

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

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Abstract

We draw on the policy diffusion literature to shed more light on the determinants of treaty ratification, a crucial step in the formation of international regimes. Our hypotheses stipulate that a country's ratification behaviour is influenced by the ratification choices of other countries in general, or of specific types of other countries. The underlying argument is that the ratification behaviour 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 is done on data for ratification of the UN Economic Commission for Europe's agreements on long-range transboundary air pollution. The results show that international factors are as important in influencing ratification choices as domestic factors. This result raises interesting questions about the relative importance of international and domestic determinants in different policy areas and at different stages of international regime formation.

Keyword

air pollution, environment, international regimes, policy diffusion, ratification

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Introduction

International treaties are crucial building blocks in most efforts to solve security, environmental, economic or social problems that extend beyond national boundaries. The study of bargaining processes that lead to formal international agreements is obviously important, but 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. Although ratification *per se* does not imply that a treaty will be effective in changing behaviour 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 behaviour across treaties and countries has not been studied in detail.

Ratification behaviour of countries is important from a policy-making viewpoint, but it also raises interesting analytical questions. Following the two-level game logic, one might be tempted to assume that negotiators are faithful and fully informed agents of their 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 et al., 2008).

In reality, there is strong variation in ratification behaviour 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 behaviour: domestic and international.

We conceptualize domestic factors in terms of country characteristics, such as features of political institutions or socioeconomic 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 interested in the extent to which the ratification behaviour of any given country is affected by the ratification behaviour of (particular) other countries.

Explaining ratification behaviour 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 behaviour with respect to a given international treaty, this

could be owing to a common external stimulus, similar domestic characteristics or interdependent behaviour 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 (for instance, countries, provinces/states, cities) as independent (e.g. Shipan and Volden, 2008). Similarly, most international relations scholars subscribe to the view that international politics is characterized by interdependent behaviour. In both realms, therefore, the behaviour 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 behaviour of other units. However, large- N empirical research in international relations has, surprisingly, paid rather little attention to interdependent behaviour 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 behaviour 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 behaviour of (particular) other units in the policy area of interest. The latter variables – mostly labelled 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, for instance, Gilardi, 2010) conceptualize those mechanisms in terms of how specific other units behave.

The circumstances of treaty ratification differ from the typical circumstances analysed 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, the 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 particular 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 own government, on these rules the treaty is opened for signature and ratification.

Compared with 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 behaviour by all other countries, by neighbouring countries, by powerful countries and by economic competitor countries influences the ratification behaviour 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 behaviour, both over time and across countries and treaties, making these agreements an interesting testing ground for our hypotheses. Using a new data set and binary time-series cross-sectional models we find that, overall, international factors are as important as domestic factors in influencing ratification behaviour. 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 behaviour, 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 socioeconomic conditions.

According to Neumayer (2002b), Fredriksson 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 1946–99. They observe (2004: 43) that variation in environmental treaty ratifications is explained mainly by 'disadvantaged insertion into the world economy' (they define this concept as a narrow export base), voice and accountability through domestic institutions, and civil society pressure (the number of non-governmental organizations 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 behaviour. Recent work on international cooperation, policy diffusion and networks (e.g. Ward, 2006; Jahn, 2008) suggests, however, that cooperative behaviour is likely to be influenced by international interdependency (policy diffusion) effects. For instance, in a recent study of ratification behaviour 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 behaviour concentrates on opportunities or constraints as well as willingness. The existing literature focuses largely on problem structures, the costs and benefits of cooperation, domestic institutional constraints or opportunities, income levels, or trade openness, but 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 the 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 the ratification choices by one country send various types of 'signals' to other countries. Those signals may affect, in both 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 behaviour 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. (2006: 787): '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)' (see also Braun and Gilardi, 2006).

Some of the policy diffusion literature seeks to distinguish between particular types of diffusion mechanisms. However, although this literature agrees that the behaviour of other political actors matters, there is much less agreement on how other actors influence any given actor's behaviour; that is, what types of diffusion mechanism are at work in 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 policy-makers' own economy, they will not adopt this policy. If adoption is likely to positively affect the competitive position of their country, they are likely to adopt the particular 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 labelled *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 the 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 important than domestic factors, or equally important. If we assume that principal-agent problems in negotiating international agreements exist and that 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 behaviour 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 behaviour.

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 an LRTAP agreement. Depending on what type of other country ratifies, the behaviour of others can send different types of information to the country that is deciding on whether to ratify. We are particularly interested in what all other countries, neighbouring countries, big countries and economic competitor countries do. The effects of the signals that emanate from the ratification choices of 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 the 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 the 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 behaviour. 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 NO_x and the VOC Protocol) despite high costs, not so much for ecological reasons but mainly in order not to ‘lose face’ (Lewanski, 2000: 273). We assume that ratification decisions are not only made based on material cost/benefit calculations (these are covered by (a)) but 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 particular 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 relevant 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 the transportation

matrices of air pollutants in Europe show that, depending on the particular pollutant and climatic and geographical conditions, air pollution can be exported only to some extent and clean air can be imported only to some extent (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 join 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.

Neighbouring 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 (or countries) ratifies the relevant agreement, diffusion effects are likely to differ. We submit that neighbouring countries, that is, countries sharing a border, are likely to influence each other's ratification choices. There are two reasons for this.

First, such neighbourhood effects may involve a positive externality: to the extent that countries A and B share a border and that at least some pollution from A flows into B, ratification of a pollution-reducing treaty by A creates, to the extent that 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 with '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 geographical distance between capitals and/or major population centres, and shorter distances are usually associated with more social, economic and political interaction.¹ One manifestation of this geographical distance effect is international trade, whose size can be quite well explained with gravity models that emphasize the size of economies as well as geographical 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 neighbouring countries that have ratified this treaty.

Large countries

Reminiscent of the gravity logic in models explaining trade flows, we expect that not only geographical distance matters for explaining ratification behaviour, 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 hold-outs that the cost/benefit ratio of joining the treaty is, overall, acceptable.

Moreover, ratification by large countries increases the reputational costs for hold-out countries. To the extent that hold-out countries pay attention not only to the number of ratifiers but also to their economic and ecological importance, ratification by a few large countries can have a similar effect to 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 more weight in international economic relations and international politics, they can credibly threaten costly action against hold-outs (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, 1995). Those effects may not be very large: environmental protection costs are in most cases in the order of very small 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 their 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 behaviour by a given country is affected by the ratification

behaviour 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 with 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, notably, economic characteristics (for instance income per capita, economic size of countries, trade openness), domestic political system characteristics (for instance veto players) and other factors (for instance 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.

Data set and statistical approach

We use a new panel data set to test the four hypotheses developed above. The data set 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 are taken from existing data sets (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 are 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 time series. Each time 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 data set with yearly observations until the year when the particular 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 0 if the country did not ratify the treaty in that year, and 1 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

relevant treaty (*Others (#)*). The lag structure, which we use for independent variables in H1–H4, controls for potential 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 10 other countries have ratified a treaty, it may well matter whether 5 of these countries are large or whether all of the 10 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)*); and 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 neighbouring countries that have ratified the relevant treaty (*Neighbours*). We use the share rather than the number of neighbouring countries because countries have varying numbers of neighbours. Using the absolute number could thus bias statistical effects with respect to countries with more neighbours.

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 relevant treaty (*Big countries*). This variable takes the value 1 if one of the three countries has ratified, and 0 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 the companion materials 7 in the Web appendix or at <http://www.ib.ethz.ch/research/data>).

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 relevant 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 imports 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, for example 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 abatement 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 cubed 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 unspecified 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 the variables in the analysis, the sources of the data, descriptive statistics, correlations, simulated probabilities and the results of robustness checks can be found in the companion materials 1–7 in the Web appendix or 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 data set after ratification took place, that is, after the value of the dependent variable changed from 0 to 1. Although the standard approach is to include splines or time dummies, we include the time (*Age of treaty*) as well as its squared and cubed 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 suggests that the approach we opt for performs as well as 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 domestic 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 behaviour.

Table 1. Main results

	Model 1 Baseline model	Model 2 Hypothesis H1	Model 3 Hypothesis H2	Model 4 Hypothesis H3	Model 5 Hypothesis H4
Others (pop)		0.03*** (0.01)			
Neighbours			0.01** (0.004)		
Big countries				0.94*** (0.26)	
Competitors					-0.008* (0.004)
Population	-0.52 (0.33)	-0.54* (0.33)	-0.49 (0.33)	-0.56* (0.33)	-0.71* (0.37)
GDP p.c.	-0.21 (0.72)	-0.22 (0.73)	-0.33 (0.71)	-0.26 (0.73)	-0.71 (0.72)
Trade openness	0.88** (0.39)	0.93** (0.38)	0.89** (0.39)	0.94** (0.39)	1.13*** (0.41)
Veto players	0.92 (1.14)	0.84 (1.08)	0.64 (1.07)	0.83 (1.08)	1.12 (1.12)
Pollution exporter	-0.82*** (0.24)	-0.87*** (0.25)	-0.89*** (0.24)	-0.87*** (0.24)	-0.80*** (0.25)
Post 1989	-1.77*** (0.23)	-1.49*** (0.24)	-1.62*** (0.22)	-1.44*** (0.25)	-1.72*** (0.25)
Age of treaty	0.76*** (0.18)	-0.07 (0.27)	0.17 (0.23)	0.06 (0.23)	0.18 (0.23)
Age of treaty^2	-0.09*** (0.02)	-0.02 (0.03)	-0.03 (0.02)	-0.03 (0.02)	-0.04 (0.02)
Age of treaty^3	0.00*** (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00* (0.00)
Constant	-16.06*** (2.39)	-15.92*** (2.37)	-14.16*** (2.11)	-15.68*** (2.32)	-13.74*** (2.11)
Observations	2235	1967	1967	1967	1829
χ^2	152.9	161.1	192.1	195.6	138.4
ll_0	-613.7	-571.6	-571.6	-571.6	-528.4
LI	-484.5	-439.3	-439.8	-437.8	-409.4
N_clust	40	40	40	40	38

Note: Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

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 owing to the fact that new countries such as the former Soviet republics, which tend to be environmental laggards, enter the data set 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 international 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 international determinants matter, overall, in comparison with other determinants. For that reason, and because our indicators for international determinants capture partly overlapping types of effects – some of these variables are in fact highly correlated (see the companion materials) – we include each international variable separately.

Including the international 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 percent level, the coefficients are significant at 1 percent (*Others* (#), *Big countries*) or 5 percent (*Neighbours*) 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 the populations of all potential ratifiers. As shown in Model 2 of Table 2, the result is very similar 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-weighted share of potential ratifiers that have ratified (Model 1 in Table 2).

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

Table 2. Additional results and robustness checks

	Model 1 Hypothesis H1 (IV = others)	Model 2 Hypothesis H1 (IV = others_GDP)	Model 3 Clogit, group: cowcode	Model 4 Clogit, group: treatyno
Others (#)	0.04*** (0.01)			
Others (pop)			2.13*** (0.75)	0.37 (0.99)
Others (gdp)		1.14*** (0.58)		
Population	-0.55* (0.33)	-0.57 (0.35)	-7.32** (3.51)	-0.46*** (0.18)
GDP p.c.	-0.23 (0.73)	-0.30 (0.75)	0.15 (1.16)	0.13 (0.37)
Trade openness	0.94** (0.38)	0.97** (0.40)	0.05 (0.53)	0.69*** (0.20)
Veto players	0.84 (1.08)	1.02 (1.07)	-2.89** (1.23)	0.55 (0.68)
Pollution exporter	-0.87*** (0.25)	-0.92*** (0.27)		
Post 1989	-1.49*** (0.24)	-1.75*** (0.24)		
Age of treaty	-0.07 (0.27)	0.13 (0.25)	0.87*** (0.21)	0.20 (0.19)
Age of treaty^2	-0.02 (0.03)	-0.04 (0.03)	-0.13*** (0.02)	-0.04** (0.01)
Age of treaty^3	0.00 (0.00)	0.00 (0.00)	0.00*** (0.00)	0.00*** (0.00)
Constant	-15.92*** (2.38)	-15.81*** (2.35)		
Observations	1967	1947	1561	1967
ll_0	-571.6	-565.0	-362.1	-527.8
χ^2	161.1	152.6	85.36	195.2
ll	-439.3	-428.7	-319.5	-430.2
N_clust	40	40		

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

*** $p < .01$, ** $p < .05$, * $p < .1$

As expected, ratification behaviour is influenced positively by whether France, Germany or the UK (*Big countries*), the largest economies in Europe, have ratified previously. Moreover, as expected, non-ratification by a country's main trade partners has a significant negative effect on ratification behaviour, though the coefficient is significant only at the 10 percent 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 the 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 favour 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

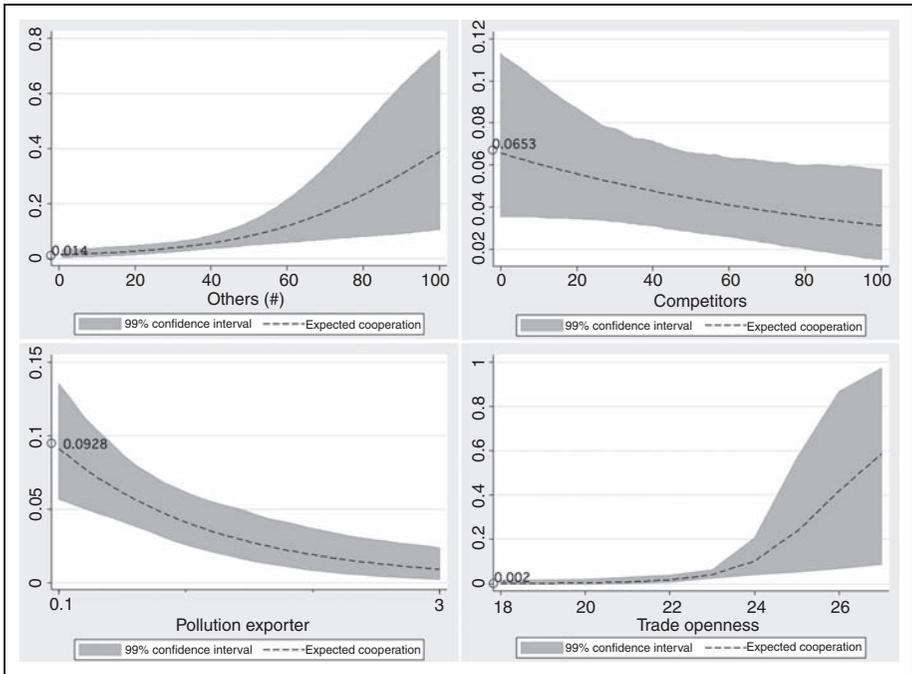


Figure 1. Predicted probabilities: illustrations.

Note: The models on which the simulated probabilities are based are shown in Table 1 and 2.

rate of pollution (free-rider effect) and trade openness. Similar figures for the other explanatory variables are shown in the companion materials 6.

Overall, these results suggest that international effects are as important in influencing ratification behaviour as domestic effects. The strongest effects emanate from the ratification behaviour of other countries most broadly defined. Depending on the specific definition of that variable, the probability of ratification increases by up to 35 percent, starting from a baseline probability of around 1 percent (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 percent of the other countries have joined.

The effects of the other three international variables (*Neighbours*, *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 the international effect emanating from ratification by other countries broadly defined clearly dominates may be that all potential ratifiers are located on the same continent. This geographical 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 relevant variable in 2000. The results indicate that some countries, such as Norway and Switzerland, can be considered ratification leaders, whereas other countries, such as Romania and Estonia, are clearly among the laggards. The simulated probability of Norway and Switzerland ratifying a treaty is around 40 percent, whereas the corresponding probability of Romania and Estonia is around 3 percent.

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 behaviour. Because treaties are usually the backbone of international regimes, and because ratification is in most cases 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 behaviour is influenced by the ratification choices of other countries as a whole, or of specific types of other countries. The underlying argument is that the ratification behaviour 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 behaviour 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 the 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, 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 take into account more explicitly the linkages between the bargaining and the ratification phases. For example, if some types of countries (e.g. poorer countries or more powerful countries) were able to obtain systematically different treaty obligations compared with 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 the 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 behaviour so that it sends strong cooperation-promoting signals to the hold-outs.

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Note

1. 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.

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