly positive outcomes like for instance the Montreal protocol on substances that deplete the ozone layer (Barrett, 2003). Moreover, it is notable that not only victims of environmental degradation join international agreements.

International pressure may sometimes tip the domestic balance and in turn influence international negotiations. International organizations like the LRTAP regime can empower some domestic constituents, e.g. with new knowledge, which modifies the domestic interest structure, and may lead to an adaptation of the government policy preferences. But those processes remain underdeveloped within the two-level game and collective action literature. They become better understandable within a diffusion approach, which explicitly models interdependencies between the international and the domestic level by offering specific mechanisms through which such interdependencies affect countries’ policy choices (e.g. Brown et al., 2007; Volden et al., 2008).

Even though the role of interdependencies is widely accepted in the international relations literature, for instance social learning is theoretically considered as an important potential factor to explain international commitment (e.g. Underdal, 1998; Wettestad, 2002; Breitmeier et al., 2006), interdependencies between the international and the domestic level have not yet been systematically analysed in a quantitative setting with regard to cooperation behaviour. Moreover the concept of diffusion has received only modest attention in the international ratification and regime literature (Underdal, 1998). Very few studies on the ratification of international agreements have tried to catch interdependence empirically (Goodliffe and Hawkins, 2006; Vreeland, 2008; Bearce and Bondanella, 2007), but the chosen indicators remain very rough. Indeed, membership in international governmental organisations (IGO) does not tell us whether or not a country’s government actually sent representatives to meetings, and even if they did, it is unknown whether or not any information transfers really took place.

At the same time, diffusion theories comprise several approaches which can explain under what conditions countries voluntarily adopt policy practices from others, thereby leading to a spread of a specific behaviour. The different ways in which interactions between countries can impact on domestic policymaking is conceptualized by different diffusion mechanisms.
I argue in my thesis that mechanisms of learning, emulation, coercion and competition are relevant to explain the dynamics of international cooperation.

A learning mechanism is at work for instance when a government takes into account new scientific results about an environmental problem that is available from abroad in its evaluation of adequate policies to deal with this issue. This new knowledge can induce a change in the beliefs of policymakers and eventually have an impact on its willingness to make a legal commitment in this policy field. In particular in cases where international cooperation is a necessary condition to alleviate the problem, it can include the ratification of an international treaty.

A mechanism of emulation is present if a country copies a practice from abroad not primarily to solve a given problem, but in order to gain credibility or legitimacy on the international level. By that governments try to signal “their alignment to socially valued policy-making models” (Brown et al. 2007: 8). When peers, e.g. neighbour countries, ratify a treaty, the international and domestic reputational rewards, as well as the costs of non-ratification related to the treaty, change and a country’s incentive to ratify at least for strategic reasons grows. This may eventually influence the ratification decision.

Even though international regimes have no coercive power, some countries with intrinsic interests in favour of the agreement and simultaneously some leverage (e.g. economic power) can put pressure on reluctant countries. Hence decision-makers may re-evaluate their position after having taken note of the demand and eventually ratify.

Finally, economic competition may also incite countries to adopt new standards or imitate others in order to ensure their competitive ability on the world market. In the context of environmental agreements, once competitors ratified, the cost of one’s ratification diminishes, which may tip the balance in favour of ratification. This would be especially relevant when a treaty is connected with higher standards.

**Overview of the project**

The first paper, written jointly with Thomas Bernauer, analyses the determinants of ratification through the lense of diffusion theory. It implements a quantitative research design

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2 Volden et al. (2008) point out that adequately distinguishing between learning from abroad and internal learning might be difficult. For example, diffusion patterns can also arise through a process of similar independent responses to a common problem.

3 For example, according to Lewanski (2000: 273), Italy ratified the Sofia Protocol (NOx) and the VOC Protocol despite the high costs related to those agreements neither for ecological reasons nor due to economic pressure, but primarily in order not to ‘lose face’.
using a new dataset and binary time series cross sectional models. We argue that a country’s cooperation behavior is influenced by ratification choices of other countries in general, or of specific types of other countries like neighbours or competitors. To test our claims, we use a new time series cross sectional dataset that comprises information about all nine LRTAP agreements and all 48 countries that ratified the 1979 LRTAP Convention.

The results show that interdependent effects in the ratification phase can play a critical role in international regime formation. Drivers of cooperation are clearly not only domestic factors like capacity and costs and benefits of cooperation benefit. Dynamic processes on the international level such as the share of other countries that have ratified previously also increase significantly the likelihood of ratification.

Unfortunately, the empirical approach of the first paper, chapter 1 of this thesis, does not allow to clearly distinguish between the different diffusion mechanisms, which are all subsumed under “international factors.” That is why the second paper, chapter 2, looks more specifically at learning mechanisms and at the role of the regime. First, I introduce regimes as knowledge providers and describe the role of learning mechanisms for international cooperation. Second, real exposure to information is accounted for.

I assess the effect that learning through involvement in the regime has on cooperation behaviour with a dataset that includes comprehensive data on participation in the regime’s institutions. Furthermore, I test for interaction effects, respectively if and how interests and domestic politics affect the effect of learning mechanisms on cooperation. The models are estimated with survival analysis. I use semi-parametric Cox-duration models that allow me to investigate the effects of covariates on the time span until ratification (survival time) once a treaty is opened for ratification. The data are completed with expert interviews of country representatives.

The results reveal that an intensive exposure to usable knowledge in the institutional bodies of a regime has a positive impact on the international environmental commitment behaviour of countries with respect to transboundary air pollution. The effect of participation on ratification behaviour remains unchanged when other factors are included in the model like the costs/benefits ratio of cooperation or domestic capacities. Findings of earlier research concerning the effects of relevant factors for ratification like capacities, interests, domestic politics, were also confirmed. However, the expected effects of participation conditional on interests and domestic politics could not be confirmed. It was expected that participation would have a bigger impact on the ratification behaviour of countries with unclear interests and “greener”
backgrounds. However, the government’s environmental emphasis does not amplify the effect of participation on its ratification behaviour and the analysis revealed a decreasing effect of participation conditional on interests even though the effect of participation is almost always positive.

Finally, the last paper, chapter 3, aims to validate previous findings with comparative cases studies of the ratification debates of the four most recent LRTAP protocols in three small or medium-sized countries whose interests to ratify are to some extent ambiguous: Austria, Switzerland and Estonia. The protocols analysed are the 1994 Protocol on Further Reduction of Sulphur Emissions negotiated in Oslo, the 1998 Protocols on Heavy Metals and on Persistent Organic Pollutants (POPs) negotiated in Aarhus, and finally the 1999 Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone, negotiated in Gothenburg. The diffusion hypotheses are assessed with a text analysis of the arguments used in the official documents regarding the ratification act of the government and during the parliamentary debates, when a debate took place. The main sources are government white papers and the minutes of legislative debates. These sources are completed with various secondary sources as well as expert interviews with country representatives and LRTAP officials. The analysis shows that even though the costs associated with cooperation dominate the debates, there is some evidence for learning and emulation effects that have tipped the balance or accelerated the ratification process.

**Conclusion**

**Main Results and academic contribution**

Overall the results of this inquiry confirm that interdependencies matter and provide qualitative as well as quantitative evidence for the effect of diffusion processes on ratification dynamics. Thus it is important to take into account temporal dynamics and diffusion mechanisms in order to better understand ratification behaviour of countries.

First and foremost, learning mechanisms play a role and foster cooperation. Chapter 2 as well as the case studies have demonstrated that new information transmitted from the regime or scientific results regarding environmental consequences from other countries are important drivers of cooperation. Especially new knowledge and information related to health risks of air pollution are effective as they provide incentives to reduce emissions for big emitters, too, which is good news for cooperation.

That said, the results also indicate that leaning effects cannot overcome all disincentives for cooperation. The biggest polluters are generally also less prone to be influenced by learning,
even though they are well involved in the regime institutions. The analysis revealed a decreasing effect of participation conditional on interests. However, the effect of participation is almost always positive.

An additional notable contribution of this thesis is that it provides evidence for the effect of emulation processes. The ratification behaviour of countries can be influenced by the ratification patterns of other states. The case studies corroborate previous quantitative results.

For instance, there are clear indications that emulation processes have accelerated the cooperation dynamics with regard to the POP protocol. The declared intention of other countries to join as well as parallel cooperative efforts on the international level were determinant arguments to join and increase the ratification pace. In contrast, competition and coercion mechanisms do not seem to have a similar impact on the ratification behaviour of states.

Two kinds of economic arguments were present in the ratification debates: The first argument concerns countries' self-interest to invest in modernization and the expected long-term benefits of these investments for the economy. Expected return of investments was the main justification to bear costly expenditure to meet the obligations that derive from an international environmental agreement.

Second, the wish for harmonization and a fair international level playing field was also a recurrent economic argument in favour of ratification. But the motivation here is rather driven by expected reciprocity than by competition. Countries join treaties to incite other to do the same and to comply.

Finally, coercion is not a mechanism that really influences ratification behaviour. EU harmonization is sometimes mentioned with regard to the LCP directive (2001/80/EC) and EU regulations on POPs that overlap some of the LRTAP obligations, but the coercive power of the EU is not sufficient at all to incite a reluctant country to ratify a treaty. Moreover, the EU has even problems with enforcing its own mandatory directives like the NEC directive (2001/81/EC). This confirms the expectation that mandatory emission reduction policies are not necessarily more successful than voluntary action as Aakre and Hovi (2010) have shown. Coercion is therefore not a promising way to foster and deepen environmental cooperation.

The results of this thesis have shown that diffusion processes, in particular learning and emulation mechanisms have an effect on the ratification behaviour of states. However, they also highlight that economic arguments generally prevail with regard to the ratification decision. If diffusion processes may tip the balance in favour of an international commitment
or accelerate a ratification process, they cannot overcome substantial costs alone. Diffusion mechanisms are not sufficient to bring a country to ratify.

Costs and benefits are the central arguments in ratification debates, but diffusion process can affect and change a country's cost-benefit calculation, for example with new information about the consequences of an environmental problem or health risks.

Moreover, the capacity of the public sector is an important factor of environmental cooperation. Ratification is closely connected with the feasibility of implementation. Countries are reluctant to commit as long as they lack the necessary resources available for implementing a treaty.

Furthermore, regarding domestic politics, the analysis illustrate that green parties have a positive impact on the pace of environmental cooperation, whereas electoral successes of nationalist movements can hinder it. Surprisingly, institutional constraints like veto points do not slow down ratification procedure with regards to LRTAP agreements.

**Policy implications**

Several policy recommendations for future environmental agreements can be drawn from this research. Firstly, an early integration of potential members into regime institutions is worth to achieve in order to encourage voluntary commitments. Regime linkages can act as valuable facilitators for knowledge transfer, and better-informed countries are more likely to deepen international environmental cooperation. In the beginning, a broad participation might not be much more effective than the status quo, but it lays the necessary basis for further improvements. For instance, decision-makers will not take measures on emission reductions before they a) have learnt about the problem b) have started to monitor and c) realized that they actually have a problem, e.g. emission values that endanger the population's health. This process can take time. After the signature of the framework LRTAP convention, it took eight years until a protocol with concrete emission reductions goals entered into force (SO₂ Helsinki protocol). But the previous agreement, the exchange of information and the research cooperation were the necessary conditions that rendered further steps possible. Interests are not carved in stone and can be re-evaluated after obtaining new and relevant information.

Secondly, as the feasibility of compliance is an important factor of participation and may retain less developed countries to commit to potentially costly obligations, capacity building is an essential issue for broadening cooperation. The LRTAP regime already provides a few very interesting examples to achieve this goal. Recent protocols include some flexibility mechanisms that take into account the economic costs of implementation and make
cooperation easier for less developed countries.

Moreover, the Executive Body of the LRTAP regime decided in 2007 to implement an action plan to improve accession by countries of Eastern Europe, Caucasus and Central Asia (EECCA) and strengthen the involvement of the EECCA countries in the activities of the regime (http://www.unece.org/env/lrtap, November 2009). The regime also facilitates bilateral cooperative projects among its members. Parties with strong interest in deeper cooperation can offer technological and legal assistance that aim at enhancing the capacity of less developed countries to cooperate more effectively if they need it (interview with Ms. Marketa Reneova-Mohn, 15.12.2009). For instance, the Netherlands have development policies whose purpose is to enable Balkan countries to join the most recent LRTAP protocols (POP, Heavy Metals and Gothenbourg) and the Czech Republic offers advisory services to Moldova (http://www.unece.org/env/lrtap/programme-EECCA.html, April 2011).

To sum up, voluntary commitment and resources are necessary to engage in substantial cooperation and eventually implement effective policies that alleviate a global good problem. The promising projects mentioned above linking technology transfer and financial support point into the right direction. They have the potential to deepen and broaden significantly the cooperation in transboundary air pollution. This is particularly relevant with regard to the agenda of the LRTAP regime; after the recent inclusion of further organic pollutants in the POPs protocol in 2009, revisions of the Heavy Metals and the Gothenburg protocol are ongoing. New emission ceilings have to be defined for 2020 and they are proposals aiming to regulate more substances, especially particles and black carbon, as well as to increase environmental standards.

**Outlook**

Future research that build on the effects of domestic factor on cooperation is needed. Scholarly work has produced inconclusive results on the role of domestic institutions and domestic actors in the ratification behaviour of countries so far. Moreover it would be interesting to look more deeply into potential tipping points and possibilities to overcome strong disincentives with regard to environmental cooperation. Research along those lines that might take up my findings could shed further light on these crucial issues.

Promising avenues for further research also exist with regard to the negotiation dynamics of new environmental agreements or amendments of earlier treaties. The architecture of the EU has dramatically changed with the entry into force of the treaty of Lisbon in 2009. Since then, the EU speaks with one voice in the LRTAP institutions and represents one position,
coordinated prior to the debates, instead of twenty-five.

This has an impact on the negotiations because the EU needs to find compromise between members with very different interests and initial positions. Insiders complain about a loss of transparency that makes it difficult to work efficiently and find effective solutions, as the positions of actors are less clear (Interviews with LRTAP representatives and officials). Instead of fostering the process of deeper cooperation, the EU now tends more frequently to block proposals that go beyond its own legal directives, similar to the United States.

The consequences of these new developments are especially relevant with regard to the depth versus participation dilemma (Spilker et al. 2010; Barrett 2003). Theoretically, an effective treaty with full participation is optimal. But examples of broad participation are often related to shallow treaties, while deeper cooperation often happens at the cost of lower participation. Future research has to shed light on these issues. The future developments of the LRTAP treaty will offer even richer empirical material for this purpose.
Chapter 1: International regime formation revisited. Explaining ratification behavior with respect to long range transboundary air pollution agreements in Europe

Sophie Perrin and Thomas Bernauer

Introduction

International treaties are crucial building blocks in most efforts to solve security, environmental, economic or social problems that extend beyond national boundaries. While the study of bargaining processes that lead to formal international agreements is obviously important, events that unfold after negotiations have been concluded are crucial for international regime formation as well. To become effective in legal terms, international treaties usually require not only signing, but also ratification. While ratification per se does not imply that a treaty will be effective in changing behavior in ways that solve the problem in question, it is usually a necessary condition for problem solving.

Existing research on international regime formation concentrates heavily on bargaining processes and their outcomes (e.g. Young, 1994; Miles et al., 2002; Mitchell, 2009). With very few exceptions (e.g. Neumayer, 2002a, b; Roberts et al., 2004, von Stein, 2008, Bernauer et al., 2010) variation in ratification behavior across treaties and countries has not been studied in detail.

Ratification behavior of countries is important from a policy-making viewpoint, but it also raises interesting analytical questions. Following the two-level game logic one may be tempted to assume that negotiators are faithful and fully informed agents of their respective government, and that governments have full information on what kinds of international bargains will be acceptable to parliament, the median voter, pivotal interest groups, or domestic veto-players more generally. If these assumptions held true, we should observe that most treaties in whose negotiation a given country participated are ratified without much delay by that country (see also Hovi, Sprinz, Bang, 2008).

In reality, there is strong variation in ratification behavior in virtually all areas of international policy-making. That is, some countries ratify a given treaty earlier than others, some countries do not ratify at all, and there is significant variation in ratification rates between treaties.
Besides idiosyncratic factors (e.g. an unforeseen change of government) and principal-agent and informational problems that are hard to model empirically (see Mitchell 2009:145), we submit that there are two main types of drivers of variation in ratification behavior: domestic and international.

We conceptualize domestic factors in terms of country characteristics, such as features of political institutions or socio-economic conditions. International factors are, in our conceptualization linkages of any given country with the international system as a whole and with other specific units (countries). More specifically, we are particularly interested in the extent to which the ratification behavior of (particular) other countries affects that of a country.

Explaining ratification behavior along these lines is reminiscent of what Galton postulated in the late 19th century in his criticism of Tylor’s work on institutions of marriage (Jahn, 2008). Transposed into the realm of international treaty ratification, Galton’s idea is the following: if we observe that two countries exhibit similar or identical ratification behavior with respect to a given international treaty, this could be due to a common external stimulus, similar domestic characteristics, or interdependent behavior of the two countries.

In our analysis we connect the literature on international cooperation with that of policy diffusion, which has been strongly inspired by Galton’s idea. Comparative politics scholars have, in the context of policy diffusion research, argued that it is, in many cases, not appropriate to treat units of analysis (e.g., countries, provinces/states, cities) as independent (e.g. Shiplan and Volden, 2008). Similarly, most international relations scholars subscribe to the view that international politics is characterized by interdependent behavior. In both realms, therefore, the behavior of one unit of analysis is influenced not only by domestic characteristics, but also by factors that affect the unit from the outside, including the behavior of other units. However, large-N empirical research in international relations has, surprisingly, paid rather little attention to interdependent behavior and has only recently started to build on insights from policy diffusion research to that end (see Vreeland, 2008, Bernauer et al., 2010).

How can ratification behavior be studied with the conceptual framework of policy diffusion analysis? The typical analytical setup in policy diffusion research is to pick a policy area (e.g. anti-smoking or social policy) and to account for policy variation across units on the basis of variables that capture unit characteristics and variables that measure the behavior of (particular) other units in the policy area of interest. The latter variables – mostly labeled as policy diffusion variables – are usually measured in terms of how all other units combined
behave. In addition, studies on policy diffusion mechanisms (e.g., learning, competition, emulation, coercion; see e.g. Gilardi, 2010) conceptualize those mechanisms in terms of how specific other units behave.

The circumstances of treaty ratification differ from the typical circumstances analyzed so far in policy diffusion research. In cases such as anti-smoking or social policies, political units respond to a given social problem in various ways, driven by domestic and international conditions. The main analytical difference between international treaty ratification and, say, anti-smoking policies of US cities is that the units do not, in most cases, explicitly and formally coordinate policies prior to deciding whether to formally enact the respective domestic policies and implement them. In the international treaty ratification case, countries negotiate legal provisions. Once all or a subset of government delegates agree, normally in close consultation with their respective government, on these rules the treaty is opened for signature and ratification.

Compared to policy diffusion processes without previous formal coordination efforts, that is, situations without prior collective bargaining and agreement on specific legal provisions, coordinated policy-making is associated with a narrower range of choices for countries (in many cases, ratification or non-ratification) and also lower ambition levels if international bargaining produces lowest-common denominator provisions. We submit that this difference between uncoordinated and coordinated policy does not rule out a policy diffusion perspective on treaty ratification. From a methodological viewpoint, the double role of countries as negotiators of agreements and as ratifiers creates the potential for selection (screening) bias. However, as long as we can control for factors that may affect both bargaining and ratification outcomes, our focus on the ratification phase alone does not produce biased results. We return to this issue in the results section.

In this article we develop and empirically test a set of hypotheses pertaining to international determinants of treaty ratification. Our focus is on examining the extent to which, ceteris paribus, ratification behavior by all other countries, by neighbor countries, by powerful countries, and by economic competitor countries influences ratification behavior of a given country. Empirically, we concentrate on the UN Economic Commission for Europe’s international agreements for reducing long-range transboundary air pollution (LRTAP agreements). The LRTAP agreements are widely heralded as important achievements in efforts to reduce air pollution in Europe (e.g. Levy, 1993; Murdoch et al., 1997). Moreover, there is strong variation in ratification behavior, both over time and across countries and
treaties, making these agreements an interesting testing ground for our hypotheses. Using a new dataset and binary times series cross sectional models we find that, overall, international factors are as important as domestic factors in influencing ratification behavior. The main implication of this finding is that interdependency effects in the ratification phase can play a crucial role in international regime formation and require greater attention by analysts of international politics. Our results also raise interesting questions about the relative importance of international and domestic determinants at different stages of international regime formation.

**Theory**

Only few large-N studies have examined the determinants of ratification behavior, that is factors that motivate countries to enter into legally binding commitments at the international level (e.g. Neumayer, 2002a, b; Roberts et al., 2004; von Stein, 2008; Bernauer et al., 2010). Most of the explanatory factors refer to the country level. They include for instance political institutions and socio-economic conditions.

According to Neumayer (2002b), Fredrikson and Gaston (2000), and other authors democracies are more likely to ratify international environmental agreements. Neumayer (2002a) also finds some empirical support for the hypothesis that trade openness promotes international environmental cooperation. Roberts et al. (2004) have undertaken a cross-sectional study of the determinants of ratification rates of 22 international environmental treaties by 177 countries in 1946-1999. They observe that variation in environmental treaty ratifications is explained mainly by “disadvantaged insertion into the world economy (2004:43)” (they define this concept as a narrow export base), voice and accountability through domestic institutions, and civil society pressure (number of NGOs in the country).

With some exceptions, for example von Stein (2008) and Bernauer et al. (2010), most existing studies do not address potentially important temporal dynamics (they are cross-sectional) and do not examine in detail the influence of factors external to the country under examination in the sense of internationally interdependent ratification behavior. Recent work on international cooperation, policy diffusion and networks (e.g. Ward, 2006; Jahn, 2008) suggests, however, that cooperative behavior is likely to be influenced by international interdependency (policy diffusion) effects. For instance, in a recent study of ratification behavior vis-à-vis global environmental treaties, Bernauer et al. (2010) find that international factors play an important role in ratification decisions.
At the most general level, our explanation of ratification behavior concentrates on opportunities or constraints as well as willingness. While the existing literature focuses largely on problem structures, costs and benefits of cooperation, domestic institutional constraints or opportunities, income levels, or trade openness, country-external factors have been dealt with much less systematically. We contribute to filling this gap by focusing on one particular, but important category of international factors, namely how ratification choices by other countries, or specific other countries, affect ratification choices of a given country. In essence, we claim that countries, when deciding on whether or not to ratify a treaty, and when, pay attention to what other countries do. This implies that ratification choices by one country send various types of “signals” to other countries. Those signals may affect, both in material and normative terms, the utility calculus of other countries when they decide on the same issue.

As noted by Simmons et al. (2006:789) ‘(...) domestic political and economic factors cannot alone predict when governments adopt new policies (...).’ We submit that the influence of international factors on ratification behavior can be examined from a policy diffusion perspective. This approach explicitly models interdependencies between the international and the domestic level and illuminates mechanisms through which international interdependencies may affect national policy choices. It also takes into account time-dynamics. We conceptualize policy diffusion similarly to Simmons et al.: ‘International policy diffusion occurs when government policy decisions in a given country are systematically conditioned by prior policy choices made in other countries (sometimes mediated by the behavior of international organizations or even private actors or organizations)’ (2006: 787; see also Braun and Gilardi, 2006).

Some of the policy diffusion literature seeks to distinguish between particular types of diffusion mechanisms, for instance the emergence and institutionalization of new norms (Finnemore and Sikkink, 1998), transnational expert networks (Haas, 1992), and competitive adaptation (Simmon and Elkins, 2004). However, while this literature agrees that the behavior of other political actors matters, there is much less agreement on how other actors influence any given actor’s behavior; that is, what types of diffusion mechanisms are at work under what circumstances. Moreover, there are obvious problems in translating quite nuanced conceptual differences between the various diffusion mechanisms into distinct hypotheses and empirically measurable variables – for instance, in our view existing work does not clearly distinguish, empirically, learning from competition or emulation. In developing our hypotheses we rely largely on assumptions about diffusion mechanisms that Gilardi (2010),
Simmons et al., (2006), and other authors have used. These mechanisms include in particular coercion, competition, learning and emulation.

Diffusion through *coercion* occurs when ‘Powerful countries can explicitly or implicitly influence the probability that weaker nations adopt the policy they prefer by manipulating the opportunities and constraints encountered by target countries, either directly or through the international and non-governmental organizations they influence’ (Simmons et al., 2006:11). Diffusion through *competition* takes place when governments consider the economic effects of adopting a particular policy and act strategically in order to become or remain competitive in international markets. If the adoption of a new policy is harmful to the policy-maker’s own economy, he will not adopt this policy. If adoption is likely to positively affect the competitive position of his country, he is likely to adopt the respective policy (e.g. Shipan and Volden, 2008:6-7). Policy diffusion can also be driven by a *learning* process. Simmons et al., (2006:19) define learning as ‘(...) a change in beliefs or change in one’s confidence in existing beliefs [e.g. about an alternative policy], which can result from exposure to new evidence, theories or behavioral repertoires.’ The adoption of similar practices or policies does not necessarily have to involve a previous change in the beliefs of policy-makers. Sometimes, a political unit can also copy a practice from another unit to gain credibility or legitimacy (e.g. Braun and Gilardi, 2006). In this case, the new policy is adopted primarily as an instrument of legitimization and not necessarily to solve a specific problem. This policy diffusion mechanism is often labeled *emulation*; we use this label synonymously with imitation and symbolic imitation. As noted in most studies on policy diffusion, the aforementioned concepts emphasize particular types of effects, but are not mutually exclusive, particularly at the empirical level.

In this article we are not interested in comparing in detail the effects of particular types of policy diffusion mechanisms. We are interested primarily in assessing the extent to which international factors as a whole matter in comparison with domestic factors. If it turns out that international factors play an important role, it will be interesting to follow up with more research that illuminates the importance of particular types of policy diffusion mechanisms in treaty ratification processes (we return to this point in the conclusion). In view of our particular research focus we need to ascertain that our explanatory model includes international variables that capture a broad set of potential diffusion mechanisms. We can thus afford to use empirical proxies that capture various diffusion mechanisms in partly overlapping ways. However, our diffusion variables are in fact very similar to those used in other policy diffusion research, though we refrain from arguing that each of these variables
captures exclusively one particular type of diffusion mechanism.

The remainder of this section develops four hypotheses that, collectively, serve to capture a broad range of policy diffusion effects. These include in particular learning, emulation, competition, and coercion. Our hypotheses are specified with respect to the empirical phenomenon that serves as the empirical testing ground – agreements on long-range transboundary air pollution in Europe.

To start with, how plausible is it that international factors matter in explaining choices of countries on whether or not to formally join international agreements to reduce transboundary air pollution? We postulate that such international effects should be important, though we cannot identify a solid reason to argue that, in relative terms, they should be more, or less, or equally important than domestic factors. If we assume that principal-agent problems in negotiating international agreements exist and ratification, which brings countries closer to implementation, is costly, we should expect that domestic ratification processes in any given political unit are not taking place in isolation. Rather, the behavior by any given country is likely to be influenced by the ratification decisions of other countries. Hitherto national environmental policies are coordinated or even harmonized through international bargaining and regime formation. In most cases, including the international LRTAP regime, such efforts aim at reducing externalities that can cross international borders, establishing an economic level playing field by distributing burdens in a way that does not increase production cost differentials across countries, or at facilitating the spread of best available practices and technologies. We submit that these are rather strong reasons for claiming that ratification processes should be characterized by interdependent behavior.

The four hypotheses outlined below rest on the assumption that policy diffusion mechanisms can be captured in terms of what other countries do, and in our specific case in very simple terms of whether other countries ratify a LRTAP agreement. Depending on what type of other country ratifies, the behavior of others can send different types of information to the country that decides on whether to ratify. We are particularly interested in what all other countries, neighbor countries, big countries, and economic competitor countries do. The effects of signals that emanate from ratification choices by those reference groups or peer groups can, by-and-large, be conceptualized as learning, emulation, coercion and competition effects.

All other countries

International regimes, such as the one constituted by the LRTAP agreements, are arenas in
which new knowledge and ideas can develop and spread among the participating countries. New information revealed during negotiations and also during the ratification phase can motivate domestic actors to re-evaluate their policy positions, thereby facilitating or slowing down the regime formation process. As noted by Underdal (2000:377), domestic decision-makers can be regarded as information-seekers and persuaders. Learning and policy-diffusion are thus likely to play an important role in the development of international regimes.

We argue that the number of other countries that ratify a treaty conveys two important types of information. The first type concerns implementation costs and technical feasibility (a), the second concerns reputational implications of ratification choices (b).

(a) Environmental policy-making and policies to reduce long-range transboundary air pollution in particular are characterized by considerable uncertainty about mitigation costs and environmental benefits from pollution reduction. Incomplete information usually continues to exist beyond the point where international bargaining is concluded and an agreement becomes open for ratification or accession. By implication we should not assume that mitigation cost and benefit differences across countries are fully internalized in the design of a treaty – in the sense that countries with higher marginal abatement costs (in absolute terms or relative to national economic capacity) receive “softer” obligations. If such cost and benefit differences (as well as other factors that determine state preferences) were fully internalized in the treaty design we should not expect much variation in ratification behavior. We submit that uncertainty about implementation costs and benefits and about technical feasibility diminishes with the number of ratifications by other countries. The more other countries have ratified, the more the decision-calculus of the not-yet-ratifiers becomes one of “if others can do it we can do it too”.

(b) The more other countries have ratified, the greater the reputational implications for the not-yet-ratifiers are likely to be. One example is that Italy appears to have ratified two LRTAP agreements (the Sofia Protocol on NOx and the VOC Protocol) despite high costs, not so much for ecological reasons, but mainly in order not to “loose face” (Lewanski, 2000: 273). We assume that ratification decisions are no only made based on material cost-benefit calculations (these are covered by (a)), but are also driven by a logic of appropriateness (March and Olsen, 1998). That is, not-yet-ratifiers experience growing tacit or open reputational problems the more other countries formally join a given agreement that is also open to the country of concern. The decision-calculus of the not-yet-ratifiers is one of “if other countries join our reputation will suffer if we don’t join as well”. These arguments lead
to hypothesis H1. The diffusion effects captured in this hypothesis pertain primarily to learning and emulation.

**H1:** The probability of treaty ratification by a given country increases with the number of other countries that have ratified this treaty.

In principle, the effect stipulated by hypothesis H1 could cut in the opposite direction if there is a free-rider problem. In that case, countries not joining and implementing the respective agreement could benefit from the collective good (cleaner air), whose production increases with growing membership. In the extreme, the hold-out country could achieve the maximum net benefit once all other countries have joined the agreement. We submit that this scenario is unlikely because transportation matrices of air pollutants in Europe show that, depending on the particular pollutant and climatic and geographic conditions, air pollution can only to some extent be exported and clean air can only to some extent be imported (Tarrasón et al., 2000). Moreover, as argued above, reputational costs emanating from norms of appropriateness cut against free-riding incentives, making it unlikely that incentives not to joint the agreement will increase with growing treaty membership. Nonetheless, our empirical models will control for the possibility of free-riding by including a control variable that captures national import/export ratios of air pollution.

**Neighbor countries**

When deciding whether to ratify a treaty countries are likely to pay varying degrees of attention to the choices of other countries. That is, depending on which other country (countries) ratifies the respective agreement, diffusion effects are likely to differ. We submit that neighboring countries, i.e. countries sharing a border, are likely to influence each other’s ratification choices. There are two reasons for this:

First, such neighborhood effects may involve a positive externality: to the extent countries A and B share a border and at least some pollution from A flows into B, ratification of a pollution reducing treaty by A creates, to the extent the international regime is effective, an improvement in environmental conditions in B. In the worst case, such a positive externality may induce country B not to ratify the treaty because it can benefit from cleaner air without investing in costly pollution reduction in its own country (see also Murdoch et al., 1997). We postulate, however, that this scenario is rather unlikely and that a positive diffusion effect is more probable. We expect the latter because, in most cases, self-inflicted pollution in country B will, in comparison to “imported” pollution, be sufficiently large to prevent country B from
obtaining important environmental improvements solely through a positive externality emanating from country A. Moreover, positive externalities are likely to enhance a diffusion effect to which we now turn.

Second, in most cases joint borders correlate with geographic distance between capitals and/or major population centers, and shorter distances are usually associated with more social, economic, and political interaction.\(^4\) One manifestation of this geographic distance effect is international trade, whose size can be quite well explained with gravity models that emphasize the size of economies as well as geographic proximity. More social, economic, and political interactions, in turn, allow for stronger learning and emulation effects. This argument leads to hypothesis H2:

**H2:** The probability of treaty ratification by a given country increases with the share of neighbor countries that have ratified this treaty.

**Large countries**

Reminiscent of the gravity logic in models explaining trade flows we expect that not only geographic distance matters for explaining ratification behavior, but also the size of other countries. What large countries do is likely to influence the ratification choices of other countries. It is particularly likely to generate learning and emulation effects, and potentially also coercion effects. Similar to the arguments underlying hypothesis H1, we assume that ratification by large countries conveys the information to holdouts that the cost-benefit ratio of joining the treaty is, overall, acceptable.

Moreover, ratification by large countries increases the reputational costs for holdout countries: to the extent holdout countries pay attention not only to the number of ratifiers, but also their economic and ecological importance, ratification by a few large countries can have a similar effect as a larger number of ratifications by smaller countries.

In some cases, ratification by large countries may also generate risks of coercion by those ratifiers vis-à-vis smaller countries. If implementation of a treaty is costly large countries are likely to demand ratification by smaller countries in order to avoid “leakage” (relocation of polluting economic activity from large ratifiers to smaller hold-outs) or free-riding (if smaller countries benefit from cleaner air without contributing to it). Because larger countries carry

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\(^4\) Economic interactions will be considered separately (hypothesis 4). To keep the model simple we do not include other, more specific driving forces, such as cultural similarity or communication flows, that may also be captured implicitly by the joint borders variable.
more weight in international economic relations and international politics, they can credibly threaten costly action against holdouts (coercion). However, it is also possible that large countries are more reluctant to ratify a treaty because they are less likely to be “punished” by other countries. We consider this possibility by including a country’s economic size as a control variable (see below). These arguments lead to hypothesis H3:

**H3:** The probability of treaty ratification by a given country is higher when large other countries have ratified this treaty.

**Competitor countries**

Clean air policies — whether they are purely national or internationally coordinated, such as in the LRTAP case — come with non-trivial implementation costs. Even if such policies target air pollution that does not flow beyond national boundaries they may have effects on the international competitive position of industry (Vogel, 2005). Those effects may not be very large: environmental protection costs are in most cases in the order of very few percentages of production costs. However, firms are usually unable to estimate implementation costs with precision. But they can easily observe whether another country in which its main competitors are located has ratified a clean air treaty. In simplified form, these assumptions can be translated into a “level playing field” argument. This argument holds that ratification behavior by a given country is affected by the ratification behavior of its economic competitors. Hypothesis H4 thus captures diffusion effects that pertain primarily to competition.

**H4:** The probability of treaty ratification by a given country decreases with the share of economic competitor countries that have not ratified this treaty.

We will examine the determinants of treaty ratification identified by hypotheses H1 – H4 in comparison to a set of other determinants that have thus far dominated the relevant literature (e.g. Grossman and Krueger, 1995, Bernauer and Koubi, 2009). The latter determinants include, in particular, economic characteristics (e.g. income per capita, economic size of countries, trade openness), domestic political system characteristics (e.g. veto players), and other factors (e.g. whether a country is a net exporter or importer of air pollution, EU membership, treaty characteristics, time trend). We will discuss these variables and their effects in the next section and the results section.
Dataset and Statistical Approach

We use a new panel dataset to test the four hypotheses developed above. The dataset includes information on all nine LRTAP-agreements and all countries on the Eurasian continent that have (eventually) ratified the first agreement, that is, the 1979 LRTAP-Convention. We exclude the USA and Canada, which are not geographically contiguous with the other countries and, therefore, are, from a geophysical viewpoint, not part of the same transboundary pollution problem. Our dependent variable measures treaty ratifications. The source of our data for the dependent variable is the LRTAP secretariat. Data for the explanatory and control variables is taken from existing datasets (see below). We restrict the analysis to the time period 1979 (opening for ratification of the first LRTAP agreement) to 2007 because data for many explanatory and control variables is not available beyond 2007.

The unit of analysis is the treaty-country dyad per year. Each of the nine treaties is paired with each of the 47 countries whose treaty membership we measure, and those treaty-country pairs are included in the data set with times-series. Each times-series starts as early as the year in which the treaty was opened for ratification, provided the country concerned existed at that time. Each treaty-country pair then stays in the dataset with yearly observations until the year when the respective country ratified the treaty and then drops out (the reasons are given below). This approach controls for differences in „exposure“ time. For example, a country that already existed when a treaty was concluded has probably had more opportunities to ratify that treaty than a country that came into existence some years after the treaty was concluded. The dependent variable for a treaty-country pair in a given year takes the value zero if the country did not ratify the treaty in that year, and one if it ratified.

The main explanatory variables are defined as follows. For hypothesis H1 we use the lagged (previous year) share of other countries that have ratified the respective treaty (others (#)). The lag structure, which we use for independent variables in H1-H4, controls for potentially reverse causality. One might argue that diffusion effects emanating from all other countries cannot be fully captured in a simple additive form. For example, if ten other countries have ratified a treaty it may well matter whether five of these countries are large or whether all of the ten countries are small. To take this possibility into account we also use two alternative indicators: the sum of the populations of those countries that have ratified divided by the total population of all countries that could ratify (others (pop)); the sum of the GDPs of all countries that have ratified divided by the sum of all potential treaty members’ GDPs (others (gdp)). These two indicators take into account the size and economic importance of countries that have ratified.
The explanatory variable in hypothesis H2 is measured as the lagged (previous year) share of neighbor countries that have ratified the respective treaty (neighbors). We use the share rather than the number of neighbor countries because countries have varying numbers of neighbors. Using the absolute number could thus bias statistical effects with respect to countries with more neighbors.

The explanatory variable in hypothesis H3 is measured as a dummy variable that indicates whether France, Germany, or the United Kingdom, the three largest economies in Europe, have ratified the respective treaty (big countries). This variable takes the value 1 if one of the three countries has ratified, and zero otherwise. We use this particular definition because ratification choices by these three countries are quite strongly correlated. To test the robustness of our results, we also employ alternative specifications (e.g. a dummy that switches to 1 once all three big countries have ratified, see companion materials).

The explanatory variable in hypothesis H4 is measured as the lagged share of the five biggest trade partners of a country that have not (yet) ratified the respective treaty (competitors). The five biggest trade partners of each country are identified by ranking all other countries in terms of the sum of exports to and import from those countries (constant USD).

The control variables are measured as follows: for country size we use the log value of a country’s population (population) and, alternatively, the log value of its GDP (gdp); for income we use the log value of GDP per capita (gdp p.c.); for trade openness we use the log value of the sum of imports and exports divided by GDP (trade openness); political system characteristics are controlled with an indicator for political constraints (veto players) (Henisz, 2009) that captures how easy/hard it is to adopt policies that change the status quo (this indicator exhibits more variation than the standard democracy indicators, e.g. the Polity IV index, which in our sample is highly skewed towards democracy); in addition, we control for EU membership because the EU has also established clean air rules separately from the LRTAP process (EU affiliation). We also control for abatements costs and benefits as well as free-riding incentives by including a variable that captures the emission-deposition ratio of transboundary pollution in each country (pollution exporter). A small ratio indicates that the country is primarily a victim of pollution imported from other countries; a large ratio indicates that the country exports more pollution than it imports. We model the time dynamics by controlling for the age of the treaty as well as the squared and cubic value of treaty age (age of treaty, age of treaty^2, age of treaty^3). We test for potential structural shifts associated with the end of the Cold War (dummy variable for the post-Cold War period, post 1989). Finally,
we include treaty variables (treaty) to control for unspecific treaty characteristics. In other words, we use a wide range of controls for country characteristics, treaty characteristics and time effects to avoid Galton’s problem.

Our approach also controls in different ways for the possibility that ratification may be affected by variation in implementation costs across treaties and across countries within a given treaty. First, our variables for time-effects control for the possibility that treaties on a similar environmental problem may become stricter (and thus more costly to ratifiers) over time. Second, we control for treaty and country effects in our robustness checks. Third, we examine the implications of differential obligations (i.e. different obligations for different countries within the same treaty). Fourth, our models include several variables that capture, indirectly, how costly it might be for individual countries to join a treaty (for example, pollution deposition rates, ratification constraints in terms of veto-players, economic capacity in terms of income levels).

A summary table of all variables in the analysis, sources of data, descriptive statistics, correlations, simulated probabilities, and results of robustness checks can be found in the companion materials at http://www.ib.ethz.ch/research/data.

We apply the binary-time-series-cross-sectional (BTSCS) approach described in Carter and Signorino (2007). This approach treats binary-time-series-cross-sectional data as grouped duration data where the interval of observing the data is fixed to one year. This is why any given treaty-country pair is dropped from the dataset after ratification took place, i.e. after the value of the dependent variable changed from zero to one. Although the standard approach is to include splines or time dummies, we include the time (age of treaty) as well as its squared and cubic terms in the regression to model time dependencies. This approach avoids problems associated with using time dummies (inefficiency, quasi complete separation issues). Experimental and empirical evidence suggest that the approach we opt for performs as well or better than splines by increasing, decreasing and non-monotonic hazard (Carter and Signorino, 2007: 18ff). To cross-examine the robustness of our results we also use conditional logit models that allow for a fixed effects procedure to account for variation in the particular characteristics of the nine LRTAP treaties. Note that standard spatial lag models, which are frequently used in policy diffusion research, cannot be used in our case because our unit of analysis is the treaty-country dyad per year, and not the country dyad per year.
Results
The baseline model shown in Table 1, Model 1, includes all country-internal and time variables. Except for income (GDP p.c.), country size (population), and political constraints (veto players) all independent variables in this model have a significant effect on treaty ratification behavior.

The results for the baseline model show that significant free-riding incentives are present, in the sense that net exporters of pollution are less likely to ratify clean air agreements. There are also some indications that larger countries (measured by population size) are less likely to ratify agreements, though the negative coefficients for this variable are significant only in some models. This finding suggests that larger countries may be less exposed to reputational costs and international political pressure resulting from non-ratification. Countries more open to international trade are more likely to ratify agreements, suggesting that “competition in laxity” is not a problem in the LRTAP case.

The post-Cold War dummy has a negative sign. This effect may be due to the fact that new countries such as the former Soviet Republics, which tend to be environmental laggards, enter the dataset after 1989. An additional interpretation is that the LRTAP treaties concluded in the 1990s became more demanding, which in turn had a negative effect on ratification. The EU variable has no significant effect in any of the models and was thus dropped. In Companion materials 6, a figure shows the substantive time effects.

Table 1, Models 2-5, show the estimates that include country-external determinants of treaty ratification. As discussed in the theory section, our aim is not to compare the relative effects of particular policy diffusion mechanisms, but to examine the extent to which country-external determinants matter, overall, in comparison to other determinants. For that reason, and because our indicators for country-external determinants capture partly overlapping types of effects, - some of these variables are in fact highly correlated (see companion materials) - we include each international variable separately.
Including the country-external determinants improves the fit and explanatory power of the models (the BIC and AIC improve, see companion materials 5). The coefficients of the main explanatory variables in Models 2-5 all point in the expected direction. With the exception of the competitor variable (Model 5), which is significant only at the 10% level, the coefficients are significant at 1% (others (#), big countries) or 5% (neighbors) levels.

In Model 2, the effect of the share of other countries that have ratified previously is positive and highly significant. In this model, we measure the ratifications of other countries in terms of the sum of the populations of countries that ratified one year prior divided by the sum of populations of all potential ratifiers. As shown in Model 2 of Table 2, the result is very similar

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<th>Table 1: Main results</th>
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<td><strong>Model 1</strong> Baseline model</td>
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Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
if we weight the ratifications of other countries by GDP (economic size of countries) rather than population. The same applies when we use the non-weighed share of potential ratifiers that have in ratified (Model 1 in Table 2).

The ratification behavior of neighbor countries (measured as the percentage of neighbor countries that ratified one year prior) has a significant, positive effect, albeit only at the 5% level. One of the reasons might be that it is, conceptually, difficult to capture neighborhood effects because the number of neighbor countries varies greatly (between one and eight). This may cause biases particularly in cases where countries have only one or two neighbors and the share of neighbor ratifiers can thus quickly jump from zero to very high shares.

As expected, ratification behavior is influenced positively by whether France, Germany or the UK (*big countries*), the largest economies in Europe, has ratified previously. Moreover, as expected, non-ratification by a country’s main trade partners has a significant negative effect on ratification behavior, though the coefficient is significant only at the 10% level.
We examined the robustness of the aforementioned findings in various ways. These robustness checks are reported in the companion materials. Our main results survive.

We now turn to simulated probabilities, which help in assessing the substantive effects of international in comparison with domestic variables. The analysis of such probabilities is useful also because multicollinearity (even though it is not a problem in our models) affects standard errors and thus statistical significance, but does not affect the direction and size of coefficients on which the estimation of substantive effects relies. Without this additional analysis one might argue that our international variables turn out to have comparatively strong effects only because we have „stacked the deck“ in favor of these variables by including all domestic variables together in the models (exposing them to multicollinearity problems) while including the unit-external variables one-by-one.
Figure 1 illustrates the effects of two international and two domestic variables: ratification by other countries, non-ratification by major trade partners, deposition rate of pollution (free rider effect), and trade openness. Similar figures for the other explanatory variables are shown in the companion materials.

Figure 1: Predicted probabilities, illustrations

Overall, these results suggest that international effects are as important in influencing ratification behavior as domestic effects. The strongest effects emanate from the ratification behavior of other countries most broadly defined. Depending on the specific definition of that variable, the probability of ratification increases by up to 35%, starting from a baseline probability of around 1% (when all other variables are set to their mean values), if ratifications by other countries change from the minimum to the maximum. This effect is non-linear, in that it kicks in primarily once 30-50% of the other countries have joined.

The effects of the other three international variables (neighbors, big countries, competitors) are smaller than those of the most broadly defined international variable (others (#), others
(pop), others (gdp)), but still similar to domestic variables, particularly when one takes into account the confidence intervals. One of the reasons why the international effect emanating from ratification of other countries broadly defined clearly dominates may be that all potential ratifiers are located on the same continent. This geographic proximity may motivate countries to pay attention primarily to what other countries as a whole do, rather than what specific types of other countries do.

As an additional illustration of substantive effects we simulated the probability of treaty ratification by specific countries (see companion materials 6). All variables that are not country specific were kept at their mean values. The domestic variables were set to the country-specific value of the respective variable in 2000. The results indicate that some countries, such Norway and Switzerland, can be considered ratification leaders, whereas other countries, such as Romania or Estonia, are clearly among the laggards. The simulated probability of Norway and Switzerland ratifying a treaty is around 40%, whereas the corresponding probability of Romania and Estonia is around 3%.

**Conclusion**

Existing theories of international regime formation concentrate quite heavily on the bargaining stage. Very few studies have thus far examined treaty ratification processes, and those that do focus primarily or even exclusively on domestic determinants of ratification behavior. As treaties are usually the backbone of international regimes, and as ratification is usually required to start the implementation of international commitments at national levels, we submit that closing this research gap is important. Our article has drawn on policy diffusion research to specify a set of international determinants. The corresponding hypotheses claim that countries’ ratification behavior is influenced by ratification choices of other countries as a whole, or of specific types of other countries. The underlying argument is that the ratification behavior of (specific) other countries sends particular signals – for instance signals about implementation costs, competitiveness effects or reputation costs – to the country in question.

The empirical testing of these hypotheses was done on data for ratification behavior with respect to agreements on long-range transboundary air pollution in Europe, the most important international clean air agreements on that continent. The results demonstrate that international effects are as important in influencing ratification choices as domestic effects. In substantive terms, the effect of ratification choices of other countries as a whole turn out to be
most important, though the other three international variables are also relevant.

Future research could use a similar analytical framework and methodological approach to investigate whether our results are relevant for other areas of international cooperation as well, for instance arms control, human rights, trade and investment. It will be particularly interesting to see whether diffusion effects differ across bilateral, minilateral and multilateral or global treaties as well as problem structures.

In view of our results, which show that international factors are important in influencing ratification decisions, future research should also concentrate on empirically identifying specific diffusion mechanisms and establishing the conditions under which particular types of diffusion mechanisms are influential. Qualitative case study work focusing on legislative ratification debates and decision-making in executives will be particularly useful because large-N studies are too crude to really capture in detail, and in a dynamic way, the motivations that attract or deter countries from ratifying international treaties.

In further research it would also be interesting to also take into account more explicitly the linkages between the bargaining and the ratification phase. For example, if some types of countries (e.g. poorer countries or more powerful countries) were able to obtain systematically different treaty obligations compared to other countries this could reduce the effects of domestic determinants at the ratification stage. If, for instance, poor countries were able to obtain treaty obligations implicating lower implementation costs this could make ratification by poorer countries more likely, or it could obfuscate the income (GDP per capita) effect on ratification.

In our rather parsimonious analytical setup we did not find convincing evidence for systematically „cheaper“ obligations in the nine LRTAP agreements for poorer or more powerful countries. Poorer countries and smaller countries are subject to somewhat less ambitious obligations in some (but not all) LRTAP agreements. But when considered in terms of relative ability to pay for pollution abatement and in terms of relative marginal abatement costs it is far from clear that poorer countries should find it easier (cheaper, relative to their national capabilities) to implement any given LRTAP agreement (see companion materials 7).

Nonetheless, it would be interesting to expand our research to include both the treaty design (bargaining) and ratification stages of international regime formation, and to investigate to what extent the effects of domestic and international determinants differ across the two phases. Such research could provide important insights into “constraining vs screening” and “enforcement vs participation” issues that have thus far been studied primarily with respect to
compliance in the post-ratification phase (e.g. von Stein, 2005).

Finally, our results show that ratification processes are important stages in international regime formation and deserve analysis in their own right. The dynamics that unfold during this phase can play an important role in determining whether an international regime gets off to a good start or not. International factors are important in shaping these dynamics. By implication, countries interested in accelerating international cooperation can form coalitions with like-minded states and time their ratification behavior so that it sends strong cooperation-promoting signals to the hold-outs.
Chapter 2: Explaining the Dynamics of International Legal Commitment in the Area of Air Pollution: The Impact of Learning Processes on Cooperation through Participation in Regime Institutions

Sophie Perrin

Introduction

What are the incentives of countries to legally commit to international environmental agreements (IEAs)? Ratification of an IEA signals that a country adheres to a set of rules, norms and decision-making procedures (Krasner 1982), and eventually will implement the prescriptions and goals set by the treaty. So far, most scholarly work solely focused on collective action problems and two-level game approaches to explain states’ ratification behavior (e.g. Barrett 1998, Putnam 1988, König and Hug 2000). According to this literature, countries are more prone to ratify an IEA a) when they expect that they will receive additional benefits relative to the status quo, b) when they assume that the majority of their parliament will support the decision, and c) when they believe that none of the domestic-level powerful interest groups will have the capacity to block the ratification process in this regard.

In reality, however, the strong variation in countries’ ratification behavior cannot be explained with these static arguments in a comprehensive and systematic way. For example, while one group of countries ratifies some treaties earlier than others, another group may ratify after a substantial elapse in time. Also, some countries are unlikely to ratify an IEA at all. Finally, it may also well be that another category of states ratifies a framework agreement significantly later than other countries, but a prospective subsequent amendment will be ratified right after it is open for ratification. Put differently, temporal dynamics are likely to play a major role in the ratification behavior of countries, but the previous literature either largely ignored the influence of this dimension or cannot explain any variance therein due to a static theoretical framework. One notable exception here is Perrin and Bernauer (2010), who analyse the ratification behavior with a dynamic policy diffusion framework. They define diffusion as the policy choice of an actor conditioned by the similar prior policy choice of other actors through different kinds of diffusion mechanisms, such as learning, emulation, coercion, or competition (Braun and Gilardi 2006), and demonstrate that the ratification behavior of countries is highly influenced by contingent factors like the ratification patterns of other states. Their empirical
approach, however, does not allow to clearly distinguishing between the different diffusion mechanisms, which are all are subsumed under “international factors.” Against this background, the aim of the following paper is to look closer at learning mechanisms and to assess the impact of learning on states’ cooperation behavior, as well as the role of international regimes in this process.

As I will elaborate below in more detail, I conceptualize cooperation as ratification and the duration until this occurs, because I interpret the respective differences in accession duration as the reflection of a country’s relative preference intensity toward the provision of a given treaty, and this can be used as an indicator for a country’s commitment to the goals of specific environmental treaties (Fredriksson and Gaston 2000). Given that there is a treaty about the environmental issue at stake, ratification of an international treaty is a form of cooperative behaviour. Ratification is important because it is a clear commitment, a legislative act that incorporates the content of the treaty into domestic law. In contrast, a signature only signals to the international community the willingness to become a party. Of course, the ratification of an international treaty does not necessarily mean that an agreement will be implemented and the targeted environmental problem solved, but it an important step for a solution.

Although social learning is theoretically considered as an important factor for explaining international commitment (e.g. Underdal 1998, Wettestad 2002, Breitmeier et al. 2006), and the development of knowledge can play a significant role on regime formation (Dimitrov 2003), evidence remains scarce. With regard to international regimes, few large-N studies on networks and the socialization effects of IGOs have been conducted. Ward (2006), for example, developed a network centrality measure to capture the involvement the international network of regimes and found that the more international linkages a country has, the more sustainable it behaves. Also, Greenhill (2010) analyzed the effect of IGO membership on human right policies; Bearce and Bondanella (2007) examined the effect of common IGO membership, which is used as a proxy for the effects of socialization, on the UN-voting behavior and observed a convergence in the voting behavior of countries that interact with one another within the context of IOs.

However, in assessing the effect of membership in various regimes on the voting behavior in the UN, on human rights, or on the implementation of environmental policies, these studies take a very long causal chain as given and use a rough proxy for learning and socialization processes. Indeed, IGO membership does not tell us whether or not a country’s government actually sent representatives to meetings, and even if they did, it is unknown whether or not
any information transfers took place, e.g., if reports were transmitted to the government.

Furthermore, although the vital role of communication channels is well-known from classical diffusion studies (see Rogers 2003) and while regime linkages are considered important facilitators of learning processes, they have not received much attention within the regime literature (Selin and VanDeveer 2003, VanDeever 2006, Levy 1993). Interestingly, the participation patterns of member countries in the LRTAP regime network differ strongly between signatory countries, but have not yet been studied in a systematic way or have not been linked to ratification behavior -- particularly with respect to the willingness of countries to ratify more constraining environmental agreements.

In this paper, real exposure to information is accounted for. First, I introduce regimes as knowledge providers and describe the role of learning mechanisms for international cooperation. With a new dataset including precise information on a regime’s meetings attendance, I eventually test the effect of exposure to usable knowledge on states’ cooperation behavior. While I control for other relevant factors, I also assess how interests and domestic politics affect the effect of learning mechanisms on cooperation.

**International Environmental Regimes as Knowledge Providers**

Scientific advancement plays an important role in international cooperation on environmental problems in terms of measuring environmental threats and outcomes and defining the countries’ interests. As such, domestic decision-makers can be regarded as “information-seekers” (Underdal 2000: 377).

This is likely to be the reason why environmental regimes generally play a crucial role in the provision and production of knowledge in their specific issue areas (Young 2004). IEAs are often connected in some way with scientific research. New insights on severe environmental problems may even lead to an agreement and an agreement may lead to more research on salient issues. If knowledge and learning are key elements of a successful regime, it is a worthwhile research topic. In particular, this pertains to the effect of learning on ratification.

However, the relationship between new scientific evidence and international cooperation is complex. We do not live in a world ruled by pure scientists and specialists, and “(…) the transition from information to interest formation is shaped by values, power and institutions” (Dimitrov, 2003:126). Before new knowledge can be effectively used in any policy debate, the value of new information is negotiated in a social process by several actors (Lidskog and Sundqvist 2002). Hence, the “use of science as well as the production of scientific data is always contingent to social order” (Lidskog Sundqvist 2002:95).
This might explain why the knowledge-oriented literature has produced inconclusive results so far (Dimitrov, 2003). In Dimitrov’s (2003) study on knowledge and regime formation, he shows that reliable scientific facts are neither necessary, nor sufficient to induce international cooperation. In some cases, despite strong uncertainties, regimes may emerge, while in other instances the impetus for an international agreement can fail -- although the problem at stake is well known. Success obviously depends in part on the state of knowledge, in particular if the information relates to the consequences and impact of a problem. In general, countries’ interests are future-oriented. Reliable information on the impact of a problem is useful for the calculation of expected benefits related to one’s preferred future scenario, because it motivates meaningful discussion about the overall policy options (Dimitrov 2003). Clear information raises the incentives for policy coordination. However, not all kinds of knowledge matter, for instance, shared knowledge about the causes or the extent of a problem are more difficult to be rendered fruitful in a policy debate.

The relevance of scientific knowledge to the state’s potential benefit from treaty ratification is contingent on how the knowledge is transmitted and processed. Along those lines, Haas (2004) developed the concept of “usable knowledge,” which usually grows and is developed in expert groups or networks with the support of the persuasive work of norm entrepreneurs. To be “usable” and transmittable to policy makers, expert knowledge needs to fulfil the criteria of credibility, legitimacy, and saliency. Necessary transmission belts of knowledge are according to Haas (2004) epistemic communities, which are “(…) networks of professionals with recognized expertise and competence in a particular domain or issue-area” (Haas 1992: 3). These often work in conjunction with broader policy and expert networks, nongovernmental organizations (NGOs), or international civil servants.

Knowledge can also have an impact on the policy process through agenda-setting-power. Although scientific advice generally has a weak effect, it has to meet non-scientific criteria in order to be used in the first place (Barke and Peter 1993). Once those criteria are met, new scientific advancements have some agenda setting power and new insights can bring a topic (back) on the policy agenda as long as they have been translated into relevant information for policy-makers before.

Still, the relationship between science and cooperation is a lively – and even controversially – debated issue in the political science. Knowledge may be a simple function of power; powerful actors produce information aligned with their preferences (see Dimitrov 2003, Downs et al. 1996). As we discussed above, power and knowledge are not fully independent
from each other. However, the empirical results show that powerful actors are not always able
to block information that runs counter to their preferences, and, even if they are capable, they
sometime do not even try to (Dimitrov 2003:143).

Some game theorists also deal with the potential cooperative effect of new information.
According to the “veil of uncertainty” argument, the less actors know about a given problem,
the more likely it is that they achieve cooperation (Kolstad 2005:32). However, research in
this area is still inconclusive and Helm’s (1998) and Finus/ Pintassilgo’s (2010) formal proofs
lead to slightly different results: in environmental cooperation, less uncertainty can increase
cooperation (Helm, 1997:198), whereas in (Finus/Pintassilgo 2010: 25) less uncertainty may
either increase or decrease chances for an agreement.

**Increased Willingness for Ratification through Learning?**

With regard to ratification behavior, the literature largely ignored the effects of learning so
far. In social sciences, different conceptualizations of learning coexist like rational learning,
bounded learning and social learning. But in all these conceptualizations, beliefs are updated
after usable knowledge about the consequences of an environmental problem has been
transmitted to decision makers. *Rational learning* is a rational update of beliefs after the
acquisition of new information (Meseger 2006), although the assumption of purely rational
learning can be relaxed with the concept of *bounded learning*. Individuals usually lacks
access to full and sufficient information and consequently can not update their beliefs
rationally so that, in general, they will have to rely on shortcuts like the arguments provided
by those information sources that are immediately available. Finally, *social learning* or
*socialization* is widely used by social constructivists. Checkel (1999: 458) explains this
concept as “a process whereby actors, through interaction with broader institutional contexts
(norms or discursive structures), acquire new interests and preferences – in the absence of
obvious material incentives.” Agent interests and identities can be shaped through
interactions. Social learning seems to be facilitated in groups, the members of which members
have similar professional backgrounds, face evidence of policy failure, meet often and are not
exposed to direct political pressure (Checkel 1999).

Therefore, in this paper, I conceptualize learning when beliefs are updated after usable
knowledge about the consequences of an environmental problem has been transmitted to
decision-makers.

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5 Cognitive psychologists also mention representativeness (unwarranted inference: overestimation of a
single case’ generalizability) and anchoring (too much weigh put on the initial values biases the
judgment) (Weyland 2005: 284f; see also Kahneman and Tversky, 1979).
Against this background, recall that usable knowledge about relevant scientific information increases the likelihood of subsequent treaty ratification. Concretely, policy-makers exposed to usable knowledge on new scientific results about an environmental issue, for instance, and about the need for international cooperation will update their beliefs on that topic. Thus, adaptation of the policy position is likely and can eventually include the ratification of an international treaty, especially if international cooperation is a necessary condition to alleviate the problem.

After country representatives attend meetings or workshops, they will increase their usable knowledge, update their beliefs, and include the new information into their evaluation of their country’s interests, incorporating the information into domestic politics (agenda setting, legislation, etc) that increases the likelihood that the government revises its position and eventually deepens their cooperation. Theoretically, however, usable knowledge could also work the other way round: the information spread within a regime may contain a negative evaluation of a planned action (useless instrument, no need for international action, etc.). But this will hardly happen. New environmental treaties are costly and they emerge out of striking problems. A regime or lobbying countries would not invest these resources as long as the ground for action is wacky. The agreements generally base on some scientific ground that is at least known among scientific communities and some frontrunner countries. However uncertainties often need more investigations in order to clarify the problem and better understand its consequences. New agreements typically derive from results that demonstrate the need of deeper cooperation.

In order to have an impact, new scientific information does not only need to be transformed in usable knowledge, but also must be transmitted to an audience and has to penetrate each country’s administration for reaching relevant decision-makers. Hence, access to and participation in arenas, where knowledge is disseminated, is an important precondition for learning. These considerations lead me to hypothesis 1 (“learning through participation”):

**Hypothesis 1:** The more often a country participates in the regime’s arenas, where the exposure to new usable knowledge is substantial, the faster it ratifies the regime’s agreements.

A country whose representatives are regularly confronted with new information should be more prone to integrate it, learn and subsequently adapt, ceteris paribus. As a result, a high degree of participation in regime institutions, where information is actively disseminated and leading experts are regularly referring to new scientific insights, should have a positive impact on the willingness to cooperate, i.e., on the likelihood ratification. On the other hand, new
relevant knowledge is less likely to reach decision-makers of a country, which does not regularly send representatives to regime institutions.

New information needs first to be processed and then filtered or magnified by existing interests and values before it can influence the position of a country, which is why I can further specify the first hypothesis. The effects of new knowledge as well as participation are expected to be stronger in countries with unclear interests, while countries with particularly strong interests are less likely to change their position.

The resolution of international environmental problems through the means of international cooperation affects countries in different ways. Global environmental problems sometimes involve asymmetries; some countries may be victims, others are perpetrators. But with regard to pollution, countries can also easily be victim and perpetrator at the same time. Benefits and costs of cooperation depend on the extend to which a country causes a given problem or suffers from it. As a victim, a country benefits when the problem is reduced; while as a perpetrator it costs to take the measure agreed on to limit pollution (reductions of emissions, industry regulations, phase out etc). For instance, a country that hardly suffers directly from an environmental problem but causes it to a considerable extent would have relatively high costs and few benefits out of an agreement dealing with this problem and, thus, it is expected to be less prone to cooperate. A country that is mainly suffers from an environmental problem without causing it, is also expected to have stable preferences -- in this case in favor of cooperative action -- as it will mostly benefit. Indeed, it seems reasonable to expect that very strong preferences in favor of or strictly against deeper cooperation can hardly be challenged by any socialization processes, while moderate countries with unclear preferences in terms of the costs/ benefits of cooperation are more likely to be influenced by learning.

**Hypothesis 2**: The effect of new knowledge on treaty ratification is stronger in countries with less clear interests

Furthermore, a key factor in a government’s openness to revise its beliefs in light of new information is its ideological position. Individuals dispose of interpretative schemata (Goffman 1974) or frames that filter and order information. Frames help interpreting the world, sorting out, decoding and labelling experience and events. Salient, familiar, or compelling information that is congruent with ones frames will have a bigger impact on beliefs and behaviour of recipients (Benford and Snow 2000; Strang and Soule 1998).

Ideological disposition can be seen as a set of frame; the assimilation of new information related to environmental problems is thus facilitated by domestic “green demand” and a
preference for “green policies,” which implies a certain awareness for environmental issues. Following this, I expect an interaction effect between a government’s preference and the likelihood of policy change.

**Hypothesis 3**: The effect of the exposure to new knowledge on ratification is stronger in countries with “greener” preferences.

Figure 2 below illustrates three main hypotheses and the theoretical model.

Figure 2: Learning through participation and interactions with “cost/benefits expectation” and “domestic green demand”

In previous studies, other important explanation factors were identified that may play an important role with regard to international commitment. As a result, I control for alternative three sets of factors that influence the propensity of a country to cooperate internationally: the net costs/ benefits ratio of cooperation, the capacities of a country, and domestic politics.

First costs/ benefits of cooperation do not only have a conditional effect but also a direct effect on the cooperative behavior. Countries on the extremes of the costs/ benefit line that derive high costs or high benefits out of cooperation are expected to have more stable preferences and be less prone to a change in position caused by the behavior of others.

Second, some environmental treaties can be quite demanding. Besides new legislation, monitoring and reporting duties need to be fulfilled. Some countries do not have the capacity to realize the necessary changes needed at home, they lack both technical know-how and financial resources and, thus, refrain from ratifying an agreement, knowing that that they are incapable of compliance. Furthermore, scarce resources also limit the possibility to cooperate - small administrative units cannot send as many representatives to expert meetings than big ministries.
Third, domestic politics can directly impact on the ratification through constituent preferences and institutions. Relevant domestic actors clearly influence the position of a country in international negotiations and have an impact on the set of possible agreements a country is willing to accept (Putnam 1988). As such, the “greener” the domestic preferences of a country, the more cooperative it is expected to behave with regard to international environmental agreements. On the other hand, institutional features influence the ratification process. Veto points are political institutions that intervene between policy demand and decisions (Tsebelis 2002); the less veto points a given political system has, the more concentrated is the allocation of power and the easier it is to change the status quo by signing an international agreement. In contrast, more veto points equal a high power fragmentation, which implies that domestic opponents have more opportunities to block ratification. Thus, policy change becomes more difficult to achieve and slow down.

Finally, diffusion studies (Shipan and Volden 2008, Braun et al. 2008, Soule and Strang 1998) have shown that policy decision cannot only be explained with internal factors. Interdependencies play also a role, especially the role of proximity. This means that simply the information about the ratification of relevant others can matters (Perrin and Bernauer 2010).

**LRTAP Regime**

The long-range air pollution regime (LRTAP) and its nine agreements from 1979 to 2007 offer an appropriate starting point for testing these hypotheses. The LRTAP Convention (CLRTAP) was signed in 1979 in Geneva by 33 governments, who committed themselves to limit air pollution with best available and economically feasible technologies (Art. 2 and 4 CLRTAP) and to develop policies and strategies that combat the discharge of air pollution through exchange of information, research and monitoring (Art 3 CLRTAP). The convention encouraged the development of research and the dissemination of new findings in the area of air pollution but agreement was considered to be weak, as it included no concrete abatement goals. Although air pollution was recognized as a serious threat to the environment and public health when the LRTAP convention was signed, concrete emission reduction goals were considered unrealistic. Only Norway and Sweden were willing to take specific measures towards abatement (Levy 1993). The United Kingdom vehemently denied that transboundary air pollution existed until evidence from OECD research program could not be longer ignored (OECD 1977). Germany did not want to recognize transboundary air pollution, as they did not wish to be held liable for environmental damages in other countries. France only signed
because the convention did not impose concrete emission reductions and the LRTAP arena was seen as a useful tool to further the détente between East and West through cooperation in environmental affairs.

However, by 2010, 51 countries have ratified the convention and more than 20 countries ratified eight of the follow-up agreements from the LRTAP regime, each of which include deeper commitments. Today, the regime is regarded as a success that influenced European air policies for decades (Wettestad 2011).

The LRTAP regime is composed of four main institutions open to all UNECE countries but whose meetings should especially be attended by parties of the LRTAP convention: the executive board (EB), the highest body of the regime, which holds yearly meetings and legislates on the LRTAP affairs. The working group on effects (WGE) holds yearly meetings, which collects and processes information about major air pollutants, especially on the consequences of air pollution, and publishes reports summarizing and assessing the most important results of the activities of the international scientific cooperative programs. Important results are brought to the attention of the Executive Body and are published in the scientific literature as well as disseminated to the public. The working group on strategies and reviews (WGSR) is the political body of the regime that prepares negotiations and drafts agreement before they are enacted by the EB. The WGSR comes together a few times a year. The EMEP steering group (European Monitoring and Evaluation Program) provides scientific support to the convention and reports on the activities of its cooperative program research centers, which monitor and evaluate the development of air pollution in Europe. The EMEP steering group meets one to two times a year. Since 1997, there is also an implementation committee that yearly reviews the compliance of the parties and reporting to the EB.6

All these bodies deal with the nine LRTAP protocols and are open for all UNECE members, not only for LRTAP agreements signatories. Therefore there is no need to have signed or ratified a protocol in order to take part to the meetings; but only parties of a given protocol are entitled to vote on new amendments related to this protocol. Non-members, accredited NGO representatives and lobbyists do not have voting rights. The participants are either members of a country’s delegation, guests or accredited observers (NGO representatives, Lobbyists). The countries delegations sent to the yearly meetings differ from country to country and can vary from year to year. Some countries sent only one UN diplomat, some send representative from the foreign department, while other send civil servants who work in the public administration

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6 The implementation committee is composed of nine members, each of them must at least be party to one protocols (Sliggers and Kakebeeke 2004:119).
and are familiar with the topic discussed. Some delegations include up to 10 people, including lawyers, experts from several ministries, scientists and even lobbyists.  

Furthermore, the LRTAP regime has also various Task Forces (TF) on more specific transboundary air pollution related problems and International Cooperative Programs (ICP). For instance, there are Task Force on Health, TF on Measurement and Modeling, TF on Hemispheric Transport of Air Pollution, ICP on Forests, ICP on Modeling and Mapping, etc. They report to their related bodies (EB, WGE, WGSR, EMEP) and present the most important findings at the yearly meetings. The Task Forces and International Cooperative Programs meetings are first and foremost attended by knowledgeable experts, and not by official country delegations. Here, scientists, lobbyists, NGO representatives and country’s representatives gather and discuss as equals. What counts and determines their participation is primarily their competence and ability to supply the regime institutions with solid information that is needed on new issues and to coordinate and monitor the research activities launched by the regime.

The bundling and dissemination of new scientific knowledge is an important aspect of the LRTAP regime, it brings leading experts together, creates working groups on various issues and disseminates new information actively among its members and in the scientific community. The working groups and task forces published reports and present general summaries of their results and offer recommendations at each Executive Board meeting. Through these means such that new relevant information about health threats, environmental damages and costs of air pollution is made available to participants.

For example, during the 2009 EB meeting, live satellite pictures from the NASA that showed the earth surrounded by a cloud of black smoke (pink on the NASA pictures) were projected on the wall of the meeting room. It illustrated the hemispheric transport of air pollution, a problem scientists are only recently aware of, in an impressive and clear way. This is an example of the kind of first hand information participants are confronted within the regime institutions.

To sum up, various non-member countries participate in the regime institutions as ratification is not a condition for participation. Only a minority of participants has signed all agreement and some not even have signed the convention. This nice feature of the regime allows to testing the effects of participation and learning on cooperative behavior.

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7 Lobbyists can be either accredited by the UN or incorporated in a country’s delegation. Some countries sometimes outsource their delegation and send independent experts instead (e.g. a lobbyist), who is then entitled to represent the country.
Data and Method

To test my hypotheses, I use time-series cross-sectional data, in which the dependent variable is the yearly time elapsed until a country ratifies a protocol. The data include information on all UNECE (United Nations Economic Commission for Europe) countries.\(^8\)

Data is available on ratification, participation, air pollution, as well as transboundary flows; secondary data about UNECE countries is also broadly accessible. The sources of data for the dependent item and the learning and participation variables are the LRTAP secretariat and the UN archive. Data for the other explanatory and control variables were taken from existing data sets. The analysis is restricted to the time period 1979, i.e., the date ratification opens for the first LRTAP agreement, to 2007.

The unit of analysis is the pair of treaty-country per year. Each of the nine treaties is paired with each of the 47 countries and included in a survival data set. Each treaty-country pair then stays in the dataset with yearly observations until the year when the respective country ratified the treaty and then drops out.

In the LRTAP Regime, usable knowledge comprises the presentation of breakthrough reports on transboundary air pollution and its consequences to a general audience in the LRTAP regime institutions (EB, WGE, etc). Important reports and the relevant scientific results are generally presented by experts during LRTAP meetings and then diffused throughout the LRTAP networks. Examples of relevant knowledge contain insight in the effects on acidification of forests and soil, on transboundary pollution fluxes, on critical loads depositions (how much pollution different kinds of soil can tolerate), and new insights on the impact of and the extent of pollutants like VOC, POP and particulate matter (PM10, PM2.5). In 2009, the NASA pictures for instance were meant to illustrate the extent and seriousness of the hemispheric air pollution problem.

The assumption in this analysis is that learning happens after exposure to information in the regime arenas. Interviews with 11 LRTAP representatives\(^9\) confirmed that direct exposure to new information is more conducive to learning about air pollution than only having access to

\(^8\) Except United States and Canada, namely members of the UNECE for historical reasons but not part of the same transboundary air pollution problem, as they are not contiguous. Tiny countries like San Marino, Liechtenstein and Andorra are also not included in the dataset because there is hardly any data available about them. Countries that do not exist any more like Czechoslovakia and Eastern Germany or are too recent like Serbia and Montenegro as separate entities are also missing. Information on USSR and Yugoslavia were kept in the dataset and considered as historical data for Russia and Serbia-Montenegro.

\(^9\) From Germany, Belgium, Austria, Ireland, Slovenia, Estonia, Cyprus, Czech Republic, USA, Switzerland, Croatia and Belarus. List of interview partners in appendix 2, table 1.
information online. Without exception, the representatives said that their attendance at the meetings always has been highly instructive. In particular the valuable scientific information about the latest developments in research that are not available in every country, the fruitful exchanges with other countries about effective problem solving strategies (new legislation, policy instruments), and the better understanding of party’s positions they have gained there were appreciated.

Regarding the essential information transfer within the domestic administration and to decision-makers, all representatives confirmed the existence a more or less institutionalized reporting. They deliver the most important results as well as a summary of the LRTAP meetings to their domestic administration. Information transfer, hence, definitely takes place; at least inside the relevant ministry.

Several participation indicators have been constructed (list of variables in appendix 2, table 2). In the models estimated in the next section, the indicators used (\(PPPwB4\) and \(PPPPwB4\)) measure the exposure to new knowledge within the regime with the lagged weighted participation at the meetings of the main LRTAP institutional bodies within the last four years. In other words, they measure Countries’ meeting attendances in the regime’s institutional bodies, where most information on scientific research is presented to a country’s delegation. These are the EB, the EMEP steering body and the WGE (\(PPPwB4\)). In \(PPPPwB4\) a country’s participation in WGSR meetings is also included, where experts have also opportunities to inform the members on relevant air pollution issues, although the main aim of WGSR meetings is to offer a setting for parties to prepare negotiations. To normalize the meetings attended by each party, because the number of meetings in any given year is different, the number of meetings each party attended during a given year is divided by the total number of meetings of this given year. Then, the weighted participation of the party in the four years before the year of interest was added for each year because it takes new information time to reach the decision-makers and the exposure to the information needs time to take effect. For robustness tests, I also use the non-weighed indicator \(PPPB4\) that is the addition of the raw attendance to the EB, WGE and EMEP steering body meeting of the previous four years.

A potential selection problem is that the factors that influence participation might be the same, which motivate cooperation. Regression analysis showed that the participation of countries in the regime is not significantly affected by the amount of imported and exported transboundary air pollution and interviews with representatives confirmed that regular participation is seen
as equally important for laggards and frontrunners. The two main determinants for participation they mentioned were policy relevance and available resources. Interviewees also mentioned technical priorities and image purpose (“important to be seen” and appear willing to discuss, noticed Ireland and Cyprus) as a motivation for participation. Actually, every country has a genuine interest to participate in order to defend its position and interests. The decision to send a delegation and who will be part of it is primarily taken at the ministry level.

The attendance to the meetings of the main regime institutions is therefore not influenced by the willingness to enhance cooperation. But cooperation willingness can affect the way a country behaves in the meetings and also the intensity of collaboration in the scientific task forces. Indeed, countries that want to push for more cooperation and particularly worry about the environmental problem have an interest in scientific progress and tend to send more experts to the specialized task forces and invest more money in research.

However, there is a factor that seems to affect both, participation and ratification, at the same time. Resources were mentioned by half of the interviewees as a relevant factor that affects participation. In the models, I control for capacity that is a good proxy for available resources. Capacities of a country are operationalized with the CINC scores from the “Correlates of War Project”. CINC scores are the annual values for the computed Composite Index of National Capability (CINC), which is based on total population, urban population, iron and steel production, energy consumption, military personnel, and military expenditures (Singer, Bremer & Stuckey, 1972). Another measure of country’s domestic capacities, the natural log of GDP per capita, is also used for robustness tests, which fairly reflects the capacities and capabilities of countries.

Another relevant control variable that affects ratification, the costs/benefits ratio of cooperation, is represented with a variable that captures the emission-deposition ratio of transboundary pollution in each country with regard to SO$_2$ and NO$_x$ ($emdepSo2_00$, $emdepNox_00$)$^{10}$. A small ratio indicates that the country is primarily a victim of pollution imported from other countries, whereas a large ratio indicates that the country exports more pollution than it imports. This reflects the genuine interests of a country and the costs it can expect, if it cooperates. The more pollution a country exports the more costs and the less benefits are expected from cooperation.

Regarding domestic politics, veto points in the political system are measured with an indicator.

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$^{10}$ Both variables are snapshots based on deposition data from the year 2000. The data are not available for every year, but as the relationship between emissions and depositions does not change very much across the years, this can be used as proxy for the costs/benefits ratio of cooperation.
for political constraints (polconiii) (Henisz 2009) to capture the difficulties in adopting policies that change the status quo. Three different variables were used to capture how green the domestic politics is: share of green in parliament (share_gr) from the Comparative Political Data Set III (Armingeon et al. 2007), the average environmental emphasis of all parties in a country legislature (av_per501), and environmental emphasis of parties in government weighed by seat share (Env_gov_w).  

Moreover, although participation facilitates learning, the effect of exposure to usable knowledge is not expected to be linear. That is why the interaction hypotheses are important in order to really assess the effect of learning. Hypothesis 2 expects a stronger effect of learning and exposure for moderate countries, i.e., countries that lack clear interests. Hence, I construct interaction terms with participation and the costs/benefits of cooperation with regard to SO\(_2\) and NO\(_x\) (PPPwB4XSo2_00, PPPwB4XNOx_00).

Hypothesis 4 expects a stronger effect of learning and participation on ratification behavior if the government and/or the relevant legislative are receptive toward environmental issues. In order to estimate this effect, three interaction terms have been built with respect to participation and the different operationalizations of “green domestic demand” (share_gr, av_per501, env_gov_w).

Finally, further potential diffusion effects induced by the behavior of neighbors have been operationalized as the lagged share of neighbor countries that have ratified the respective treaty (ln_pernb), an alternative operationalization of diffusion is the share of other countries (potential treaty members) that ratified one year prior (lperc_totratif2).

**Methodology**

To estimate the model\(^{12}\) and test the hypotheses, I use semi-parametric Cox-duration models. This statistical approach is appropriate because I investigate the effects of covariates on the time span until ratification (survival time) -- once a treaty is open for ratification. Ratification patterns do not show typical weibull or exponential distributions, which is why the Cox model is well suited in this case as it makes no assumptions about the form of the hazard function. Moreover, this model assumes that covariates have a proportional and constant effect


\(^{12}\) The model: Ratification=f(Lagged_weighted_participation + participationXexport/import_of_transboundary_air_pollution + participationXshare of greens + CINC + veto points + share of green +export/ import_of_transboundary_air_pollution).
invariant of time, which is why proportionality is tested and adjusted for when necessary.

**Results and interpretation**

The first step of the analysis includes a comparison of the hazard function across groups and by treaties. In order to estimate a model on the whole data set including all treaties, a log rank test of the equality of the survivor functions was conducted.\(^{13}\)

Figure 3: Survival estimates by treaties

The log rank test confirms the equality of the survival functions. Figure 3 shows the survival estimates by treaties: Each of the treaties exhibits similar trends, which also indicates the similar survival functions. Thus, the hypotheses can be tested with data, which include all treaties.

Regarding hypothesis 1 on the effect of learning through participation, the estimation results with the Cox model give significant results in the expected direction (see Table 3). Hence, the exposure to usable knowledge in the bodies of the LRTAP regime, in which new knowledge is most actively diffused, seems very well to influence the ratification behaviour of countries - - even if I control for other factors.

\(^{13}\) In case these functions would vary between the groups (by treaty), the model would need to be tested on nine separate datasets for each treaty.
Table 3: Estimation results (Cox proportional Hazards Model)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Model 1: Only participation (H1)</th>
<th>Model 2: Participation and controls (H1)</th>
<th>Model 3: Interaction with interests (H2)</th>
<th>Model 4: Full model and interaction with green domestic demand (H1-H3)</th>
<th>Model 5: controls &amp; alternative specifications</th>
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<td>0.4408***</td>
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<td>1620</td>
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*** p<0.01, ** p<0.05, * p<0.1 (Standard errors in parentheses)

Table 3 displays the results of different specifications of the model, which include a model...
only with the participation variable (model 1), a model with participation and main control variables (model 2), model 3 presents the results with the interaction term participation and costs/ benefits of cooperation with regard to NOx, while model 4 is the full model including interaction terms between participation and costs/ benefits of cooperation with regard to SO2 as well as the interaction with green domestic demand (here the percent of green in parliament). Finally, model 5 is estimated with alternative specifications of the variables (ln_gdp, av_per501, PPPB4).

All models but model 5 are run with the PPPwB4 participation variable. The same models were also estimated with the PPPPwB4 variable and virtually produced the same results. Therefore, I strongly believe that all operationalizations are adequate to measure learning and participation. The proportionality of the effect of the covariates across time was tested with the Schoenfeld residuals and the assumption of proportional hazard holds in all models shown here.  

The main variable of interest, the learning and participation indicator clearly shows that exposure to relevant new scientific information influences the ratification behavior even when other ratification parameters are controlled for (model 2). One unit of change in the weighed lagged participation indicator, which represents three to four meetings within four years, depicts a ratification hazard ratio, which is 1.5 to 2.4 times higher than the baseline hazard.  

The considerable explanatory power of factors that were identified in previous studies, i.e., interests, capacities, and domestic politics, is confirmed in this analysis. Particularly, the genuine interests for cooperation among parties is prevalent: a one unit of change in the emission-deposition ratio along the victim-polluter line results in a hazard to ratify, which is up to 30% smaller compared to the baseline hazard, at least for SO2 emission-deposition ratio. This means that a country, which exports twice as much air pollution as it imports, is less likely to ratify compared to a country, which exports as much air pollution as it gets into its territory. The picture is less clear for NOx emission deposition ratio, though, as the effect is smaller and varies across the models.  

Domestic green demand has also a positive effect. The greener the legislative or the executive

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14 In some models not reported here, the variables ln_gdp and share_gr needed to be interacted with ln_time in order to correct the non-proportional hazard (see Box-Steffensmeier and Zorn 2001).
15 \( \exp(0.4376) = 1.54898 \) (model 2); \( \exp(0.4408) = 1.55394 \) (model 3); \( \exp(0.8940) = 2.44888 \) (model 4).
16 \( \exp(-0.3832) = 0.681676 \) (model 2), \( \exp(-0.0133) = 1.01338 \) (model 3), \( \exp(-0.1564) = 0.855217 \) (model 4).
of a country or the higher the average environmental emphasis of all parties in a country legislature, the faster a country ratifies an LRTAP agreement. National capacities have an impact on the ratification behavior, too. Lack of resources partly explains ratification delays. The veto-points variable is more surprising, because it has the opposite effect than expected, and the output is not always stable when it is included in the models. The more veto points a country has, the faster it ratifies. As indicated, this is an unexpected result that could merit further investigation. Haftel and Thompson (2008) obtained similar, counterintuitive results with regard to veto players in their analysis of the ratification of bilateral investment treaties. While legislative hurdles like a majority in two chambers explains delays in ratification, the effect of veto-players are mixed. Their interpretation is that leaders, who are more constrained by domestic politics, anticipate their domestic problems and are able to negotiate better treaties. These results could also arise from the fact that several well known “big polluter” like Poland, UK and Russia are centralistic countries.

The small number of cases in some of the estimated models may also explain why some covariates have unstable estimation results. In fact, the data on green demand do not cover all years and all countries of the dataset, 17 which is why the number of total observations is lower when different specifications of green demand are included in the models. It may be one of the reasons why some parameter estimates are not stable across these models.

The inclusion of the share of neighbors that have also ratified does not reduce the effect of participation, and has in most models a positive and significant effect; the same holds for the alternative diffusion variable. Hence, the behavior of countries’ peers has an effect. The more neighbors or other countries ratify a treaty the faster a country will also ratify it, independently of its involvement in the regime.

With regard to the hypotheses on the conditional effect of learning through participation, the estimation of effects gives results that are different from what I expected. On the effect of participation conditional on a country’s domestic green demand, as shown by the figure below, the result is significant, 18 at least up to a percentage of 10% of greens in parliament, but the effect is weak and negative. Domestic green demand hardly affects the effect of

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17 The share of green parties in parliament (share_gr) is based on the CPDS III dataset (Armingeon et al. 2007) and encompasses a group of 34 OECD and/or EU countries from 1990 to 2004. The average environmental emphasis of all parties in a country legislature (av_per501) only covers 24 OECD countries until 2004, most Western European countries of this dataset plus Hungary, Poland and Turkey (the latter only for a few years).

18 With a Cox model, interactions need first to be plotted in order to assess the significance of the results. All interaction graphs are created with „grinter“, a STATA command that allows graphing the marginal effect of an interacted variable.
participation on ratification.

Figure 4: Marginal effects of (weighted) participation conditional on the percentage of green parties in Parliament (based on model 4)

This result is surprising since Kaplan-Meier survival estimates of the share of greens in parliament were plotted and the resulting graph illustrates that the presence of green parties in a country’s parliament lead to a faster ratification of LRTAP treaties. Because information causes more likely a learning process when the new knowledge is congruent with ideology, I expected that participation would have a bigger effect on the ratification for countries with greener domestic demand. However, this is not the case. An explanation for this unexpected effect could derive from the fact that green parties are able to bring environmental issues to the domestic agenda, where environmentalist movements are represented in the parliament. Hence the government as well as the administration may already be well informed about transboundary pollution issues. In this case, information learnt at LRTAP meetings does not comprise many key elements, which could affect the position of decision makers and even increase ratification pace. Countries, where environmental interests are represented in the parliament or government tend to ratify such agreement rapidly anyway.
Figure 5: Survival estimates by share of greens in the parliament (0=0%, 1= >0% - <8%, 2= >8%)

With regard to the effects of participation conditional on interests, the results do not fully correspond to the expectations that the effect of participation would be highest for countries with unclear interests. As fig. 6 and 7 show, the more a country exports pollution relatively to its involuntarily imports from abroad, the impact of participation on ratification decreases. Interestingly, the conditional effect slightly differs depending on the way the costs of cooperation are measured. If interests are measured with SO$_2$ emission/deposition ratio, the big SO$_2$ polluters are more reluctant to cooperate than big NO$_x$ polluters. Domestically, NO$_x$ and SO$_2$ emissions relate to different actor-constellations at the national level as Murdoch et al. (1997) notice. The domestic sources of pollution are different and regulations affect different actors. SO$_2$ regulations can be costly but affect comparatively few actors (polluting industry, energy sector), while a broader spectrum of actors with rather diffuse interests is concerned with NO$_x$ reduction instruments (e.g., car drivers), which is similar to CO$_2$. This makes NO$_x$ reduction goals more difficult to implement politically than SO$_2$ reductions.

However, participation has still a positive effect on the pace of ratification for most polluters. Exposure to usable knowledge in regime institutions thus fosters ratification for countries that would not necessarily cooperate otherwise. But this positive effect it is not significant any more for SO$_2$ polluters that cause more than twice pollution abroad than at home; even if they
are well integrated in the regime, it is difficult to motivate big SO$_2$ pollution exporters for deeper cooperation.

Figure 6: Marginal effects of (weighted) participation conditional on the cost/benefits of cooperation with regard to SO$_2$ (based on model 3)
The fact that victims of transboundary pollution ratify faster when they participate regularly in regime institutions can also be explained by learning. During LRTAP meetings, countries are confronted with research results that relate to their own situation and interests, which they are not necessarily aware of. Expert information about the extent or urgency of a problem can reinforce their willingness to ratify soon.

Having said that, this interpretation should be taken with care, as an alternative interpretation is that victim countries, which participate in regime institutions on a regular basis, are the frontrunners. They have strong interests in international cooperation and lobby actively in the regime. Their earlier commitments aim to set a good example and inspire other countries to act in the same way. For instance, Sweden and Norway, which suffer considerably from transboundary air pollution and pushed for deeper international cooperation for decades, regularly ratify LRTAP agreements within two years after they are open for ratification. Their representatives probably do not learn much as they are likely to actually be the ones who actively spread new insights into problems related to air pollution.
Conclusion

This research demonstrated that an intensive exposure to usable knowledge in the institutional bodies of a regime has a positive impact on the international environmental commitment behavior of countries with respect to transboundary air pollution. The effect of participation on ratification behavior remains unchanged when other factors are included in the model like the costs/benefits ratio of cooperation or domestic capacities.

This result confirms that we have to take into account temporal dynamics and diffusion mechanisms in order to better understand ratification behavior of countries. Learning and socialization processes take time to unfold their effects, in contrast to static factors that influence a country’s decision to commit to international agreements like interests, resources, institutions, or party constellation.

Nonetheless, findings of earlier research regarding the effects of relevant factors for ratification like capacities, interests, domestic politics, and contingent factors were also corroborated. The capacity of the public sector is an important predictor of environmental cooperation; obviously, countries are reluctant to commit as long as they lack the necessary resources available for implementing a treaty. Costly commitment without prospect for many benefits generally refrains countries to intensify cooperation. The more costs are expected from a given agreement, the longer it takes until a country eventually ratifies it. Regarding domestic politics, green parties and the environmental emphasis of parties in the parliament have a positive impact on the pace of environmental cooperation, the “greener” a country the faster it ratifies an agreement. Surprisingly, institutional constraints like veto points do not slow down ratification procedure with regards to LRTAP agreements.

Moreover, other interdependent factors can also affect the pace of ratification besides learning. Perrin and Bernauer (2010) showed that contingent effects in general matter: for instance, the more other countries have ratified a given treaty, the more likely a country ratifies it. Simmons (2009) explained the so-called „false negatives“ – a country’s ratification of international human rights agreements without intention to comply because the treaty runs counter its interests - with emulation mechanisms.

However, my results showed that the regular presence of country representatives in meetings, where relevant information on the issue at stake is directly transmitted, has a crucial impact on the pace of ratification and is unlikely to be affected when other factors for cooperation are included in the model.

Of great interest – although only partially overlapping with the theoretical expectations -- are
the findings on the different effect of participation conditional on interests and domestic politics. It was expected that participation would have a bigger impact on the ratification behavior of countries with unclear interests and “greener” backgrounds. However, the analysis revealed a decreasing effect of participation conditional on interests (fig. 5 and 6). Participation and learning seem to affect victim countries more than big polluters, but the effect of participation is almost always positive.

The conditional role of domestic politics does not entirely correspond with the expectations either. The government’s environmental emphasis does not amplify the effect of participation on its ratification behavior. The assumption that representatives of greener countries are more prone to assimilate and learn from new knowledge about the environmental problem at stake did not hold. The effect of participation on ratification is even decreasing a little bit the greener a country is.

Most likely, representatives of countries where environmental interests are represented in the government or in the parliament are already well informed about a lot of the issues presented in the LRTAP meetings and about scientific progress. These countries generally environment agreements faster than average anyway. Therefore, an increase in participation and exposure to information in the regime arenas does not much affect the policy position much or fasten the ratification of a treaty.

Several policy recommendations for future environmental agreements can be derived from this research. First, an early integration of potential members into regime institutions is worth to achieve. It might be useful for decision-makers to consider incentives available to achieve this goal in order to incite a broader circle of countries to actively participate on a regular basis. As shown in this paper, regime linkages can act as valuable facilitators for knowledge transfer. Better-informed countries, which have a straightforward access to usable knowledge through regular participation in the regime, are more prone to deepen international environmental cooperation. Interests are not carved in stone and can be re-evaluated after obtaining of new and relevant information.

Actually, the working group of effects (WGE) of the LRTAP regime is an excellent example for an institutional setting that offers access to specialized know-how and to expert knowledge that is beneficial for the participants. It facilitates scientific advancements, brings experts together, and sustains epistemic communities while spreading relevant scientific results -- especially about the consequences of pollution within the regime, in the scientific community, and out to various audiences. These advantages should provide incentives to more potential
members to get involved.

Second, capacity building is an essential issue for broadening cooperation. Parties with strong interest in deeper cooperation could support the regime and co-finance instruments aiming at developing the capacity of poorer countries to cooperate more effectively. At least with regard to the LRTAP regime, such kinds of mechanisms already exist, e.g. via monitoring stations that have been sponsored in Southern and Eastern Europe.

Third, as learning and involvement in a regime cannot always overcome strong interests, other mechanisms to convince polluters to reduce transboundary air pollution should be explored. Besides positive incentives, economic pressure or coercive measures can incite to ratify agreements. However, international regimes do not have many coercive instruments available. They can offer a setting, where issue-linkages are negotiated among members. Concerning the environmental issues covered by the LRTAP agreements, the European Union (EU) could pressure uncooperative EU members. Such a strategy might be more promising in generating higher participation rates in LRTAP treaties in the future.

Against this background, a couple of promising avenues for further research do exist. For instance, given adverse interests, it would be interesting to look more deeply into potential tipping points and possibilities to overcome unfavorable initial positions with regard to environmental cooperation. A better understanding of the effect of domestic factors on cooperation is also necessary. Research along those lines that might take up my findings could shed further light on these crucial issues.
Chapter 3: Explaining the dynamics of international legal commitment in the area of air pollution: Diffusion mechanisms as drivers of international environmental cooperation.

Sophie Perrin

Introduction

Most, if not all, environmental problems are of transnational nature and, thus, cannot be solved unilaterally but require international cooperation. Such environmental problems include global warming, air pollution, and toxic waste trade. Despite increasing efforts to address this from an academic perspective, we still lack sound and thorough knowledge on what precisely affects the willingness of countries to agree on and join international cooperative arrangements. The following paper seeks to contribute to this debate by studying diffusion mechanisms in the realm of international legal commitments, i.e., the ratification of environmental treaties.

This paper focuses on domestic incentive structures regarding the ratification of LRTAP treaties and the debates leading up to ratification. I consider the ways in which incentives toward international environmental agreements may change after treaty negotiations, and what processes can foster or hinder the ratification of international treaties.

Previous studies of cooperation are pessimistic regarding the success of international legal commitments. Theoretically agreements should be self-enforcing, i.e., countries should have a rational interest to join to avoid the problem that enforcement is unlike or implausible (Barrett 2003). Nevertheless, the outcomes of self-enforcing treaties are generally not much better than (uncooperative) unilateral approaches, since polluters do not have a rational interest to join. International treaties should also motivate broad participation, include the relevant states and, ultimately, induce significant behavioural changes that improve the global environmental problem they aim to solve. Yet it is difficult to motivate countries with opposing interests to participate in international agreements that are meant to lead to meaningful environmental improvements.
This pessimistic view is based on the assumption that the incentive structures defined by the design of a negotiated treaty are static. However, this is unlikely to hold true. If the costs and benefits of cooperation were static and stable over time, we would expect prompt ratification from countries that expect to gain from such an agreement and, on the contrary, no ratification from countries expecting a negative cost/benefit ratio. Yet, this is not mirror what we observe. There is great variation in the ratification behaviour of countries and even notorious polluters have joined international environmental agreements.

Why some countries do ratify faster than others, and what factors can support a broad and rapid ratification of international environmental agreements even after a treaty has been negotiated?

First, I build upon existing research and contend that a country’s incentives to cooperate can change after the treaty negotiations and that the pace of ratification can be affected by diffusion. Thus, I explicitly reject the static view of the previous works and take into account diffusion approaches that allow conceptualizing ratification as a reactive process and, thereby, offer some pathways to explain variation in time until ratification between countries. My central argument is that countries lacking an interest in cooperation, can be influenced by diffusion effects like learning, emulation, coercion or competition, to the extent that the likelihood of cooperation increases and ratification is encouraged.

I also explore pro-active processes that influence the pace of ratification. Countries that expect high benefits from successful cooperation (such as countries that are directly suffering from the consequences of global warming, climate change, rising sea levels, etc.), might employ strategic means in order to influence others and to accelerate ratification.

This study relies on existing insights that highlight the role of interdependencies, diffusion and learning in the international relations literature generally and/or explaining international commitment specifically (e.g., Underdal, 1998; Wetterstad, 2002; Breitmeier et al., 2006; Perrin and Bernauer, 2010).
This paper presents comparative cases studies of proactive and reactive processes in the ratification of the four most recent LRTAP agreements in three countries. The expected cost/benefits ratio expected from ratification is not obvious. Although it is challenging to derive far-reaching generalizations from these case studies, they can be considered as preliminary evidence for the proposed theoretical framework, delivering interesting insights into the dynamics of international cooperation.

The analysis confirms that economic interests and costs are the central determinants of international cooperation, but the appreciation of these costs can change after a treaty is open for ratification. In this context, I am able to show that learning and emulation play a role in the ratification process and can lead to faster and even broader participation. In contrast, coercive pressure is unlikely to be an effective way to foster and deepen international cooperation regarding the four last LRTAP treaties under study. Strategic ratification in order to encourage others commitments can also be an important motivation to accelerate the ratification process.

The chapter proceeds as follows. First, I give an overview of the motivations for deeper international environmental cooperation and present a set of possible explanations for delayed ratification. Second, based upon learning, emulation, coercion and competition mechanisms, I then develop causal mechanisms, which illustrate the dynamics of ratification behaviour beyond static approaches. The third section presents the empirical approach, where I begin with illustrating the contexts in the three countries under study and summarize the ratification debates. The fifth section presents the results, while the last section concludes and discusses the implications of my findings.

**Theoretical background: Motivation for ratification**

**Interest-based and domestic explanations**

“The evidence suggests that treaty commitments clearly reflect underlying state and societal preferences” (Simmons 2009: 18). As Simmons notes, costs and benefits related to a treaty and domestic institutions are a relevant explanatory factor for cooperation. Countries that expect a considerable benefit from an environmental treaty, are more likely to ratify promptly,
while countries that would incur large costs from greater cooperation tend to delay ratification if they join at all (Sprinz and Vaahotoranta, 1994). If countries incurring high costs for ratification never ratify, successful treaties mitigating transboundary environmental problems will not be agreed upon.

The central problem of international environmental cooperation and international cooperation is that there is no direct international control over participation and compliance. Theoretically, international treaties should be self-enforcing, that is, structure incentives for broad participation, and to encourage cooperation (Barrett, 1998; Barrett, 2003). In practice this is hard to achieve. Strategic instruments such as side-payments and trade sanctions may be used, but can be costly and difficult to implement.

There are also domestic hurdles to ratification. The assessment of the costs and benefits of a potential ratification can differ between the relevant domestic actors. For example, the government that was involved in the original treaty negotiation and the parliament’s majority that has to ratify do not necessarily have homogeneous preferences and interests with regard to a given environmental treaty. Hence, even if a government favours a treaty, it has to anticipate domestic problems regarding ratification before signing and beginning a ratification procedure.

Having said that, if only treaties conforming to static preferences of states had the possibility of being ratified, treaties could not change states’ behaviour: their primary goal. Countries who did not want to change their behaviour would not ratify and those who did ratify would already be engaged in the behaviours demanded by the treaty. Countries agreeing with the contents of a treaty would be screened in, and those disagreeing would be screened out, but no behaviours would change.

Nevertheless, Simmons (2009) showed that human rights treaties influence the behaviour of laggard countries that would not be expected to join at all. Ratification can ignite constraining effects on the members even in areas where no centralized enforcement mechanisms are in place and where no mutual gains nor reciprocity are expected. There are also contingent factors that can induce the ratification of a treaty and then affect the behaviour of countries. Some countries with opposing incentives are reluctant, but still ratify. The behaviour of other
countries, external pressure or other policy goals can tip the balance in favour of ratification.

The numerous international environmental agreements that exist have not only been ratified by victims of environmental degradation. Assessment of costs and benefits is complex and actors can be both victim and perpetrator at the same time. Moreover, evaluating costs and benefits is complex and the country’s final stance is often unclear. It is difficult to assess potential damages, the feasibility and costs of tackling these problems, and even how to tackle these problems..

So what does explain ratification, beyond the traditional static cost-benefits explanations? Learning, emulation, coercion and competition are potential reactive mechanisms while strategic ratification is one potential proactive mechanism.

**Learning mechanisms**

When new scientific evidence becomes accessible to a wider audience, decision makers can take into account the new knowledge, re-engage in domestic debate, re-evaluate their positions, and potentially ratify a treaty they were reluctant to ratify prior to the introduction of new evidence.

Novel information about the severity of environmental problems or about solutions will shift the domestic debate. New knowledge can tip the balance in either direction. New information about a diminution of the problem or loopholes in the treaty could discourage ratification. However, scientific advancements generally work in the opposite direction. Better knowledge of the issue at stake, its related risks and damages, and new technologies make policy options more concrete and transparent, improve the quality of the debate and make the problem more difficult to ignore. Scientific insights reach decision makers through general public debate, well-targeted reports from knowledgable sources, or through a country’s own administration. Given new information, governments update their beliefs, re-evaluate their position toward a given treaty, and potentially ratify the treaty.

**Hypothesis 1**: A country is more likely to ratify an environmental treaty (and faster) when novel scientific information about the consequences of an environmental problem is available.
for and known by the policy makers of that country.

**Emulation mechanisms**

The behaviour of other countries can impact a country’s incentive structure and ratification decision. In the research this can be called “imitation,” “emulation” or “symbolic imitation.” All three terms describe a policy decision based on the actions of other countries and do not necessarily imply a change in the beliefs of policy makers. Emulation is a more strategic and reward-oriented mechanism than learning. When neighbouring countries, or internationally relevant players like the EU, or powerful countries ratify a treaty, the international and domestic reputational rewards and the costs of non-ratification increase. Hence, the behaviour of others changes the international frame of reference. Neighbours may be the most influential as they share regional transboundary problems and the reputational costs of non-cooperation rise significantly if the regional ratification rate is high (Simmons, 2009). The pressure to ratify can increase based on the power of perceived level of “advancement” among ratifiers. As other countries ratify, the perceived feasibility and the cost of ratification could change. Countries can also copy each other to gain credibility or legitimacy abroad (Braun et al., 2008:7; Shipan and Volden, 2008:7).

**Hypothesis 2**: A country is more likely to ratify an environmental treaty (and faster) when most neighbours or a group of internationally relevant countries have ratified this environmental treaty before.

**Coercion mechanisms**

Countries also influence one another through direct coercion; for example, economically powerful countries or political entities (Bechtel and Tosun, 2009) can increase pressure to ratify. For instance, the EU can put pressure on potential future members to ratify international treaties. In other words, “powerful countries can explicitly or implicitly influence the probability that weaker nations adopt the policy they prefer by manipulating the opportunities and constraints encountered by target countries, either directly or through the international and non-governmental organizations they influence” (Simmons, Dobbin and Garett, 2006:11).

**Hypothesis 3**: A country is more likely to ratify an environmental treaty (and faster) when
powerful actors exercise pressure to ratify.

**Competition mechanisms**
External pressure that forces a country to adapt does not necessarily have to be coercive. Economic competition alone may incite countries to adopt new standards or imitate behaviour (Vogel 1995). In the context of environmental agreements, after competitors have ratified and agreed on higher standards, the costs of one’s ratification slightly diminish, which may tip the balance in favour of ratification. Some treaties include market restrictions for non-members, directly exerting pressure on non-ratifiers.

**Hypothesis 4**: A country is more likely to ratify an environmental treaty (and faster) when most competitors have ratified the treaty.

**Pro-active mechanism of ratification**
Interdependent behaviour, however, is not only reactive as described by the diffusion mechanisms above, where countries react to one another. Countries can also pro-actively ratify a treaty with the intention of influencing others. Countries with clear genuine interests in international cooperation should be pro-active front-runners. The first ratifiers should be victims of transboundary environmental problems while those with unclear or very few genuine interests for cooperation would be more likely influenced through diffusion.

**Hypothesis 5a**: The more affected by a given environmental problem a given country is, the more likely the country will be to independently ratify an environmental treaty with the intention of influencing others (expected reciprocity, pro active mode of cooperation).

**Hypothesis 5b**: When a country has unclear intrinsic interests to ratify a treaty, the more likely it will be motivated to ratify an environmental treaty based on diffusion (reactive mode of cooperation).

To sum up, the argumentation in this section moves beyond internal explanations that stem from domestic interests and domestic politics. In fact, I argue that learning, emulation,
coercion and competition processes also affect the chances of environmental cooperation at the international level. Finally, I also take into account pro-active mechanisms of ratification. Table 4 lists in detail all the potential mechanisms, which can influence the pace of the environmental treaty ratification of environmental treaties.

<table>
<thead>
<tr>
<th>Processes</th>
<th>Mechanisms</th>
<th>Effect</th>
</tr>
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<tbody>
<tr>
<td>Learning</td>
<td>New scientific insights reach a broader audience ⇒ re-evaluation of the position with new information ⇒ incentives to ratify increase (new cost/benefit calculation) ⇒</td>
<td>Ratification</td>
</tr>
<tr>
<td>Emulation</td>
<td>Relevant peers (e.g. neighbours) ratify a treaty ⇒ international and domestic reputational rewards (or costs of non ratification) related to the treaty change (benchmark), (“learning short-cut”: sent information about feasibility and meaningfulness of treaty) ⇒ re-evaluation of the position ⇒</td>
<td>Ratification</td>
</tr>
<tr>
<td>Coercion</td>
<td>Actors with coercive power have an interest in other’s participation ⇒ formulation of the constraint (pressure) ⇒ re-evaluation of the position with new information ⇒</td>
<td>Ratification (coerced)</td>
</tr>
<tr>
<td>Competition</td>
<td>Important economic partners ratify ⇒ re-evaluation of the position with new information ⇒</td>
<td>Ratification</td>
</tr>
<tr>
<td>Expected reciprocity</td>
<td>Ratification in order to induce others to ratify, too ⇒</td>
<td>Early ratification</td>
</tr>
<tr>
<td>Change in cost/benefits</td>
<td>Benefits of ratification &lt; costs ⇒</td>
<td>No ratification</td>
</tr>
<tr>
<td>Change in domestic politics</td>
<td>Economic changes ⇒ incentives to ratify change (new cost/benefit calculation) ⇒</td>
<td>(No) delayed ratification</td>
</tr>
<tr>
<td></td>
<td>Domestic political changes ⇒ new parliament majority ⇒</td>
<td>(No) Ratification</td>
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</table>
**Empirical approach**

Empirically, I focus on the area of transboundary air pollution. Dramatic changes in air quality have taken place in Europe over the past decades. Until the 1970s, air pollution was mainly considered to be a local problem in highly industrialized areas. However, in the late 1970s, air pollution became a salient international environmental issue due to the increasingly visible damages caused by acid rain. In 1979, 33 countries joined the Convention on Long-Range Transboundary Air Pollution (C-LRTAP) with the explicit aim to limit and gradually reduce air pollution with the best available technology that was economically feasible. The contracting countries did not agree on any clear reduction goals, but committed “by means of exchange of information, consultation, research, and monitoring, to develop without undue delay policies and strategies which should serve as a mean of combating the discharge of air pollutants, taking into account efforts already made at the national and international levels” (C-LRTAP, article 3).

The LRTAP regime started with very modest goals given that the signatory countries were, at that time, not ready to incur a costly liability (Wettestad, 2002; Dai, 2007). However, it was followed by eight additional international agreements in the same policy area (protocols to the C-LRTAP, see Table 2 in the Appendix). By 2010, 51 countries have ratified the convention and more than 20 countries ratified eight of the follow-up agreements from the LRTAP regime, which include deeper commitments with regard to reduction goals and the implementation of new technologies. Nowadays, the regime is regarded as a success that has influenced European air policies effectively (Wettestad, 2012).

Based on theory, I seek to assess the influence of different diffusion mechanisms and proactive cooperation on the timing of ratification decisions. I do this via comparative case studies of three countries (George and Bennett, 2006). The analysis focuses on the intrinsic incentives, including the costs of pollution reduction implied by the treaty, and on the domestic legislative ratification debates with regard to the four most recent LRTAP treaties in the three countries (Austria, Estonia and Switzerland) between 1992 and 2007. The protocols analysed are the 1994 Protocol on Further Reduction of Sulphur Emissions negotiated in Oslo, the 1998 Protocols on Heavy Metals and on Persistent Organic Pollutants (POPs) negotiated in Aarhus, and the 1999 Protocol to Abate Acidification, Eutrophication and
Ground-Level Ozone, negotiated in Gothenburg that regulates SO$_2$, NO$_x$, VOC and NH$_3$ (ammonia).

Geopolitical changes like the emergence of new countries and the end of the cold war as well as the availability of sources limit my empirical research to the years after 1992. After the fall of the Berlin wall, the international arena and the dynamics of cooperation changed dramatically. Therefore, those post-1991/1992 agreements are more comparable. Additionally, the first LRTAP agreements have already been investigated by several scholars (Levy, 1993; Hanf and Underdal, 2000).

I examine Austria, Estonia and Switzerland as these countries share many characteristics, which makes it possible to clearly outline and identify the decisive causal mechanisms. Austria, Estonia and Switzerland are small to medium sized countries whose interest profile is not always clear with regard to the treaties under study, as they are simultaneously victims of transboundary air pollution and polluters. The three countries were chosen based on their theoretically indecisive positions towards most or some of the protocols.

Another important parameter is the importance of a country. Powerful countries can usually invest more resources in international negotiations, make sure that a treaty does not interfere with their interests, and are less dependent on others economically. Austria, Estonia and Switzerland are all more or less low-power countries in terms of the C-LRTAP protocols.

Regarding domestic politics, a strong conservative right-wing party that is reluctant to deepen international cooperation is present in the parliament of all three countries and in all three green parties are relatively weak. The three countries vary with regard to their relationship to the EU; Switzerland is not a member while Austria and Estonia joined the EU in 1994 and 2004, respectively.

I assess the hypotheses using text analysis of governmental white papers and the protocols of legislative debates regarding the ratification of an environmental treaty. These sources contain the main arguments for and against adoption. These sources are complemented with secondary sources and expert interviews with country representatives and LRTAP officials.
In order to test the first hypothesis, I measure the emergence of incentives to ratify an international treaty as a result of novel scientific information, i.e., the effect of knowledge on international cooperation through learning mechanisms, in different ways. First, I code justifications in favour of a ratification related to new available scientific information. Second, because it is difficult to reconstruct an exact chronology of the spread of information, I also rely on the LRTAP regime itself as an important information-provider through its coordination activities and the promotion of research. Besides the various working groups on specific topics, the EMEP (European Monitoring and Evaluation Program) and the WGE (Working Group on Effects) provide extensive information on major air pollutants and their effect on human health and environment to their LRTAP members. They regularly publish reports on current scientific knowledge and make this accessible to a broader audience, including policy makers.

Policy makers have access to other sources of information, like domestic scientific advisers, i.e. “internal learning” (Volden et al. 2008). This is, however, not a diffusion effect and, hence, excluded from my theoretical approach. Yet, to minimize this risk of confusing learning and internal learning, I focus on rather small countries, i.e., Austria, Estonia and Switzerland. Small countries’ administrations have less resource in absolute terms than bigger countries and are therefore more dependant on international scientific research. With the help of expert interviews, I elaborate a chronology of the knowledge developments available to a broad audience. If Hypothesis 1 applies, I expect novel scientific information about the consequences of pollution to be extensively used as an argument in the parliamentary debates and in the white papers.

To assess the second hypothesis, I operationalize emulation mechanisms via ratification justifications relating to the ratification of other countries like neighbours or relevant groups of countries, as well as the international image of a country. Moreover, to validate the results, the ratification status of neighbours is also used as an indicator. If Hypothesis 2 applies, I expect that the parliamentary debates and white papers directly refer to the ratification of neighbours in their arguments. We may also observe other justifications related to the international image of a country.

Regarding the operationalization of the third hypothesis, indicators for coercion include the existence of a coercive power towards potential recipients, which in this study corresponds to
the status as a EU-accession country. However, I also consider justifications in favour of ratification related to “a necessity” derived by international engagements, “package deals” or other kinds of coercive pressure. If Hypothesis 3 is true, I expect that arguments underlining the necessity to comply with EU requirements are mentioned in parliamentary debates and governmental white papers. EU accession countries should ratify more quickly.

To assess the fourth hypothesis on competition, I consider competitor countries to be the most important trade partners of a country, according to the IMF trade statistics. In addition, I employ justifications in favour of ratification relating to the notion that alignment to international standards is necessary and/or that there is no competitive risk due to the prior ratification of trade partners. If Hypothesis 4 is valid, I expect arguments related to the competitiveness of the country. Furthermore, countries whose competitors have ratified a treaty should ratify faster.

Regarding the hypotheses on proactive and reactive ratification, if Hypothesis 5a is true, I expect clear victims of transboundary pollution to ratify an environmental treaty first. Furthermore, I expect arguments of expected reciprocity and the necessity to behave as a role model to be used in the parliament debates and in the white papers. Finally, if Hypothesis 5b applies, those countries without clear-cut interests should be more influenced by diffusion.

It is also necessary to control for alternative explanations of delayed ratification. Indeed, a delayed ratification can also be driven by significant changes in the intrinsic costs or benefits of a country (e.g., due to reduced emissions as a result of economic modernization and de-industrialization) or a change in the constellation of domestic interests (e.g., due to electoral success of parties particularly opposed or in favour of international environmental cooperation), which lead to re-evaluation of the ratification decision. I operationalize these variables as follows. First, changes in genuine costs and benefits of a treaty are measured using both the damages caused by transboundary pollution (transboundary emission/deposition ratio and depositions trends) and also using the potential abatement costs that derive from the emissions of the concerned pollutants (SO$_2$, NO$_x$, NH$_3$). Finally, I rely on the share of electricity production from coal sources as well as the fact that high GDP per capita and an advanced legislation lower the costs of treaty ratification. The emissions and depositions data come from EMEP sources (Tarrasón et al., 2006), while the economic
indicators (GDP per capita, electricity production) come from the World Bank Development Indicators (2008). In the legislative debate, indicators for costs/benefits changes, which may lead to ratification, are justifications, in which the indicators detailed above are mentioned (e.g. changes in emissions, depositions, GDP per capita, electricity production and legislation).

Changes in domestic politics are operationalized using the share of parties in the national parliament (Nordsieck, 2008), particularly the percentage of green parties (CPDS, 2008). Other parties may also support environmental cooperation, but increases in votes for green parties clearly reflect a demand for more environmental engagement. Table 5 illustrates how the main concepts and processes of interest are operationalized.

Table 5: Indicators and sources

<table>
<thead>
<tr>
<th>Processes of interest, main concepts</th>
<th>Indicators</th>
<th>Sources</th>
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</thead>
<tbody>
<tr>
<td>Learning</td>
<td>New available knowledge for a broad audience</td>
<td>WGE reports, interviews</td>
</tr>
<tr>
<td></td>
<td>Justification in favour of ratification related to new available scientific information on the environmental problem (damage, abatement techniques etc.)</td>
<td>White papers, Protocols of legislative debates</td>
</tr>
<tr>
<td>Emulation</td>
<td>Ratification of other countries and neighbours.</td>
<td>LRTAP/ own data</td>
</tr>
<tr>
<td>Behaviour of peers</td>
<td>Justification in favour of ratification related to the ratification of other countries, to the international image, an ambitious program and/or conformance to international standards</td>
<td>White papers, Protocols of legislative debates</td>
</tr>
<tr>
<td>Coercion</td>
<td>EU accession member</td>
<td>Secondary sources</td>
</tr>
<tr>
<td></td>
<td>Justification in favour of ratification related to “a necessity” derived by international engagements, “package deal” or other kind of coercive pressure</td>
<td>White papers, Protocols of legislative debates</td>
</tr>
<tr>
<td>Adaptation/competition</td>
<td>Ratification of important trade partners</td>
<td>Secondary sources, DOTS IMF</td>
</tr>
<tr>
<td></td>
<td>Justification in favour of ratification related to the fact that alignment to international standards are necessary and/or that no competitive risk is to be feared due to the prior ratification of trade partners</td>
<td>White papers, Protocols of legislative debates</td>
</tr>
<tr>
<td>Pro-active ratification</td>
<td>Frontrunners (rapid ratification).</td>
<td>LRTAP/own data</td>
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In a first step, I analyse the incentive structure of the three countries regarding the LRTAP treaties. Air pollution trends, transboundary flow, electricity production and domestic politics are scrutinized. In the next section of the paper, I turn to the white papers and the parliamentary ratification debates.

Depending on the treaty of interest, countries could be ambivalent, victims, or polluters. As soon as LRTAP treaties are open for ratification, they can be enacted by domestic parliaments. The treaty enters into force after the 16th country ratifies the treaty. Victims of air pollution have a strong interest in a fast ratification. Norway and Sweden, for instance, which are prominent victims of transboundary sulphur pollution, have ratified all LRTAP treaties within the first two years after the treaty was open for ratification.

As expected by theory and hypotheses, results show that expected high benefits from a treaty lead to ratification. Austria and Switzerland are clear victims of transboundary sulphur pollution. For both countries high benefits without many costs can be anticipated from the 2nd SO2 protocol, which they ratified after four years. The same holds with regard to the heavy metal protocol for Switzerland, ratified after only two years. Estonia, a net SO2 polluter, is not
yet part of the 2\textsuperscript{nd} SO\textsubscript{2} protocol.

However, as shown in Table 6, incentives do not always explain the pace of ratification. Moreover, countries reacted differently when incentives were unclear. Switzerland ratified the POP protocol in just two years and ratified the Gothenburg protocol despite costs, while Austria and Estonia have not yet ratified this protocol at all – despite the fact that my analysis highlights that all three countries had similar uncertainties related to the costs and benefits of participation.

Table 6: Incentives to join a treaty according the costs/benefits related to the LRTAP protocols under study and ratification status

<table>
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<tr>
<th></th>
<th>2nd SO\textsubscript{2} protocol, Oslo 1994</th>
<th>POP protocol, Aarhus 1998</th>
<th>Heavy Metal protocol, Aarhus 1998</th>
<th>Multi-effect protocol, Gothenburg 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Ratified after 4y</td>
<td>Ratified after 4y</td>
<td>Ratified after 5y</td>
<td>-</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Ratified after 4y</td>
<td>Ratified after 2y</td>
<td>Ratified after 2y</td>
<td>Ratified after 6y</td>
</tr>
<tr>
<td>Estonia</td>
<td>-</td>
<td>Ratified after 8y</td>
<td>Ratified after 9y</td>
<td>-</td>
</tr>
</tbody>
</table>

Legend:
- Clear incentive to ratify (high benefits, few costs)
- Incentive to ratify (benefits, moderate costs)
- Incentives to ratify unclear (costs and benefits)
- No incentive to ratify (high costs, few benefits)

POP and Heavy Metal protocols offer advantages for all countries because of the expected lower depositions, but are also connected with some costs, too. In Switzerland as well as in Austria to some extent, the costs are rather moderate, because most treaty’s obligations were already encompassed by domestic law prior to ratification.

Regarding the political constellation, the participation or the absence of a conservative right wing party in the government coalition does not really affect the ratification behaviour of the countries under study. Green parties are relatively weak in all three countries. They have never been part of the government and have had less than 10\% of the seats.

Table 7: Domestic politics

<table>
<thead>
<tr>
<th>Domestic politics</th>
<th>Austria</th>
<th>Switzerland</th>
<th>Estonia</th>
</tr>
</thead>
</table>
**conservative parties in the government coalitions**  | coalitions.  | seat (out of seven) in the government. Two seats out of seven between 2003 and 2007.  | different nationalist conservative parties were, together with the reform party, part of the government coalitions.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gothenburg: -</td>
<td>Gothenburg: 2005</td>
<td>Gothenburg: 2005</td>
<td>Gothenburg: -</td>
</tr>
</tbody>
</table>

Table 7 gives an overview of the political constellation in the three countries under study. No clear patterns with regard to the effect of the domestic politics on ratification behaviour are observed. In all three countries, strong conservative right-wing parties are represented in the parliament (>20%) and are often in the government. The preservation of the national sovereignty, the reluctance towards the European Union and towards deeper international cooperation are common features of the FPÖ in Austria, the SVP in Switzerland and the various nationalist conservative parties in Estonia. Moreover, they are not particularly sensitive to green issues and often represent the interest of the farmer lobby. The better nationalist conservative parties are represented in a parliament or in government, the less likely the ratification of an international environmental treaty should be. But in the three countries analysed, LRTAP treaties have been signed even with a strong nationalist conservative representation in the government coalition (the Gothenburg treaty in Switzerland, POP and heavy metal protocol in Austria and Estonia), while the centrist social-democrat ÖVP/ SPÖ coalition in the Austrian government has not yet ratified Gothenburg. The political situation may have slowed down the ratification process in Switzerland, where the ratification of Gothenburg took longer than usual, as at the time, the SVP had two representatives in the government.

19 Although the ratification of 2nd SO2 protocol has been debated in the parliament in 2003, Estonia is not yet formally party of the protocol according LRTAP-sources (http://www.unece.org/env/lrtap/status/lrtap_s.html).
Austria

Austria, a relatively quick ratifier until the mid-nineties, has since become a less cooperative international partner. Austria has ratified the initial eight LRTAP treaties so far. The first five treaties were ratified in the first three years following the opening of ratification. Since 1995, the lag until ratification has increased from four to seven years and the last protocol, Gothenburg, has not yet been ratified, twelve years after the signature.

A close look at the costs and benefits related to the LRTAP treaties shows that Austria was clearly a net victim of SO$_2$ deposition from abroad and still is today, although SO$_2$ depositions have been considerably reduced since the 1980s. The picture looks different, when we look at NO$_x$ emissions, though. Here, Austria is neither a clear victim nor a clear polluter. According the EMEP data on transboundary fluxes (see appendix, Fig. 1), Austria exported in 2005 more pollution to its neighbours than it received from abroad. The abatement of its own NO$_x$ emissions was not linear, with emissions even starting to rise again from 1995 on. During the same time span, NH$_3$ emissions stagnated (see Figure 8).

Figure 8: Emissions and depositions of transboundary air pollution in Austria.
Thus, there is a clear trend until the mid-1990s; national emissions were reduced and the SO\textsubscript{2} pollution decreased in the country. However, since then, there has been stagnation and the pace of Austria’s emissions reductions are slackening.

As polluter and victim at the same time, Austria has had uncertain interests in cooperation, except in the case of the second SO\textsubscript{2} protocol. The rising GDP per capita brings, on one hand, more resources to implement abatement measures, but, on the other hand, it also can boost the total energy consumption.

The emissions-deposition trends indicate that Austria had a strong interest in a successful 2\textsuperscript{nd} SO\textsubscript{2} protocol (Oslo 1994), but its substantial incentives regarding the other three LRTAP protocols are not that clear. In the case of Gothenburg, which regulates SO\textsubscript{2}, NO\textsubscript{x}, VOC and NH\textsubscript{3}, Austria has conflicting interests.

Regarding domestic interests, Austria experienced considerable changes in its domestic politics from the mid-1990s with the electoral successes of the nationalist right (FPÖ and BZÖ) and the weakening of the grand coalition of SPÖ and ÖVP that strongly dominated the political landscape of Austria since 1945. Until 2000, the government was composed of an SPÖ-ÖVP coalition, but in 1994 the FPÖ gained more than 20% of the vote in the national
election for the first time and was eventually integrated into the government from 2000 to 2007 (ÖVP - FPÖ coalition). Since the mid-1990s, green parties have also gained seats in the parliament (up to 9.5% since 2003) (Nordsieck 2008, see Appendix 3, Fig. 2, tables 2 and 3).

1995 and 2000 were clear breaks in Austrian domestic politics. Nevertheless, the political conditions cannot fully explain ratification. The Conservative nationalist coalition of ÖVP and FPÖ finally ratified the POP and the heavy metal protocols, even if relatively late. The new SPÖ and ÖVP coalitions have not yet ratified the Gothenburg protocol, although they in the past they ratified more rapidly.

**Switzerland**

Switzerland has ratified all LRTAP treaties so far. It took the country four years to ratify the framework convention, but the next four treaties were rapidly ratified one or two years after they were open for ratification. The second SO$_2$ Protocol took four years to be ratified in 1998, the heavy metals and the pop protocols were ratified after two years in 2000. Finally, the Gothenburg protocol was signed after six years, only shortly before its entry into force. Switzerland was a relatively quick ratifier from the mid-1980s to the mid-1990s, but has slowed down its ratification pace since.

According to the EMEP data on transboundary fluxes, Switzerland was also a clear victim of SO$_2$ transboundary air pollution as Switzerland exports less SO2 than it suffers from foreign SO2-emissions. Regarding NO$_x$ the situation is more ambivalent, as Switzerland exports more NOX to its neighbouring countries than it imports.

According the deposition data from EMEP (Tarrason et al., 2006), SO$_2$ decreased dramatically between 1980 and 2000, while NO$_x$ and NH$_3$ exhibit a weaker downward trend (Figure 9).
Domestic emissions as well as depositions have constantly decreased since the 1980s, although the curve has flattened out since 2000 and NH₃ emissions from agriculture even started to rise. Switzerland reduced its consumption of fossil fuel and its dependency on
energy imports from abroad over the last few decades.

As transboundary victim of SO$_2$, Switzerland had some interests in a successful 2$^{nd}$ SO$_2$ protocol (Oslo 1994), but its interests to cooperate are far less clear with regard to the Gothenburg protocol. Switzerland is a polluter and a victim at the same time, at least with regard to NO$_x$ and NH$_3$, two substances regulated by the Gothenburg protocol. Therefore, its incentives to ratify this treaty are ambivalent.

Regarding the parliament, Swiss domestic politics have also undergone considerable changes since the late 1990s with the electoral success of the isolationist nationalist SVP party, lead by Christoph Blocher. In 1999, the SVP acquired more than 20% of the votes for the first time. During the 2004-2007 legislative period, the right wing party gained a second seat in the government coalition and was represented by two ministers of the seven ministers. The share of green parties in parliament remained constant, fluctuating between 5% and 8% (see Appendix 3).

Despite the fact that some power shifts occurred in the national parliament and in the government, they are unlikely to explain the variation in ratification behaviour with regard to LRTAP treaties. Two protocols were quickly ratified unanimously after the electoral rise of SVP and the Gothenburg protocol was ratified during the legislature with 2 SVP ministers, although with some delay.

**Estonia**

After gaining independence from the Soviet Union in 1991, Estonia elected its first parliament in 1992 and ratified four LRTAP protocols in 2000 (the Convention, the first SO$_2$ Helsinki protocol, the Sofia NO$_x$ and the VOC protocol); the EMEP protocol in 2002, the POP in 2005 and the heavy metals protocol in 2006. According to LRTAP sources, Estonia is not part of the second SO$_2$ protocol and the Gothenburg protocol. The Gothenburg protocol has neither been signed nor ratified and has not yet been an issue in the parliament. The Estonian parliament did debate the ratification of the second SO$_2$ protocol and accepted it on the 4$^{th}$ of June 2003. However, the parliament could not agree on the ways to reach the emission reduction goals and finally decided to comply with the obligations primarily by means of innovation and technology transfer, and agreed on relatively modest sulphur reduction obligations (40% of 1980 year levels by 2010, which have almost already been reached in the
1990s due to deindustrialisation).

Estonia is a net polluter with regard to sulphur emissions and causes more SO$_2$ depositions abroad than it suffers from foreign SO$_x$ emissions. At the same time, Estonia is also a net victim of NO$_x$ transboundary air pollution (Tarrasón, 2006). One of the reasons for the relatively high emissions levels with respect to the size of the country is that the Estonian economy heavily relies on fossil fuels, in particular oil shale, which account for 90% of the total energy consumption. According the EMEP data, Estonia’s emissions started to significantly decrease in the 1990s. On the other hand, emissions of NO$_x$ and NH$_3$ stagnated from 2000 on, as shown in Figure 10.

Figure 10: Depositions of transboundary air pollution in Estonia

Sources: EMEP (Tarrasón et al. 2006)
Estonia has grown richer in the last 20 years and the pollution levels have decreased. However, the country is still both polluter and a victim of transboundary air pollution and its economy relies heavily on fossil fuels. The emission-intensive oil shale industry will remain an important part of the economy.

Similar to Austria and Switzerland, the domestic political landscape of Estonia is characterized by weak green parties and strong conservative right wing parties. The nationalist parties have over 20% of the seats in parliament and were integrated in most governmental coalitions since 1992 (see appendix 3, Fig. 4, tables 6 and 7).

However, the variation in domestic politics cannot fully explain the ratification behaviour of Estonia with regards to the LRTAP protocols under investigation, similar to Austria and Switzerland. Estonia ratified five LRTAP protocols during the 1999-2002 legislature, when a liberal, conservative and social democratic alliance governed. Between 2005 and 2007 two more protocols were ratified under the government of the conservative, liberal and centrist coalition of the People’s Union, the Centre Party and the Reform Party.

Considering the costs related to ratification and the state of its polluting industry, Estonia would not have been expected to ratify any of the LRTAP treaties. Other factors must have tipped the balance in favour of ratification. When the costs are considered too high, for example with regard to SO2 reduction goals in the Gothenburg treaty and the second SO2 protocols, learning and emulation could not bring Estonia to join.

To recapitulate the insights from the analysis of the cases so far, neither the benefits nor the expected costs related to a treaty nor the composition of the government coalition can truly explain the time elapsed until ratification. Other mechanisms most probably played a role, too. That is why I turn now to the analysis of the debate and white papers.

**Ratification debates**

The analysis of the debates and white papers depicts the main arguments used in favour of or against the ratification of an environmental treaty. Besides justifications suggesting diffusion
effects, other lines of argumentation were identified. Justifications in favour of ratification related to the (moderate) costs of ratification were coded as “genuine interest.” Justifications related to a new majority and its programme—“domestic politics”—were not mentioned in any debates.

The ratification of competitors and issue of competitiveness were not explicitly mentioned in the debates and the white papers. The statements related to (positive) economic consequence referred rather to harmonization of standards and new export opportunities. The necessity to harmonize standards was mentioned in relation to the EU in Estonia and in relationship with “the level playing field” in Austria and Switzerland. Such arguments were coded as “harmonization of standards” and the arguments related to the advantage of economic modernization and new export opportunities were coded as “positive effect for the economy.”

A recurring argument, especially in Austria, was reciprocity: Justifications in favour of a ratification related to the expectation it may incite others to ratify. Those arguments were coded as “reciprocity.” Justifications in favour of a ratification related to the international image of the country were coded as “international image.” Finally, general justifications in favour of ratification related to the environment but unrelated to concrete new scientific facts were coded as “Environment”.

All justifications mentioned above appeared once or more in the source documents, with the exception of arguments regarding the ratification by competitors and those related to domestic politics. Such arguments might have been unnecessary. By the time a ratification debates takes place, the government is generally in favor of ratification because it previously signed the treaty. In case the government is no longer in favor of ratification, they might not present the issue to the parliament. General arguments about the importance of a clean environment were always mentioned and are therefore not included in the table. Table 8 summarizes the results of the text analysis of the debates and government papers.
<table>
<thead>
<tr>
<th>Argumentative lines in the white papers and in the parliamentary debates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Austria</strong></td>
</tr>
<tr>
<td>Argumentation referring to 2nd SO2</td>
</tr>
<tr>
<td>Learning</td>
</tr>
<tr>
<td>Emulation</td>
</tr>
<tr>
<td>Coercion</td>
</tr>
<tr>
<td>Harmonization of standards</td>
</tr>
<tr>
<td>Reciprocity</td>
</tr>
<tr>
<td>International image/role model</td>
</tr>
<tr>
<td>Genuine interests (few costs)</td>
</tr>
<tr>
<td>Positive effect for the economy</td>
</tr>
<tr>
<td>Particularly important/recurring argument</td>
</tr>
</tbody>
</table>

In Austria as well as in Switzerland, the cost argument was recurrent. All LRTAP treaties ratified by Austria bear costs and the only case where the necessary legal adaptations had already been fulfilled before ratification was the SO\textsubscript{2} protocol. However, these costs were described as “marginal,” “reasonable,” “low,” or “acceptable” during parliamentary debates and in white papers. The fact that they were easily overcome by the benefits of the expected broader cooperation was underlined several times. The benefits were the reduced emissions from neighbours that Austria wanted to foster by behaving as a role model in the SO\textsubscript{2} case with the hope that others would join too.

The gravity of the consequences of POP and Heavy Metal emissions for human health and the environment was also a reason to bear some additional costs of cooperation. During the debates, references to current research results were frequent. In the POP case, the fact that
various other EU members announced their ratification before the international UN summit on sustainable development in Johannesburg in 2002 probably accelerated the ratification process, a clear indication of emulation. The Austrian government explicitly recommended ratifying the protocol before the summit of Johannesburg, because other EU members had also planned to do so.\textsuperscript{20}

Coercion did not influence Austria. If Austria were to vigorously apply EU law, it would comply with the Gothenburg goals too, and would have no reason to delay ratification. The European NEC directive (2001/81/EC) adopted in 2001 set binding emission ceilings similar to those of the Gothenburg protocol for SO\textsubscript{2}, NO\textsubscript{x}, VOCs and NH\textsubscript{3} to be achieved by 2010. Austria currently anticipates missing the goal for NO\textsubscript{x} (by more than 10\%) and for VOC in 2010 (by 5\% to 10\%) (Technical report No 10/2010) and is not yet ready to take additional action, even though the NEC is compulsory.

Market mechanisms and competitors do not seem to play an important role. New export markets for Austria’s clean-tech industry have been the sole economic argument mentioned during the debates. The parliament always accepted the ratification of the LRTAP treaties with a very comfortable majority or even unanimity when the issue was brought to the parliament. All parties agreed to the ratification of the SO\textsubscript{2} protocol, the heavy metal and the POP protocol.

In the Austrian case, relatively rapid ratification could have been expected from the first treaties while the incentives to join Gothenburg were less clear although the European Union made similar objectives compulsory. Austria did not quickly ratify the SO\textsubscript{2}, POP and HM protocols. Due to its high NO\textsubscript{x} emissions, it is not ready to bear the costs to reduce them.

Similarly to Austria, the Swiss argumentats in favour of ratification of LRTAP always mentioned the reasonable costs of the agreement. This is due to the fact that the Swiss legislation generally does not need much adjustment regarding air pollution. However, two treaties, Gothenburg and the POP imply some costs. In the case of the second SO\textsubscript{2} and the

\textsuperscript{20} “Eine Ratifikation durch Österreich bis zum Weltgipfel zur nachhaltigen Entwicklung in Johannesburg (August 2002) erscheint als wünschenswert, zumal dies auch durch die anderen Mitgliedsstaaten der EU ins Auge gefasst wurde.” (Regierungsvorlage, 1171 der Beilagen).
heavy metal protocol, all necessary changes had already been adopted by the legislature. Most regulations fitted Swiss environmental laws and were in line with the policy goals of the Ministry of Environment. As such the POP and the Gothenburg protocols had already been implemented before the parliamentary debates.\textsuperscript{21}

New insights on the severity of the problem and studies from Germany and Scandinavia were also regularly referred to, which seems to be a clear indicator for learning. The ratification of others countries is also systematically mentioned in the government’s white papers and in debates. In the debates, politicians also mentioned Switzerland’s interest in a reciprocal behaviour of others: “We have no material, additional obligations. Conversely, we have a natural interest that this protocol will be ratified as soon as possible, because then the other countries must also meet their obligations. (...) The Protocol shall enter into force when 16 States have ratified it. At the time of the Commission meeting in May, 5 Ratifications were already there - that of England, Luxembourg, the Netherlands, Norway and Sweden. You see, it still needs 11 ratifications, one of which can be ours.” (Gian-Reto Plattner, social-democratic party, ratification debate in the Ständerat, 18.06.1997 on the second SO\textsubscript{2} protocol.\textsuperscript{22} The importance of harmonization of environmental standards and a level playing field was also brought up in relation with HM, POP and Gothenburg.\textsuperscript{23} The same holds for the seriousness of the environmental problem.\textsuperscript{24}

\textsuperscript{21} Legal adaptations after the parliamentary decision were only needed for the POP protocol. To comply with the goals of the Gothenburg protocol minimum adaptations, basically the implementation of federal law, were still to be done in a few cantons in relation with NH\textsubscript{3} emissions (Botschaft on the Gothenburg protocol).


As in Austria, there is also a clear evidence for emulation regarding the POP protocol, where one of the main arguments in the white papers was, besides the moderate costs and the expected reciprocal effect on other countries, the expected ratification of other countries during 2000.

There was definitely no coercion at work. Switzerland is not a member of the EU and no other external pressure was identified. Switzerland ratified all LRTAP protocols and most were ratified with a very comfortable majority of the parliament, even unanimity. But during the parliamentary debate on the Gothenburg protocol, an animated debate came up and the entire right-wing conservative SVP fraction refused ratification. In Switzerland, based on the domestic legislation and the costs related to the treaties implementation, a rapid ratification would have been expected for the second SO\textsubscript{2} protocol and the heavy metal protocol, while some resistance could be expected for the POP and the Gothenburg protocol. However, the Heavy Metal and the POP protocol were ratified extremely rapidly, while the second SO\textsubscript{2} and the Gothenburg protocols took longer, though they were finally ratified.

Due to its old and inefficient energy sector, the ratification of the LRTAP protocols involved considerable costs for Estonia. However, the costs were described as “not substantial” or moderate in most sources, at least from the point of view of the government. Estonia had a strong interest in the modernization of energy production, which probably accounts for why they agreed to bear substantial costs. Estonia has also implemented several policies and programs to meet its reporting and monitoring obligations and to modernize its infrastructure and the energy sector.

In the white papers related to the ratified POP and Heavy Metal protocols, recurrent arguments in favour of ratification also pointed to the gravity of the environmental problem. In the debates, Estonia’s ability to comply as well as the number of other signatories and ratifiers were recurrently mentioned.\textsuperscript{25} The fact that the content of the protocol is consistent

with EU regulation was also mentioned, which suggests a coercion effect. However, harmonization with EU law was not a sufficient reason to ratify. Estonia only ratified five of nine LRTAP protocols in the years before its EU accession even though the protocols were part of the “acquis communautaire” whose ratification would have been a precondition for EU membership. As of today, Estonia has ratified seven LRTAP treaties under different political coalitions. The country is not yet party to the Gothenburg and the second SO$_2$ protocol.

**Discussion and conclusion**

This chapter considered the ways in which states’ incentives to ratify international environmental agreements may change after treaty negotiations, and what processes can foster or hinder the ratification of those treaties. First, I relied on diffusion approaches that allow conceptualizing **ratification as a reactive process** and I argued that countries, which do not have a genuine interest to cooperate can be influenced by diffusion effects like learning, emulation, coercion, or competition, increasing cooperation and ratification. Second, I also explored **pro-active processes** that affect the speed of ratification. For instance, countries that expect high benefits from an international agreement might employ strategic means in order to affect and move others, and to accelerate ratification dynamics. To assess these arguments, I employed comparative case studies of three countries (Austria, Switzerland, and Estonia) and four ratification debates with regard to agreements under the Framework Convention of Long-range Transboundary Air Pollution (CLRTAP).

The analysis confirmed that economic interests, the feasibility of complying with a treaty’s obligations, and costs are – and remain – the central influence in the domestic debates with regard to international cooperation. However, I could demonstrate that the appreciation of these costs can change after a treaty is open for ratification. **Learning** and **emulation** can play a role in the ratification process and may lead to faster and even wider participation. Considering the costs related to ratification for its economy and the state of its polluting industry, one would not expect Estonia to ratify any of the LRTAP treaties. Other factors tipped the balance in favour of ratification. As stated in the first hypothesis, in all countries under study, arguments relying on new scientific research about the consequences of pollution were extensively used in almost all debates and white papers. These arguments were typically meant to justify unavoidable costs that ratification would imply. New insights on health risks were particularly effective
according to interview partners in and outside the regime. The broad and relatively quick ratification of the POP and Heavy Metal protocols has certainly also been fostered by the broad and rapid diffusion of new knowledge on the health impacts of carcinogen pollutants like VOC, POP and particles ($\text{PM}_{10,2.5}$) that became increasingly relevant for policy makers,\(^{26}\) while environmental risks connected with the substances regulated by the Gothenburg protocol ($\text{SO}_2$, $\text{NO}_x$, $\text{NH}_3$ and VOC), fluxes of transboundary air pollution, acidification, and eutrophication of soils and water are not visible or are not (yet) considered as a serious danger for human health. Hence, the results support the first hypothesis on learning processes, and countries seem indeed to be more likely to ratify when novel scientific information about an environmental problem becomes available for and known to policy makers.

Regarding the second hypothesis on emulation processes, the results are less clear. The theoretical argument stated that a country is more likely to ratify an environmental treaty, when most neighbours or a relevant group of countries have ratified the treaty. The attitude of other countries as a whole seems to influence ratification, but there seems to have been no examination of the timing of neighbours’ ratification. Austria joined the $\text{SO}_2$-, the POP-, and the Heavy Metals protocol in the same time span as its neighbours, but has not yet ratified the Gothenburg protocol, even though most of its neighbours have. Switzerland behaves as a frontrunner regarding the POP- and Heavy Metals protocol, but ratified the $\text{SO}_2$-protocol after some of its neighbours. Estonia has generally ratified LRTAP treaties after most of its neighbours, but has not yet ratified the Gothenburg protocol despite the fact that most of its neighbours have.

The inconclusive results with regards to the ratification of neighbours corroborate previous research (Perrin and Bernauer 2010). Having said that, results suggest that the expected ratification behaviour of relevant peers can foster the ratification of an environmental treaty to some extent. For instance, Switzerland and Austria brought the POP treaty bill to parliament earlier than they might have done otherwise and mentioned that other countries intended to ratify. Thus, the global agenda seems to have supported cooperation. Switzerland aimed to ratify it before the UNEP meeting in Stockholm in 2001, where an international agreement based on the model of the LRTAP POP protocol was elaborated and intended to be adopted.

\(^{26}\) VOC in the late 1980s, POP in the early 1990s and particles after 2000 (Interview with Mr. H.-M. Seip, 29.9.2010).
Austria wanted to ratify the POP protocol before the international UN summit on sustainable development in Johannesburg in 2002. Moreover, other countries that have ratified a treaty are almost always referred to in the ratification debates and in the white papers – except in the SO$_2$ and heavy metal debates in Austria and the SO$_2$ debate in Estonia. The argumentation analysed not only pertains to neighbours, but also countries “worth imitating” like Canada and the US, which are not directly related to the transboundary pollution problem, but whose cooperative behaviour counts at the international level. Reputational arguments also played a role in favour of ratification. For instance, the Estonian documents reveal the importance of the country’s image as seen by others: “Estonia can do it”, it “wants the same as other ratifiers,” and is “capable of meeting the treaty’s obligations” were justifications that I found in the white paper and during the debates.

Therefore the second hypothesis is partly confirmed by the case studies. The attitude of other countries as a whole definitely seems to influence ratification behaviour. But a look at the timing of neighbours’ ratification, cannot explain the ratification delays of the three countries under study.

The third hypothesis has to be rejected. Coercive pressure did not foster and deepen international cooperation regarding the four last LRTAP treaties. Switzerland, unlike the other states, the only non-EU member, ratified all treaties. Moreover, accession countries did not ratify faster, even when ratification was a precondition for EU accession. This is somewhat surprising but confirms previous research (Aakre and Hovi 2010) on emission trading programmes, which show that not only participation, but also compliance, must be enforced in order to be effective.

Regarding the fourth hypothesis, competitiveness arguments played a minor role. Depending on the country, it fuelled the pro-active or the reactive ratification behaviour. Countries that faced few costs but could potentially derive substantial benefits of a certain treaty underline the “level playing field issue” and ratified treaties in an attempt to impose more stringent standards on others. While countries confronted with high costs of implementation underlined the economic advantages of the modernization of certain economic sectors related to these treaties.
Competitive pressure from important trading partners did not seem to influence ratification behaviour. Austria ratified the POP protocol when the majority of its main trading partners had not yet ratified, but has not ratified the Gothenburg protocol although most of its trade partners have. Switzerland ratified the POP and Heavy Metals protocols before most of its trade partners in 2000, but ratified the second SO\textsubscript{2} and the Gothenburg protocols after its most important trade partners did. Finally, Estonia joined the POP and Heavy Metals protocols after most of its trade partners, except Russia, but has not yet ratified Gothenburg.

Economic arguments related to the competitiveness of the country, like new export opportunities for the cleantech industry and the prospect of technology transfer and innovation were used in the debates. In Switzerland, the harmonization of standards was emphasised. This refers to the “level playing field” argument and was often mentioned with respect to expected reciprocity. However, in this case, the motivations of Switzerland to ratify are clearly pro-active and not a reaction induced by diffusion mechanisms. This brings us to the hypothesis 5a: *strategic ratification* in order to foster others’ commitments as an important motivation to accelerate the ratification process.

The ratifications of the second SO\textsubscript{2} protocols by Switzerland illustrate this mechanism and support the hypothesis. The decision to ratify was clearly motivated by proactive intentions. The same holds for Austria, for which diffusion mechanisms like learning and emulation are secondary with regard to the second SO\textsubscript{2} treaty. Austria wanted to be a role model in the context of the second SO\textsubscript{2} protocol and justified the importance of ratification with the impact on others.

Pro-active processes can somewhat overlap with reactive processes. The results regarding the last hypothesis are therefore less clear and the analysis of more cases would be needed to test this claim. It is partly true that countries with ambiguous interests can be influenced by learning and emulation although when the costs are too high, these processes are insufficient to tip the balance in favour of ratification. Table 9 below briefly summarizes the results of the analysis.
Table 9: Overview of the results

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Austria</th>
<th>Switzerland</th>
<th>Estonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis 1: A country is more likely to ratify an environmental treaty (and faster) when novel scientific information about the consequences of an environmental problem is available for and known by the policy makers of that country.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hypothesis 2: A country is more likely to ratify an environmental treaty (and faster) when most neighbours or a group of internationally relevant countries have ratified this environmental treaty before.</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
</tr>
<tr>
<td>Hypothesis 3: A country is more likely to ratify an environmental treaty (and faster) when powerful actors exercise pressure to ratify.</td>
<td>No</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Hypothesis 4: A country is more likely to ratify an environmental treaty (and faster) when most competitors have ratified the treaty.</td>
<td>No</td>
<td>unclear</td>
<td>Yes, partly</td>
</tr>
<tr>
<td>Hypothesis 5a: The more affected by a given environmental problem a given country is, the more likely the country will be to independently ratify an environmental treaty with the intention of influencing others (expected reciprocity, pro active mode of cooperation)</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Hypothesis 5b: When a country has unclear intrinsic interests to ratify a treaty, the more likely it will be motivated to ratify an environmental treaty based on diffusion (reactive mode of cooperation).</td>
<td>unclear</td>
<td>unclear</td>
<td>Yes, partly</td>
</tr>
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</table>

This paper was able to shed more light on previously unanswered questions about treaty ratification though the findings are still incomplete and further research is necessary. The analysis relies on just three case studies. Despite providing new insights, they are not a robust and definitive test of the hypotheses on diffusion theory. To validate findings more cases studies are necessary, in particular using a research design that can consider cases in which no ratification debates have taken place. The research design used in this paper does not always distinguish between the different pro-active and reactive processes, as these somewhat overlap in the three countries. To better understand how diffusion can influence ratification dynamics, more countries should be integrated in the analysis, including laggards and frontrunners. In order to test these hypotheses in an exhaustive way and derive generalization for cooperation theory, this theoretical framework should be applied to more than one regime.

Nonetheless, policy implications can be derived from this research. First and foremost, learning processes can positively influence cooperation behaviour. Therefore, the promotion of transnational cooperation in research and intensive exchange between scientists and policy
makers is an important way to increase cooperation (Hordijk and Amann 2007).

As noted by Richard Ballaman, the chairman of the WGSR (Working Group of Strategic and Research), one of the four main institutions of the LRTAP regime, the science-driven architecture of the LRTAP could even inspire other environmental regimes:

« Un aspect positif du LRTAP est de travailler sur la base de faits scientifiques avérés (flux transfrontaliers identifiés, impacts sur la nature, mesures possibles). La science guide la politique. Une expérience fantastique qui pourrait inspirer d’autres régimes. » (Interview with R. Ballaman, 15th of April, 2010).

However, diffusion processes cannot surmount all barriers to ratification. That is why programmes aiming at facilitating accession countries by means of capacity building, technical and legal support are also important to overcome high costs, and to influence laggard countries. The weight put on the diffusion of technology transfer and knowledge by the LRTAP regime are promising. This is important since the use of the coercive power from the EU has proved ineffective.
Bibliography


Armengeon, Klaus et al. (2007). Comparative Political Data Set III 1990-2004, Institute of Political Science, University of Berne.


Sources
Armingeon, Klaus et al. (2007). Comparative Political Data Set III 1990-2004, Institute of Political Science, University of Berne.
UNECE: www.unece.org

Legal documents
EU: NEC directive (2001/81/EC)
EU: LCP directive (2001/80/EC)
CH: LRV
CH: VOCV
CH: TAFV1-3
CH: DZV
UNECE (LRTAP): The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 26 Parties. Entered into force on 17 May 2005


**White papers and minutes from parliamentary debates**

**Austria**


**Switzerland**


Ständerat, Sommersession 2000, Zwölfte Sitzung, 22.06.00: 00.029 Grenzüberschreitende Luftverunreinigung. Übereinkommen betreffend Schwermetalle. Botschaft des Bundesrates 01. März 2000 (BBI 2000 3097)

**Estonia**


X Riigikogu Stenogramm, I Istungjärk, 4.6.2003 (Piiriülese öhusaaste kauglevi 1979, aasta konventsiooni väävli heitkoguste edasise vähendamise protokolliga ühinemise seaduse eelnõu (10 SE) teine lugemine). (Word protocol of the parliament debates, 4.6.2003, on the accession to the protocol on further sulphur reductions, bill (10SE) second reading).

X Riigikogu Stenogramm, I Istungjärk, 4.6.2003 (Piiriülese öhusaaste kauglevi 1979, aasta konventsiooni väävli heitkoguste edasise vähendamise protokolliga ühinemise seaduse eelnõu (10 SE) teine lugemine)

X Riigikogu Stenogramm, I Istungjärk, 7.5.2003 (Piiriülese öhusaaste kauglevi 1979, aasta konventsiooni väävli heitkoguste edasise vähendamise protokolliga ühinemise seaduse eelnõu (10 SE) esimene lugemine)


**Interviewpartners**

Table 10: Interview partners

<table>
<thead>
<tr>
<th>Interview partner</th>
<th>Fonction</th>
<th>Contactaddress</th>
<th>Place and date of interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Hans Martin Seip</td>
<td>Professor of chemistry at the University of Oslo (UiO), and former advisor of the Norwegian Ministry for Environment, Norway.</td>
<td><a href="mailto:h.m.seip@kjemi.uio.no">h.m.seip@kjemi.uio.no</a></td>
<td>28.9.2010, Oslo</td>
</tr>
<tr>
<td>Matti Johansson</td>
<td>Environmental Affairs Officer</td>
<td><a href="mailto:Matti.johansson@unece.org">Matti.johansson@unece.org</a></td>
<td>31.3.2010</td>
</tr>
<tr>
<td>Name</td>
<td>Position and Organization</td>
<td>Email</td>
<td>Date</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Johansson</td>
<td>Secretary of Working Group on Effects (LRTAP)</td>
<td><a href="mailto:richard.ballaman@bafu.admin.ch">richard.ballaman@bafu.admin.ch</a></td>
<td>15.4.2010,</td>
</tr>
<tr>
<td>Dr. Richard Ballaman</td>
<td>Head of Section, Air Quality Management, Air Pollution Control and NIR Division, Swiss Federal Office for the Environment (FOEN), Switzerland</td>
<td></td>
<td>15.4.2010,</td>
</tr>
<tr>
<td>Marketa Reneova-Mohn</td>
<td>Multilateral Agreements Unit, Department of Multilateral Relations, Ministry of the Environment, Czech Republic</td>
<td><a href="mailto:Marketa.Reneova@mzp.cz">Marketa.Reneova@mzp.cz</a></td>
<td>15.12.2009,</td>
</tr>
<tr>
<td>Tarmo Pauklin</td>
<td>Member of the board, Estonian Environmental Research, Centre, Marja 4D, 10617 Tallinn, Estonia</td>
<td><a href="mailto:tarmo.pauklin@klab.ee">tarmo.pauklin@klab.ee</a></td>
<td>17.12.2009,</td>
</tr>
<tr>
<td>Andrei Pilipchuk</td>
<td>Head of department of Regulation of Impacts on air pollution and ozone layer Division of regulation impacts on air and water resources Ministry of Natural Resources and Environmental Protection, Belarus</td>
<td><a href="mailto:air@minpriroda.by">air@minpriroda.by</a></td>
<td>14.4.2010,</td>
</tr>
<tr>
<td>Sonja Vidic</td>
<td>Chair Person of EMEP as well as Air Quality Research Unit, Meteorological and Hydrological Service of Croatia</td>
<td><a href="mailto:vidic@cirus.dhz.hr">vidic@cirus.dhz.hr</a></td>
<td>16.12.2009,</td>
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<tr>
<td>John E Thompson</td>
<td>Division Director, Air and Water resources Division, Office of Environmental Policy, US Department of State, USA</td>
<td>Office of Environmental Policy US Department of State</td>
<td>18.12.2009,</td>
</tr>
<tr>
<td>Dr Chrysanthos Savvides</td>
<td>Labour Inspection Officer, Departement of Labour Inspection, Cyprus,</td>
<td><a href="mailto:csavvides@dlm.mlsi.gov.cy">csavvides@dlm.mlsi.gov.cy</a></td>
<td>18.12.2009,</td>
</tr>
<tr>
<td>Name</td>
<td>Role</td>
<td>Email</td>
<td>Date</td>
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<tr>
<td>--------------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Michael Young</td>
<td>Senior Adviser, Environment Division, Environment, Heritage and local Government Ministry, Ireland</td>
<td><a href="mailto:Michael.young@environ.ie">Michael.young@environ.ie</a></td>
<td>18.12.2009</td>
</tr>
<tr>
<td>Melanija Lesnjak</td>
<td>Secretary-Head of Air Quality Section, Environmental Agency of the Republic of Slovenia, Ministry of the Environment and Spatial Planning, Slovenia</td>
<td><a href="mailto:melanija.lesnjak@gov.si">melanija.lesnjak@gov.si</a></td>
<td>16.12.2009</td>
</tr>
<tr>
<td>Katja Kraus</td>
<td>Umweltbundesamt, FG III 2.1, Internationale Angelegenheiten der Luftreinhaltung, Germany</td>
<td><a href="mailto:katja.kraus@uba.de">katja.kraus@uba.de</a></td>
<td>14.4.2010</td>
</tr>
</tbody>
</table>
Appendix 1

International regime formation revisited:
Explaining ratification behaviour with respect to long-range transboundary air pollution agreements in Europe

Sophie Perrin and Thomas Bernauer

This set of companion materials comprises:

1. List of variables and data sources, and descriptive statistics
2. Description of the nine LRTAP agreements
3. Ratifications of the nine LRTAP agreements over time
4. Correlations
5. Properties of the models shown in Table 1 of the article
6. Simulated probabilities
7. Robustness checks
### 1. List of variables and descriptive statistics

<table>
<thead>
<tr>
<th>Variables</th>
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<th>Description</th>
<th>Sources</th>
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<tr>
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<td></td>
<td></td>
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<tr>
<td>Ratification</td>
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<td>Own coding, based on information from the LRTAP secretariat (<a href="http://www.unece.org/env/lrtap">www.unece.org/env/lrtap</a>)</td>
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<td><strong>International factors</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Others (#)</td>
<td>L_others</td>
<td>Share of other countries (potential treaty members) that ratified one year prior</td>
<td>Own coding</td>
</tr>
<tr>
<td>Others (pop)</td>
<td>L_others_pop</td>
<td>Sum of populations of countries that ratified one year prior divided by sum of populations of all potential ratifiers</td>
<td>Own coding; data for population from World Bank (2008) (see below)</td>
</tr>
<tr>
<td>Others (gdp)</td>
<td>L_others_GDP</td>
<td>Sum of GDPs of countries that ratified one year prior divided by sum of GDPs of all potential ratifiers</td>
<td>Own coding, data for GDP from World Bank (2008)</td>
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<td>Neighbours</td>
<td>L_neighbors</td>
<td>Percentage of neighbouring countries that ratified one year prior</td>
<td>Own coding</td>
</tr>
<tr>
<td>Big countries</td>
<td>L_big_3</td>
<td>France or Germany or the UK have ratified the treaty one year prior (no/yes; 0/1)</td>
<td>Own coding</td>
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<tr>
<td>Competitors</td>
<td>L_competitors</td>
<td>Share of the five biggest trade partners that have not yet ratified the treaty</td>
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<td><strong>Domestic factors</strong></td>
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<td>GDP</td>
<td>gdp</td>
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<td>World Bank (2008)</td>
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<td>gdppc</td>
<td>Log value of GDP per capita in PPP, constant 2005 international USD</td>
<td>World Bank (2008)</td>
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<tr>
<td>Trade openness</td>
<td>trade_op</td>
<td>Log of trade openness: exports + imports divided by GDP</td>
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<tr>
<td>Veto players</td>
<td>veto_players</td>
<td>Political constraints index (POLCON III)</td>
<td>POLCON 2005 (Henisz, 2009)</td>
</tr>
<tr>
<td>EU affiliation</td>
<td>EU_status</td>
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<td>------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Pollution exporter</td>
<td>polluter</td>
<td>Deposition rate of pollution (SO₂ in metric tons): total emissions of the country divided by the amount of pollution that is deposited nationally. Net exporter of pollution if polluter &gt; 1; net importer of pollution if polluter &lt; 1</td>
<td>Based on data from EMEP (Tarrasón et al., 2006)</td>
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**Control variables (time)**

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<tr>
<th>Age of treaty (^2, ^3)</th>
<th>t, t2, t3</th>
<th>Age of treaty, squared value of age of treaty, cubed value of age of treaty (see Carter and Signorino, 2007)</th>
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<tbody>
<tr>
<td>Post 1989</td>
<td>post_coldwar</td>
<td>Post-Cold War dummy (pre-Cold War = 0 / post-Cold War = 1)</td>
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**Treaty characteristics**

<table>
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<th>Treaty</th>
<th>treatyno</th>
<th>LRTAP treaties (1–9); see also below</th>
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<td>Variable</td>
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<td>Mean</td>
<td>SD</td>
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<tr>
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<td>3609</td>
<td>0.067</td>
<td>0.25</td>
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<td>21.64</td>
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<td>Big countries</td>
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<td>3050</td>
<td>4.02</td>
<td>1.67</td>
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<tr>
<td>Population</td>
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<td>79.73</td>
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<tr>
<td>Age of treaty^3</td>
<td>3609</td>
<td>1140.93</td>
<td>2140.37</td>
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</table>
Concept of ‘international factors’

Our conceptualization of domestic versus international factors implicates a somewhat narrow notion of ‘international’ effects, which are sometimes also called ‘reaction function’. A more comprehensive definition of international factors would also have to include broader, or non-unit-specific, changes in the international system (e.g. technological innovation, end of the Cold War) and the effects of international or supranational actors (e.g. the EU, the UN, international courts, existing international regimes). Our analysis concentrates on international factors more narrowly defined, but will control for influences of other international factors (e.g. by means of treaty age, time polynomials and a Cold War dummy).

Countries not included in our sample

We exclude the USA and Canada, which are not geographically contiguous with the other countries and therefore are, from a geophysical viewpoint, not part of the same transboundary pollution problem. The USA and Canada joined the LRTAP process because they were (and still are) facing similar transboundary air pollution problems, and because the regime-building process has taken place in the Economic Commission for Europe (ECE), in which the USA and Canada are, for historical reasons, also members. We exclude San Marino, the Vatican, Czechoslovakia, Serbia and Montenegro. San Marino and the Vatican are extremely small and data for the explanatory and control variables are not available. Czechoslovakia does not exist anymore, and Montenegro and Serbia became independent countries only recently. However, the Czech Republic (since 1993), Slovakia (since 1993) and Serbia and Montenegro combined are included in our data set.

Dependent variable

We focus on ratification, and not on signature, because ratification (and also accession) expresses a stronger commitment under international law. Moreover, countries sometimes accede to or ratify treaties without having signed them before. For the same reason we do not use the time delay between signature and ratification as a dependent variable.

Competitor variable

Our sample comprises a maximum of 47 countries. Constructing the indicators for trade competitor behaviour with reference to the five biggest trade partners is computationally efficient and keeps a clear distinction between this indicator and the indicator for the ratification behaviour of all other countries. Moreover, the five biggest trading partners account for a very large share in most countries’ international trade. Trade competition effects could also be assessed on the basis of more complex indicators for the structural similarity of
trade relationships. However, constructing such data is far beyond the scope of this paper and one existing such project has not yet made its data public (see Cao and Prakash, 2010).
### 2. The nine LRTAP agreements

<table>
<thead>
<tr>
<th>Treaty</th>
<th>Place of signature</th>
<th>Year of signature</th>
<th>Open for ratification or accession</th>
<th>Entry into force</th>
</tr>
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<tr>
<td>1985 Protocol on the Reduction of Sulphur Emissions or Their Transboundary Fluxes By At Least 30 per cent</td>
<td>Helsinki</td>
<td>1985</td>
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</tr>
<tr>
<td>1999 Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone</td>
<td>Gothenburg</td>
<td>1999</td>
<td>31.5.2000</td>
<td>17.5.2005</td>
</tr>
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</table>
3. Ratifications of the nine LRTAP agreements over time

![Graph of ratifications over time for the 1st LRTAP Agreement](image1)

![Graph of ratifications over time for the 2nd LRTAP Agreement](image2)
7th LRTAP Agreement
1998 Aarhus Protocol on Heavy Metals

8th LRTAP Agreement
1998 Aarhus Protocol on Persistent Organic Pollutants
9th LRTAP Agreement
1999 Gothenburg Protocol on Acidification, Eutrophication and Ground-level Ozone

Number of countries that have ratified

Year

0 5 10 15 20

4. Correlations

<table>
<thead>
<tr>
<th></th>
<th>Ratification</th>
<th>Others (#)</th>
<th>Neighbours</th>
<th>Others (pop)</th>
<th>Others (gdp)</th>
<th>Big countries</th>
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<th>GDP</th>
<th>Population</th>
<th>GDP p.c.</th>
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<th>Veto players</th>
<th>Pollution exporter</th>
<th>Post 1989</th>
<th>EU affiliation</th>
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<th>Age of treaty</th>
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<td>-0.02</td>
<td>-0.13</td>
<td>0.14</td>
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<tr>
<td>Others (#)</td>
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<td>0.93</td>
<td>0.94</td>
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<td>0.20</td>
<td>0.20</td>
<td>0.05</td>
<td>0.19</td>
<td>0.03</td>
<td>-0.05</td>
<td>-0.11</td>
<td>0.05</td>
<td>0.56</td>
<td>-0.67</td>
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<td>-0.45</td>
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<tr>
<td>GDP</td>
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<td>0.83</td>
<td>0.49</td>
<td>0.93</td>
<td>0.19</td>
<td>0.22</td>
<td>-0.09</td>
<td>0.53</td>
<td>0.23</td>
<td>-0.26</td>
<td>-0.23</td>
<td>-0.19</td>
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<td></td>
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<tr>
<td>Population</td>
<td></td>
<td>1.00</td>
<td>-0.06</td>
<td>0.61</td>
<td>-0.11</td>
<td>0.08</td>
<td>-0.03</td>
<td>0.19</td>
<td>0.10</td>
<td>-0.14</td>
<td>-0.12</td>
<td>-0.10</td>
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5. Properties of models shown in Table 1 of the article

<table>
<thead>
<tr>
<th>Model</th>
<th>BIC</th>
<th>AIC</th>
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<tr>
<td>Model 1, baseline model</td>
<td>1046.08</td>
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<td>Model 2, H1 (Others (pop))</td>
<td>964.40</td>
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<td>Model 3, H2 (Neighbours)</td>
<td>963.08</td>
<td>901.66</td>
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<tr>
<td>Model 4, H3 (Big countries)</td>
<td>958.98</td>
<td>897.55</td>
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<tr>
<td>Model 5, H4 (Competitors)</td>
<td>901.49</td>
<td>840.86</td>
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</table>
6. Simulated probabilities

The simulated probabilities in the table below indicate the extent to which shifts in the respective explanatory variable from the minimum value to the maximum value, from the minimum to the mean, and from the mean to the maximum affect the probability of treaty ratification. The probabilities indicate by how much the probability of ratification increases from the baseline probability. The latter indicates the probability of ratification of a given treaty by a given country in a given year (on average); all variables other than the one of interest are set to their mean values.¹

¹ All simulated probabilities were computed with the CLARIFY software: Tomz et al. (2001); King (2000).
Simulated probabilities for key explanatory variables

<table>
<thead>
<tr>
<th>Simulated probability Pr(ratification = 1)</th>
<th>Min to max</th>
<th>Min to mean</th>
<th>Mean to max</th>
</tr>
</thead>
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<tr>
<td>Others (#) (M1/T2)</td>
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<td>.02</td>
<td>.32</td>
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<tr>
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<td>(.00)</td>
<td>(.16)</td>
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<tr>
<td>Others (pop) (M2/T1)</td>
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<td>.01</td>
<td>.06</td>
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<td>(.03)</td>
<td>(.00)</td>
<td>(.03)</td>
</tr>
<tr>
<td>Neighbours (M3/T1)</td>
<td>.05</td>
<td>.01</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>(.02)</td>
<td>(.00)</td>
<td>(.02)</td>
</tr>
<tr>
<td>Big countries (M4/T1)</td>
<td>.03</td>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td></td>
<td>(.00)</td>
<td>(.00)</td>
<td>(.00)</td>
</tr>
<tr>
<td>Competitors (M5/T1)</td>
<td>−.03</td>
<td>−.02</td>
<td>−.01</td>
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<tr>
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<td>(.03)</td>
<td>(.01)</td>
<td>(.00)</td>
</tr>
<tr>
<td>Population (M2/T1)</td>
<td>−.27</td>
<td>−.24</td>
<td>−.02</td>
</tr>
<tr>
<td></td>
<td>(.20)</td>
<td>(.19)</td>
<td>(.01)</td>
</tr>
<tr>
<td>Pollution exporter (M2/T1)</td>
<td>−.07</td>
<td>−.05</td>
<td>−.02</td>
</tr>
<tr>
<td></td>
<td>(.02)</td>
<td>(.01)</td>
<td>(.00)</td>
</tr>
<tr>
<td>Trade openness (M2/T1)</td>
<td>.66</td>
<td>.03</td>
<td>.62</td>
</tr>
<tr>
<td></td>
<td>(.26)</td>
<td>(.01)</td>
<td>(.25)</td>
</tr>
</tbody>
</table>

Notes: Robust standard errors in parentheses; all other variables are kept at their mean values. The models on which the simulated probabilities are based are indicated in brackets (M = Model, T = Table, with references to Tables 1 and 2 in the main text).
The figures shown below illustrate simulated probabilities for key explanatory variables in the form of graphs.
Simulated probabilities for time effects

Note: all other variables kept at their means.

Simulated probabilities for Others (#)
Simulated probabilities for ‘Others (pop)’

Simulated probabilities for ‘Neighbours’
Simulated probabilities for ‘Competitors’

Simulated probabilities for ‘Population’
Simulated probabilities for ‘Trade openness’
### Simulated Ratification Probabilities for Selected Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Simulated Probability $Pr(\text{ratification} = 1)$</th>
<th>Population</th>
<th>GDP p.c.</th>
<th>Trade openness</th>
<th>Veto players</th>
<th>Pollution exporter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland</td>
<td>.38 (.07)</td>
<td>8.87</td>
<td>10.44</td>
<td>25.44</td>
<td>0.63</td>
<td>0.43</td>
</tr>
<tr>
<td>Norway</td>
<td>.39 (.09)</td>
<td>8.40</td>
<td>10.68</td>
<td>25.08</td>
<td>0.51</td>
<td>0.20</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>.10 (.03)</td>
<td>10.99</td>
<td>10.24</td>
<td>26.72</td>
<td>0.35</td>
<td>2.37</td>
</tr>
<tr>
<td>Belgium</td>
<td>.20 (.07)</td>
<td>9.23</td>
<td>10.31</td>
<td>26.00</td>
<td>0.71</td>
<td>2.12</td>
</tr>
<tr>
<td>Italy</td>
<td>.24 (.04)</td>
<td>10.94</td>
<td>10.22</td>
<td>26.41</td>
<td>0.42</td>
<td>0.91</td>
</tr>
<tr>
<td>Estonia</td>
<td>.03 (.01)</td>
<td>7.22</td>
<td>9.29</td>
<td>22.29</td>
<td>0.55</td>
<td>1.86</td>
</tr>
<tr>
<td>Romania</td>
<td>.03 (.007)</td>
<td>10.01</td>
<td>8.83</td>
<td>23.22</td>
<td>0.39</td>
<td>1.11</td>
</tr>
<tr>
<td>Portugal</td>
<td>.03 (.01)</td>
<td>9.23</td>
<td>9.89</td>
<td>24.23</td>
<td>0.41</td>
<td>2.17</td>
</tr>
</tbody>
</table>

*Note:* Robust standard errors in parentheses; all other variable are kept at their mean values. Note that the values for some explanatory values are log values and differ from the ‘real world’ numbers (e.g. population).
7. Robustness checks

We have carried out a wide range of additional tests to examine whether our main results are robust.

First, we ran conditional logit models that add additional controls for non-observed country and treaty heterogeneity. Fixed effects cannot easily be integrated in our baseline setup (models in Table 1 of the main text). Hence we use conditional logit models, which is the standard approach for integrating fixed effects in logistical models. However, the results should be regarded with great caution because conditional logit models are less appropriate for modelling the time dynamics of treaty ratification (they are not survival models); and our results in fact show that taking such time dynamics into account is important. These problems notwithstanding, the conditional logit approach adds another layer of controls for the possibility that specific environmental or political or economic problem structures produce specific types of agreements (see Mitchell, 2009) and also influence the probability of ratification. For instance, some forms of pollution might be more relevant for some countries than for others, and these circumstances may influence both treaty design and ratification choices; e.g. in the sense of an implicit upper limit of countries that a treaty will attract, heavier implementation burdens for some countries, or greater risk of principal-agent problems owing to uncertainty about mitigation costs and benefits. Model 3 in Table 2 of the main text shows that the effect of ratification by other countries (Others (pop)) remains highly significant if we add country fixed effects. When we add treaty fixed effects (Model 4), the coefficient still points in the expected direction but becomes insignificant. The first table below indicates that the effects of the other international factors are robust to this change in statistical approach. The only partial exception is the Competitors variable, whose effect points in the expected direction but becomes insignificant with treaty fixed effects.

Second, we examined whether earlier treaties are ratified faster than later treaties, assuming that countries first opt for the ‘long hanging fruits’, and we also examined the opposite claim, that countries find it hardest to join the first agreement in a given issue area. We did not find support for either of these claims (see companion material 3).

Third, we examined the effects of our unit-external variables in non-lagged form. The results are shown below and turn out to be very similar to the results for the lagged variables. In fact, some of the unit-external effects become more significant and substantively stronger.

Fourth, we implemented the regressions with different definitions of the Big countries variable. The results (see below) are very similar.

Fifth, another potential challenge to our results concerns selection effects. As discussed in the introductory section, selection effects could bias our estimates if our model omits variables...
that affect both bargaining and ratification outcomes. The most obvious candidates, which are all included in our models, are power, capacity, domestic ratification constraints and possibilities for free-riding.

One might argue that poorer countries or more powerful countries systematically obtain laxer obligations, or that they ‘count on’ being able (owing to a power or power of the weak effect) to get away cheaply with non-compliance later on. This could also mean that they ratify faster because of lower implementation costs. Our models include power and income variables. However, we also examined treaty characteristics (obligations specified in those treaties) but did not find convincing evidence for systematically ‘cheaper’ obligations in the nine LRTAP agreements for poorer or more powerful countries. Poorer countries and smaller countries are subject to somewhat less ambitious obligations in some (but not all) LRTAP agreements. But, when considered in terms of relative ability to pay for pollution abatement and in terms of relative marginal abatement costs, it is far from clear that poorer countries should find it easier (cheaper, relative to their national capabilities) to implement any given LRTAP agreement (see below).

Drawing on the Schelling conjecture, several authors have argued that countries with stronger domestic ratification constraints have more bargaining leverage (Tarar, 2001). If so, these countries should be more likely to obtain favourable bargaining outcomes and should, therefore, also be more likely to ratify. Again, we inspected the characteristics of treaty obligations and did not find significant differences across countries with stronger and weaker constraints (measured in our case by a Veto players indicator). Moreover, we include the Veto players indicator in our models, which makes selection bias unlikely anyway.

Finally, one might argue that ‘net exporters’ of pollution have more bargaining power because they can more easily live without an international agreement. Hence they may obtain laxer obligations. Again, even though our models include an indicator capturing pollution exports, we inspected the contents of the nine treaties and found no indication that net exporters of pollution have obtained laxer commitments.
<table>
<thead>
<tr>
<th>GDP p.c.</th>
<th>Trade openness</th>
<th>Veto players</th>
<th>Pollution exporter</th>
<th>Post 1989</th>
<th>EU affiliation</th>
<th>Treaty</th>
<th>Age of treaty</th>
<th>Age of treaty^2</th>
<th>Age of treaty^3</th>
</tr>
</thead>
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<td>GDP p.c.</td>
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<td>0.51</td>
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<td>0.66</td>
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### Clogit models

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<th>Model 2 Hypothesis H2 clogit, gp(treatyno)</th>
<th>Model 3 Hypothesis H3 clogit, gp(cowcode)</th>
<th>Model 4 Hypothesis H3 clogit, gp(treatyno)</th>
<th>Model 5 Hypothesis H4 clogit, gp(cowcode)</th>
<th>Model 6 Hypothesis H4 clogit, gp(treatyno)</th>
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<td>0.01*</td>
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<td>Competitors</td>
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<td>(0.23)</td>
<td>(0.23)</td>
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<td>1561</td>
<td>1967</td>
<td>1568</td>
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<td>$\hat{\chi}^2$</td>
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<td>101.5</td>
<td>213.2</td>
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<tr>
<td>ll_0</td>
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<td>L1</td>
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<td>-412.3</td>
<td>-310.7</td>
<td>-409.3</td>
<td>-287.6</td>
<td>-383.0</td>
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</tbody>
</table>
Notes: Robust standard errors in parentheses. The *Pollution exporter* variable had to be dropped from the country fixed-effects models owing to time-invariant data.

, *** $p < .01$, ** $p < .05$, * $p < .1$
Main results: International factors without lags (compare with Table 1 in main text)

<table>
<thead>
<tr>
<th></th>
<th>Model 1 Baseline model</th>
<th>Model 2 Hypothesis H1</th>
<th>Model 3 Hypothesis H2</th>
<th>Model 4 Hypothesis H3</th>
<th>Model 5 Hypothesis H4</th>
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<tbody>
<tr>
<td>Others (pop)</td>
<td>0.10***</td>
<td>0.01***</td>
<td>1.49***</td>
<td>-0.02***</td>
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<tr>
<td>Neighbours</td>
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<td>0.01***</td>
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<tr>
<td>Big countries</td>
<td></td>
<td></td>
<td>1.49***</td>
<td>(0.35)</td>
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<td>Competitors</td>
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</tr>
<tr>
<td>Population</td>
<td>-0.52</td>
<td>-0.61*</td>
<td>-0.47</td>
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<td>GDP p.c.</td>
<td>-0.21</td>
<td>-0.27</td>
<td>-0.46</td>
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<td>-0.94***</td>
<td>-0.86***</td>
<td>-0.8***</td>
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<tr>
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</table>

**Notes:** Robust standard errors in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$
Robustness checks without lags (compare with Table 2 in main text)

<table>
<thead>
<tr>
<th>Model</th>
<th>Hypothesis</th>
<th>Hypothesis</th>
<th>Model 3</th>
<th>Model 4</th>
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<tr>
<td></td>
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<td>H1</td>
<td>Clogit, group: cowcode</td>
<td>Clogit, group: treatyno</td>
</tr>
<tr>
<td></td>
<td>(IV = others)</td>
<td>(IV = others GDP)</td>
<td></td>
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<tr>
<td>Others (#)</td>
<td>0.12***</td>
<td>5.67***</td>
<td>7.10***</td>
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<td></td>
<td>(0.01)</td>
<td>(0.75)</td>
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<td>(0.38)</td>
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<td>(0.80)</td>
<td>(1.08)</td>
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<tr>
<td>Population</td>
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<td>0.87**</td>
<td>0.93*</td>
<td>0.76***</td>
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<td></td>
<td>(0.42)</td>
<td>(0.42)</td>
<td>(0.49)</td>
<td>(0.20)</td>
</tr>
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<td>GDP p.c.</td>
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</tr>
<tr>
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<td>(1.24)</td>
<td>(1.13)</td>
<td>(0.66)</td>
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<tr>
<td>Trade openness</td>
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<td>-0.87***</td>
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<td></td>
</tr>
<tr>
<td>Veto players</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
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<td>0.80***</td>
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<td>(0.16)</td>
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<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.01)</td>
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<tr>
<td>Age of treaty^2</td>
<td>0.00</td>
<td>0.00*</td>
<td>0.00***</td>
<td>0.00**</td>
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<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
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<tr>
<td>Constant</td>
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<td>-19.98***</td>
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</tr>
<tr>
<td></td>
<td>(2.98)</td>
<td>(2.68)</td>
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<td></td>
</tr>
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<td>-613.7</td>
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<tr>
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<td>-474.6</td>
<td>-320.5</td>
<td>-447.5</td>
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<tr>
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</tr>
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</table>

Notes: Robust standard errors in parentheses. The Pollution exporter variable was dropped from the Clogit models because of time-invariant data for most of our period of analysis.

*** $p < .01$, ** $p < .05$, * $p < .1$
Models with different definitions of ‘Big countries’ (1)

<table>
<thead>
<tr>
<th>Model</th>
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<th>Dummy</th>
<th>Ordinal variable (0–3)</th>
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</thead>
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<tr>
<td>Big countries</td>
<td>1.61***</td>
<td>0.94***</td>
<td>0.26*</td>
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<tr>
<td></td>
<td>(0.51)</td>
<td>(0.26)</td>
<td>(0.14)</td>
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<td>Big countries b</td>
<td>0.70*</td>
<td>0.16</td>
<td>0.16</td>
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<tr>
<td></td>
<td>(0.42)</td>
<td>(0.22)</td>
<td>(0.22)</td>
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<tr>
<td>Big countries c</td>
<td>−0.50</td>
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<td>0.26*</td>
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<tr>
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<td>(0.37)</td>
<td>(0.14)</td>
<td>(0.14)</td>
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<tr>
<td>Population</td>
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<td>0.56*</td>
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<tr>
<td></td>
<td>(0.33)</td>
<td>(0.32)</td>
<td>(0.33)</td>
</tr>
<tr>
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<td>−0.18</td>
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<tr>
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<td>(0.72)</td>
<td>(0.71)</td>
<td>(0.72)</td>
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<td>0.92**</td>
<td>0.94**</td>
<td>0.86**</td>
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<tr>
<td></td>
<td>(0.38)</td>
<td>(0.38)</td>
<td>(0.38)</td>
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<tr>
<td>Veto players</td>
<td>0.88</td>
<td>0.83</td>
<td>0.96</td>
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<tr>
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<td>(1.10)</td>
<td>(1.06)</td>
<td>(1.06)</td>
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<tr>
<td>Pollution exporter</td>
<td>−0.86***</td>
<td>−0.87***</td>
<td>−0.82***</td>
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<tr>
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<td>(0.24)</td>
<td>(0.23)</td>
<td>(0.23)</td>
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<td>Post 1989</td>
<td>−1.44***</td>
<td>−1.44***</td>
<td>−1.68***</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.22)</td>
<td>(0.22)</td>
</tr>
<tr>
<td>Age of treaty</td>
<td>0.11</td>
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<tr>
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<td>(0.24)</td>
<td>(0.23)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>Age of treaty^2</td>
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<td>−0.05*</td>
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<tr>
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<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Age of treaty^3</td>
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<td>(0.00)</td>
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<td>−15.68***</td>
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<tr>
<td>ll</td>
<td>−436.6</td>
<td>−437.8</td>
<td>−443.7</td>
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</table>

Notes: Robust standard errors in parentheses. Big countries: France or Germany or the UK has ratified the relevant LRTAP treaty one year prior (no/yes; 0/1). Big countries b: all ‘important countries’ countries (France, Germany and the UK) have ratified the relevant LRTAP treaty one year prior (no/yes; 0/1). Big countries c: France and/or Germany and/or the UK have ratified the relevant LRTAP treaty one year prior (ordinal variable: 0, 1, 2, 3).

*** p < .01, ** p < .05, * p < .1
### Models with different definitions of ‘big countries’ (2)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>United Kingdom</td>
<td>France</td>
<td>Germany</td>
</tr>
<tr>
<td>lUK</td>
<td>0.45**</td>
<td>(0.19)</td>
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<tr>
<td>IFrance</td>
<td></td>
<td>0.84***</td>
<td>(0.29)</td>
</tr>
<tr>
<td>IGER</td>
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<tr>
<td>Population</td>
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<td>GDP p.c.</td>
<td>−0.14</td>
<td>−0.22</td>
<td>−0.15</td>
</tr>
<tr>
<td>Trade openness</td>
<td>0.84**</td>
<td>0.89**</td>
<td>0.80**</td>
</tr>
<tr>
<td>Veto players</td>
<td>0.99</td>
<td>0.95</td>
<td>1.11</td>
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<tr>
<td>Pollution exporter</td>
<td>−0.81***</td>
<td>−0.86***</td>
<td>−0.79***</td>
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<td>Post 1989</td>
<td>−1.64***</td>
<td>−1.51***</td>
<td>−1.73***</td>
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<td>−0.04</td>
<td>−0.05**</td>
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<td>−582.9</td>
<td>−582.9</td>
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<td>164.6</td>
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<td>II</td>
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<td>−452.2</td>
<td>−456.4</td>
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</table>

**Notes:** Robust standard errors in parentheses. lUK: The United Kingdom has ratified the relevant LRTAP treaty one year prior (no/yes; 0/1). lFrance: France has ratified the relevant LRTAP treaty one year prior (no/yes; 0/1). lGER: Germany has ratified the relevant LRTAP treaty one year prior (no/yes; 0/1).

*** $p < .01$, ** $p < .05$, * $p < .1$
### Obligations created by the nine LRTAP treaties

<table>
<thead>
<tr>
<th>Treaty</th>
<th>Obligations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1979 LRTAP Convention</td>
<td>Framework convention; same obligations for all countries; no specific emission reduction targets.</td>
</tr>
<tr>
<td>2 1984 Protocol on Long-Term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)</td>
<td>Financial contributions to the monitoring and evaluation programme are scaled in part to income levels and country size; that is, financial burdens are related to national capabilities, but correlations between financial contributions and income and country size are in fact rather low.</td>
</tr>
<tr>
<td>3 1985 Protocol on the Reduction of Sulphur Emissions or Their Transboundary Fluxes by at Least 30 per cent</td>
<td>Uniform reduction target for all countries: reduce sulfur dioxide emissions by at least 30% (base year 1980) by 1993. We graphed Kaplan-Meier survival estimates and carried out stratified tests (log-rank, Wilcoxon) for equality of survivor functions to examine whether poorer or bigger countries ratify this agreement earlier. The assumption of equality of the survivor function across size and income categories has to be rejected (though this result is less clear when analysing categories separately). Richer countries ratify somewhat earlier, as expected, and country size has a positive effect on early ratification.</td>
</tr>
<tr>
<td>4 1988 Protocol Concerning the Control of Nitrogen Oxides or Their Transboundary Fluxes</td>
<td>Uniform obligation for all countries not to exceed 1987 emissions by 1994.</td>
</tr>
<tr>
<td>5 1991 Protocol Concerning the Control of Emissions of Volatile Organic Compounds or Their Transboundary Fluxes</td>
<td>Uniform obligation for all countries: reduce VOC emissions by at least 30% by 1999 from 1988 levels or any other annual level during the period 1984-1990, or to ensure that emissions of VOCs do not exceed 1988 levels by 1999 in case the emissions of VOCs in 1988 were below a certain threshold. While formally equal, these provisions create different de facto obligations for countries. We graphed Kaplan-Meier survival estimates and carried out stratified tests (log-rank, Wilcoxon) for equality of survivor functions to examine whether poorer or bigger countries ratify this agreement earlier. The assumption of equality of the survivor function across size and income categories has to be rejected. Country size has a minor positive effect on early ratification, and richer countries ratify somewhat earlier. Poorer countries do not seem to obtain ‘cheaper’ commitments, otherwise we should observe that poorer countries ratify earlier or at least not later than richer countries.</td>
</tr>
<tr>
<td>6</td>
<td>1994 Protocol on Further Reduction of Sulphur Emissions</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>7</td>
<td>1998 Protocol on Heavy Metals</td>
</tr>
<tr>
<td>8</td>
<td>1998 Protocol on Persistent Organic Pollutants (POPs)</td>
</tr>
<tr>
<td>9</td>
<td>1999 Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone</td>
</tr>
</tbody>
</table>
## Appendix 2

Table 1: List of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Label in dataset</th>
<th>Description</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratification</td>
<td>Ratif</td>
<td>Ratification: no/yes (0/1)</td>
<td>Own coding, based on information from the LRTAP secretariat (<a href="http://www.unece.org/env/lrtap">www.unece.org/env/lrtap</a>)</td>
</tr>
<tr>
<td>Participation and learning (a)</td>
<td>PPPwB4</td>
<td>Participation at the meetings of the main LRTAP institutional bodies (EB, the EMEP steering body, WGE) in the previous four years (weighted, lagged).</td>
<td>Own coding, based on LRTAP reports (UN archives).</td>
</tr>
<tr>
<td>Participation and learning (b)</td>
<td>PPPPwB4</td>
<td>Participation at the meetings of the main LRTAP institutional bodies (EB, the EMEP steering body, WGE, WGSR) in the previous four years (weighted, lagged).</td>
<td>Own coding, based on LRTAP reports (UN archives).</td>
</tr>
<tr>
<td>Participation and learning (c)</td>
<td>PPPB4</td>
<td>Participation at the meetings of the main LRTAP institutional bodies (EB, the EMEP steering body, WGE, WGSR) in the previous four years (lagged).</td>
<td>Own coding, based on LRTAP reports (UN archives).</td>
</tr>
<tr>
<td>Costs/benefits of cooperation (with regards to SO$_2$ pollution)</td>
<td>emdepSo2_00</td>
<td>Deposition rate of pollution (SO$_2$ in metric tons): total air pollution caused by a country divided by the amount of pollution that is deposited nationally. Net exporter of pollution if polluter &gt; 1; net importer of pollution if polluter &lt; 1</td>
<td>Based on data from EMEP (Tarrasón et al., 2006)</td>
</tr>
<tr>
<td>Costs/benefits of cooperation (with regards to NO$_x$ pollution)</td>
<td>emdepNox_00</td>
<td>Deposition rate of pollution (NO$_x$ in metric tons): total air pollution caused by a country divided by the amount of pollution that is deposited nationally. Net exporter of pollution if polluter &gt; 1; net importer of pollution if polluter &lt; 1</td>
<td>Based on data from EMEP (Tarrasón et al., 2006)</td>
</tr>
<tr>
<td>Green domestic demand (share of green in parliament)</td>
<td>share_gr</td>
<td>Share of green parties in parliament.</td>
<td>Comparative Political Data Set III (Armingeon et al., 2007), 34 OECD countries from 1990 – 2004.</td>
</tr>
</tbody>
</table>
Green domestic demand (in the legislature) | av_per501
---|---
The average environmental emphasis of all parties in a country legislature.

Domestic capacities (a) | cinc
---|---
CINC scores from the “Correlates of War Project”, are the annual values for the computed Composite Index of National Capability (CINC), which is based on total population, urban population, iron and steel production, energy consumption, military personnel, and military expenditures.

Domestic capacities (b) | ln_gdppc
---|---
Log value of GDP per capita in PPP, constant 2005 international USD.

Veto Points | polconiii
---|---
Political constraints index (POLCON III).

Behaviour of neighbours | lpercnb
---|---
Percentage of neighboring countries that ratified one year prior.

Behaviour of all other countries | lperc_totratif2
---|---
Share of other countries (potential treaty members) that ratified one year prior

Table 2: Summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPPwB4</td>
<td>3609</td>
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Table 3: Correlations

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<td>0.2535</td>
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</table>
Figure 1: Survival estimates by share of greens in the parliament (0=0%, 1= >0% - <8%, 2= >08%)
Figure 2: Survival estimates by moderate countries with regards to SO2 emissions/depositions ratio
(<0.5; 0.5-1.5; >1.5)
## Appendix 3

Table 1: LRTAP treaties

<table>
<thead>
<tr>
<th>Treaty, year and place of signature (entry into force)</th>
<th>Main obligations ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 LRTAP Convention, 1979, Geneva (16.3.1983)</td>
<td>Framework convention; same obligations for all countries; no specific emission reduction targets; general commitments on strategies to combat air pollutants pollution, on exchange of information and cooperation in research.</td>
</tr>
<tr>
<td>2 1984 Protocol on Long-Term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), 1984, Geneva (5.10.1984)</td>
<td>Ensure the availability of financial resources to implement the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP); mandatory financial contributions to EMEP are scaled in part to income levels and country size and supplemented by voluntary contributions.</td>
</tr>
<tr>
<td>4 1988 Protocol Concerning the Control of Nitrogen Oxides or Their Transboundary Fluxes, 1988, Sofia (14.2.1991)</td>
<td>Uniform obligation for all countries not to exceed 1987 emissions by 1994; application of national emission standards based on “best available technologies which are economically feasible” (BATEF) to new mobile sources and major stationary sources; ensuring of the availability of unleaded fuel.</td>
</tr>
<tr>
<td>5 1991 Protocol Concerning the Control of Emissions of Volatile Organic Compounds or Their Transboundary Fluxes, 1991, Geneva (29.9.1997)</td>
<td>Uniform obligation for all countries: reduce VOC emissions by at least 30% by 1999 from 1988 levels or any other annual level during the period 1984 – 1990; application of appropriate national or international standards (BATEF) to new stationary and mobile sources two year after the entry into force; application of measures to products containing VOC (labelling, etc); application of BATEF to existing stationary sources no later than 5 years after the entry into force.</td>
</tr>
<tr>
<td>6 1994 Protocol on Further Reduction of Sulphur Emissions, 1994, Oslo (5.8.1998)</td>
<td>Country specific reduction obligations of sulphur (SO_{2}) defined in part through an integrated assessment model that takes into account various factors, such as environmental damages and implementation costs (“critical loads” and “effect based approach”); application of national emissions limits to major new stationary sources and introduction of pollution control measures for major existing stationary sources by July 2004.</td>
</tr>
<tr>
<td>7 1998 Protocol on Heavy Metals, 1998, Aarhus (29.12.2003)</td>
<td>Each country commits to reducing emissions of harmful heavy metals (lead, cadmium and mercury). The baseline year can be chosen by each country individually within</td>
</tr>
</tbody>
</table>

¹ Reporting and monitoring obligations, the promotion of research, technology exchange and cooperation as well as the development of strategies, policies and programmes to discharge the obligations under the protocol are part of all protocols and not mentioned in the table 1.

² Differentiated commitments possible for countries with particular geographic and demographic circumstances, e.g. to ensure that emissions of VOCs do not exceed 1988 levels by 1999 in case the emissions of VOCs in 1988 were below a certain threshold.
the time-period 1985-1995; implementation of emission standards based on best available technologies (BAT); phase out the use of unleaded fuel; a range of voluntary measures is also suggested.

Uniform obligations for all countries with regards to the production and use of sixteen POPs divided in three groups: ban of use and production of the first group (Annex 1), restrictions of the use of the second group (Annex 2 group) and reduction of emissions of the substances in the third group (base year between 1985 and 1995); application of emissions limits (BAT) for furans and dioxin for new and existing stationary sources; to take effective measures to control POP emissions from mobile sources; to ensure the environmentally sound destruction and disposal of waste according the 1989 Basel Convention.

Country specific emissions ceilings for four pollutants (SO2, NOx, ammonia and VOCs) defined in part through an integrated assessment model that takes into account various factors, including implementation costs; in the long term, parties ensure that depositions do not exceed the critical loads of acidity, nutrient nitrogen and ozone; differentiated emissions ceilings for SO2, NOx, ammonia and VOCs are to be attained by 2010; BAT requirements and limit values for specific emissions sources, fuel and new mobile sources; application of ammonia control measures and promotion of good agricultural practices to control ammonia emissions.

Fig. 1: Transboundary fluxes: net exporters and victims with regard to sulphur and nitrogen

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Sulphur</th>
<th></th>
<th>Nitrogen</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.29</td>
<td>0.25</td>
<td>0.82</td>
<td>1.36</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.34</td>
<td>0.44</td>
<td>0.92</td>
<td>1.05</td>
</tr>
<tr>
<td>Estonia</td>
<td>1.77</td>
<td>1.86</td>
<td>0.54</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Source: Tarrason et al. 2006.

The table shows the total air pollution caused by a country divided by the amount of pollution that is deposited nationally according to the EMEP data on deposition rate of pollution (SO₂ and NOₓ in metric tons). If the result is over 1, the country is a net exporter of pollution. If the number is below 1, the country is a net importer of pollution from abroad.

Because data on transboundary pollution are not available for each year and different EMEP-models have been used to estimate the data, I rely on data from 2000 and 2005 that have been estimated with the same EMEP-model. But earlier estimations do not dramatically differ.
Fig. 2: Domestic politics in Austria

Sources: Nordsieck (2011)

Table 2: Austrian government coalitions

<table>
<thead>
<tr>
<th>Time period</th>
<th>Government</th>
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<tbody>
<tr>
<td>1979-1983</td>
<td>SPÖ</td>
</tr>
<tr>
<td>1983-1986</td>
<td>SPÖ-FPÖ</td>
</tr>
<tr>
<td>1986-1990</td>
<td>SPÖ-ÖVP</td>
</tr>
<tr>
<td>1990-1994</td>
<td>SPÖ-ÖVP</td>
</tr>
<tr>
<td>1994-1999</td>
<td>SPÖ-ÖVP</td>
</tr>
<tr>
<td>1999-2002</td>
<td>ÖVP-FPÖ</td>
</tr>
<tr>
<td>2002-2006</td>
<td>ÖVP-FPÖ/BZÖ</td>
</tr>
<tr>
<td>2006-2008</td>
<td>FPÖ-ÖVP</td>
</tr>
</tbody>
</table>
Table 3: List of political parties in Austria:

<table>
<thead>
<tr>
<th>Name (in German)</th>
<th>Name (English) (when available)</th>
<th>Ideological orientation (when available)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BZÖ Bündnis Zukunft Österreich</td>
<td>Alliance for the future of Austria</td>
<td>Centre right, national conservatism</td>
</tr>
<tr>
<td>FPO Freiheitliche Partei Österreichs</td>
<td>Freedom Party of Austria</td>
<td>Right-wing populism, national conservatism</td>
</tr>
<tr>
<td>ÖVP Christlich-demokratische Partei</td>
<td>Austrian people’s party</td>
<td>Centre right, Christian democracy</td>
</tr>
<tr>
<td>SPO Freisinnige demokratische Partei</td>
<td>Social democratic party of Austria</td>
<td>Centre-left, social democracy</td>
</tr>
<tr>
<td>GRÜNE Grüne Partei Österreich</td>
<td>The Greens</td>
<td>Green politics, centre left</td>
</tr>
</tbody>
</table>

*Bold: parties that are or were member of a government coalition.*
The Swiss Government (Executive) consists of the seven members of the Federal Council („Bundesrat“).
Table 5: List of political parties in Switzerland:

<table>
<thead>
<tr>
<th></th>
<th>Name (in German)</th>
<th>Name (English) (when available)</th>
<th>Ideological orientation (when available)</th>
</tr>
</thead>
<tbody>
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<td>liberal</td>
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<tr>
<td>EVP</td>
<td>Evangelische Partei</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GPS</td>
<td>Grüne Partei Schweiz</td>
<td>Green party</td>
<td>Green politics, center left</td>
</tr>
<tr>
<td>CVP</td>
<td>Christlich-demokratische Partei</td>
<td>Christian democrats</td>
<td>Center right, Christian democracy</td>
</tr>
<tr>
<td>FDP</td>
<td>Freisinnige demokratische Partei</td>
<td>Liberal democrats</td>
<td>Liberal, center-right</td>
</tr>
<tr>
<td>SP</td>
<td>Sozial-demokratische Partei</td>
<td>Social democrats</td>
<td>Social-democracy</td>
</tr>
<tr>
<td>SVP</td>
<td>Schweizerische Volkspartei</td>
<td>Swiss people’s party</td>
<td>National conservative, right-wing populism</td>
</tr>
</tbody>
</table>

*Bold: parties that are or were member of a government coalition.*

\(^4\) Ms Widmer-Schlumpf was elected as SVP Minister by the parliament, but was subsequently excluded from the party and eventually founded the BDP.
Fig. 4: Domestic politics in Estonia

Table 6: Estonian government coalitions

<table>
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<tr>
<th>Time period</th>
<th>Government coalition</th>
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<tr>
<td>1999-2002</td>
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<tr>
<td>2002-2003</td>
<td>Reform Party, Center Party</td>
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<tr>
<td>2003-2005</td>
<td>Res Publica, Reform Party, People’s Union</td>
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<td>2005-2007</td>
<td>People’s Union, Centre Party, Reform Party</td>
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<td>2007-2009</td>
<td>Pro Patria Union, Social Democrats, Reform Party</td>
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<tr>
<td>2009-2011</td>
<td>Reform Party, IRL</td>
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<tr>
<td>2011-</td>
<td>Reform Party, IRL</td>
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Table 7: List of political parties in Estonia

<table>
<thead>
<tr>
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<th>Name (English)</th>
<th>Ideological orientation (when available)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KE Eesti Keskerakond</td>
<td>Centre Party</td>
<td>Centrism, social liberalism</td>
</tr>
<tr>
<td>RE (since 1994) Eesti Reformierakond</td>
<td>Reform Party</td>
<td>Liberalism</td>
</tr>
<tr>
<td>RP Res Publica</td>
<td>Res Publica</td>
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</tr>
<tr>
<td>IL</td>
<td>Pro Patria Union</td>
<td></td>
</tr>
<tr>
<td>IRL (RP+IL since 2006) Isamaa ja Res Publica Liit</td>
<td>Pro Patria and Res Publica Union</td>
<td>Liberal conservatism</td>
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<tr>
<td>ERL Eestimaa Rahvaliidit</td>
<td>People’s Union of Estonia</td>
<td>Agrarianism, Conservatism</td>
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<tr>
<td>KE</td>
<td>Coalition Party</td>
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<tr>
<td>PK</td>
<td>Farmer’s Party</td>
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<tr>
<td>KMU (ERL+KE+PK, 1995)</td>
<td>Coalition Party and Country People’s Union</td>
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</tr>
<tr>
<td>SDE Sotsiaaldemokraatlik Erakond</td>
<td>Social Democratic Party</td>
<td>Social demoracy</td>
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<tr>
<td>ER Eestimaa Rohelised</td>
<td>Estonian Greens</td>
<td>Green politics, centrism</td>
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<td>EüRP</td>
<td>Estonian United People’s Party</td>
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<td>VKR</td>
<td>Republican and Conservative People’s Party</td>
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<td>ERSP</td>
<td>Estonian National Independence Party</td>
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<tr>
<td>EEE</td>
<td>Estonian Entrepreneur’y Party</td>
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<td>SK</td>
<td>Independent Royalists</td>
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<tr>
<td>EK</td>
<td>Estonian Citizens</td>
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*Bold: parties that were member of a government coalition.*
Text analysis: coding scheme

White papers

LEARNING: Justification in favour of ratification related to new available scientific information with regard to the environmental problem (current state of knowledge on consequence, damage, abatement techniques etc).

EMULATION: Justification in favour of ratification related to the ratification of other countries or to the international image of the country.

COERCION: Justification in favour of ratification related to “a necessity” derived by international engagements, “package deal” or other kind of coercive pressure

COMPETITION: Justification in favour of ratification related to the fact that alignment to international standards are necessary and/or that no competitive risk are to be feared due to the prior ratification of trade partners

GENUINE INTERESTS (COST/BENEFITS): Justifications in favour of a ratification related to the costs of ratification (e.g. in relation to changes in industry structure, transboundary fluxes and/or pollution). (cost/benefits: null hypothesis)

DOMESTIC POLITICS: Justifications in favour of a ratification related to the new majority in government and its program (domestic politics – null hypothesis)

RECIPROCITY: Justifications in favour of a ratification related to the reciprocity argument (to ratify in order to incite others to ratify)

ROLE MODEL: Justifications in favour of a ratification related to the country role as role model

ENVIRONMENT: Justifications in favour of a ratification related to the highly endangered environment (in general - not related to new scientific facts)

Protocols of legislative debates

LEARNING: Justification in favour of ratification related to new available scientific information with regard to the environmental problem (current state of knowledge on consequence, damage, abatement techniques etc).

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