The Marketing of Environmental Treaties: Non-Binding Signature as Information and Raising Public Awareness*

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Abstract

Research has demonstrated that state executives may use their non-binding signature power to claim value from environmental treaties in the form of obtaining ego rents and in response to international pressures. This paper advances the literature by demonstrating how the attachment of signature also has the capacity to alter the dynamics of the ratification decision which follows it. Multilevel modeling on a dataset of 49 environmental treaties agreed between 1980 and 2000 is used to demonstrate that the state executive's non-binding signature helps to overcome the information asymmetry regarding treaty design faced by the ratification actors and to politicize the treaty itself, making ratification more likely in wealthy states.

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Many states across the globe have been forced to confront sizable domestic pollution problems that are, at least to some degree, sourced from activities undertaken in other states. These problems are further complicated because the transboundary emissions often deliver their costs across wide geographic regions (or globally if greenhouse gases are categorized in the same way as acid rain). Therefore, addressing such situations requires effort to formalize international cooperation (create international policy) which will likely involve a large number of affected states. As is to be expected, and as the research on the creation of international policy has demonstrated, the creation of stringent policies at the international level are difficult to achieve when the number of states involved is large and the behavior you wish to see constrained is tied directly to a state's economic growth. In scenarios such as these, states are generally more willing to negotiate over the form and reach of these types of policy rules than are willing to rapidly bind themselves to them.[1]

In an effort to explore these ratification outcomes, a broad literature has developed to identify those predictors which explain the variation in whether, and how quickly, states choose to ratify environmental treaties (examples include: Frank 1999, Neumayer 2002*a*,*b*, Hug and König 2002, Recchia 2002, Beron, Murdoch and Vijverberg 2003, Fredriksson and Ujhelyi 2006, Bernhagen 2008, von Stein 2008, Bernauer, Kalbhenn, Koubi and Spilker 2010). While this literature has usefully explored many aspects of the ratification decision, it has done so by assuming that a state's decision to bind itself to an environmental treaty is taken independently of any other state behaviors related to the treaty's construction. Recent research has begun to raise doubts about the usefulness of this assumption by noting that the state executive's non-binding signature decision is a formally separate action from the state's ratification decision, that each are the responsibility of different actors and that signature has certain characteristics which distinguish it as a valuable political tool for the state executive (e.g. high visibility, only minor obligations established) (Leinaweaver 2011).

[1]For the sake of simplicity, "ratification" will be used to refer to the state's binding action regardless of the fact that some states use different language to refer to their particular binding procedures. What is important is that all states have the capacity for a binding action and the binding action represents the moment when a state decides whether or not to formally adopt the obligations in the treaty.

This paper builds on that research by asking whether the attachment of non-binding signature to an environmental treaty, in addition to providing the state executive with a valuable political tool, may also alter the dynamics of the ratification decision by some informal linkage.[2] Preliminary support for such an informal linkage may be found in the sample of 49 environmental treaties explored in this paper. Cross-tabulation of this sample, a selection of multilateral, environmental treaties agreed between 1980 and 2000, clearly demonstrates that treaties to which a non-binding signature has been attached receive a positive ratification outcome far more frequently than those that do not (82% vs 34%) (See Table 1).[3]

[INSERT TABLE 1 HERE]

To move beyond this correlative evidence requires that signature be more than just a visible, political action, it also needs to precede the ratification decision. Returning to the sample, it is clear that modern environmental treaties typically open a defined and limited window during which the signature option is available. Most often this window is open for a single year or less, although in rare cases a two year window has been introduced. This limited window creates a situation in which the signature decision, if it is attached, always precedes the ratification decision.[4]

That signature is an observable, political action which always precedes ratification raises the possibility that signature has the capacity to alter ratification dynamics. In order to test for such an informal linkage, non-binding signature is taken as exogenous and three mechanisms are proposed to explore how its attachment may impact the ratification actors.[5]

[2]The non-binding criterion is included to separate it from those circumstances where a state chooses to bind itself to a treaty (ratify) using a definitive signature. The ability to use definitive signature depends on the domestic institutions established at the domestic level, however, the great majority of modern environmental treaties now explicitly require ratification and so such a binding signature is rarely, if ever, observed.

[3]The selection criteria used to create this sample and justification for the creation of a new environmental treaty dataset will be discussed in the methodology section.

[4]The average ratification delay in the sample is 4.8 years, excluding non-ratifying states.

[5]The exogeneity assumption of signature is a particularly strong one, however, it is used in order to focus specifically on how the ratification actors are affected by signature without yet introducing the executive's strategic concerns about its own reputation.

The first proposed mechanism focuses on signature's ability to provide low-cost information. In this way, signature may allow the ratification actors to overcome the considerable information asymmetries between them and the state executive regarding treaty design. The second proposed mechanism focuses on signature's ability to politicize, and raise awareness of, an environmental treaty. In this way, signature may activate domestic political dynamics relevant to the ratification decision. The final proposed mechanism considers how increased network centrality may imply a greater cost to the state of not meeting its international pledges, with signature playing the role of establishing such a pledge on the international level.

Analysis of the previously described data set provides support for the contention that that non-binding signature provides low-cost information regarding treaty design to the domestic ratification actors. It is suggested that these actors lack the treaty design information available to the state executive and face constraints in time and resources which make overcoming that information asymmetry challenging. The analysis also demonstrates that, in line with general expectations linking societal wealth to a greater demand for environmental protection, the attachment of signature is necessary, in this sample, for the per capita wealth predictor to reach a significant and sizable positive effect on ratification. This result is interpreted as support for the idea that treaty awareness is typically quite low among the mass public and that the signature act of the state executive activates public awareness which, in turn, increases the likelihood of ratification in wealthier states.

In sum, this paper broadens our consideration of how a state decides whether or not to bind itself to an environmental treaty by exploring whether the state executive's non-binding signature changes the dynamics of the ratification decision. Central to this argument is the idea that, despite the lack of any formal institutional connection, we should not ignore either the signature process itself or the state executive's role in it when exploring ratification outcomes. The non-binding signature decision belongs to a political actor, its attachment can be highly visible and it has the ability to dramatically alter the behavior of domestic actors

and the domestic information environment which combine to explain ratification outcomes.

The next section discusses signature and ratification as institutions structuring the behavior of actors, section 3 elaborates the hypotheses derived from the three proposed mechanisms and their relation to the established ratification literature, section 4 presents the analysis and section 5 concludes.

State Commitment to Environmental Treaties: The Legal Structures and Formal Separation of Signature and Ratification

Modeling the impact of signature on the ratification decision requires us to first consider the institutional rules that govern the ratification procedure, the actors who make the ratification decision and the information available to them when they act.

Conceptualizing ratification as an institution, or set of rules, requires us to acknowledge that the rules of ratification are sourced from both the treaty and state levels. At the treaty level, each treaty establishes its own rules for whether ratification is required, what form it should take and where it should be deposited (in line with the guidelines established by the *Vienna Convention on the Law of Treaties* (1969)). Generally speaking, with regards to all modern, multilateral, environmental treaties, these rules require each invited state to meet certain preconditions (ratify a prior convention or participate in the negotiation) and then to perform a binding act and deposit its notice of that act with the treaty's depositor (See Articles 11 & 16).[6] Important for establishing the overall argument, it should be noted that no formal linkage exists in any of the environmental treaties in this sample which would require non-binding signature as a pre-requisite for ratification.

[INSERT TABLE 2 HERE]

At the state level, the ratification rules are sourced from domestic constitutions or, in the case of states with unwritten constitutions, in foreign relations laws or general laws of

[6] "Ratification", "acceptance", "approval" and "accession" are all synonymous in regards to the binding act.

operation for the executive and the legislature.[7] These procedures vary from representing only a minor obstacle in the case of autocracies to democratic states where legislative oversight can represent a very substantial obstacle to ratification. Interestingly, considerable domestic variance also exists across democracies. For example, the government in the UK need only allow for the House of Commons to review a prospective treaty for 21 days before it may be made binding by the government's own action (United Kingdom House of Commons 2010) whereas in the US the President requires approval of two-thirds of the Senate to achieve domestic ratification (US Constitution Art 2, Sec 2). Restated, in the former case the legislature is only empowered as a veto player if a majority decide to cooperate (inaction equals tacit approval) whereas in the latter case a much smaller proportion of only the upper chamber is necessary to prevent ratification (inaction as rejection). In addition, no formal linkage is identified at the state level which would require non-binding signature as a pre-requisite for ratification.

Elaborating the international and domestic rules of ratification makes clear that attempts to model ratification outcomes should absolutely consider the important role played by those domestic actors involved in the decision. As this paper focuses on the effect of signature on ratification, the sample of states analyzed is limited to only those for whom the *de jure* or *de facto* ratification decision belongs to actors other than the state executive. In other words, asking how the state executive's treaty-specific action alters the domestic ratification actors' behavior on that treaty is inherently less interesting if ratification belongs to the state executive either formally or by some illegitimate means of coercion. For the remaining states, ratification procedures are universally the responsibility of domestic legislators, although the precise subset of those legislators necessary for ratification varies by state (e.g. the upper chamber, the lower chamber or both chambers). As for the distribution of information, it is assumed, in line with the literature on legislative decision-making, that these domestic

[7]For examples, see the "Constitutional Reform and Governance Bill" (2010) in the UK and in paragraphs 7.112 to 7.122 of the Cabinet Manual and in the Standing Orders of the House of Representatives in New Zealand.

ratification actors are constrained in time, resources and issue-specific expertise (Downs 1957, Salisbury and Shepsle 1981, McCubbins and Schwartz 1984, Milner and Rosendorff 1996, Hall and Deardorff 2006).

Signature, as a visible action that precedes ratification (if attached), may have the capacity to impact the ratification actors and the distribution of information. Leinaweaver (2011) explores signature similarly to how ratification is discussed above and summarizes it as a political decision, formally disconnected from ratification, with rules explicitly written into each treaty and whose attachment creates very minor international obligations on the state.[8] The signature decision belongs to the state executive who faces no legal constraints when making the decision and who, as the chief foreign policy representative for the state, has access to all relevant treaty design information.

Very little research exists that has explored signature as a dependent variable, and none exists that uses it as an intervening variable when explaining ratification outcomes. Neumayer (2002*b*) uses signature as a dependent variable when exploring the effect of trade openness on a state's level of multilateral environmental cooperation. However, this choice was made not because signature was of particular interest but because the paper's sample included treaties too recent for enough ratifications to have been registered and so a proxy was required. Recchia (2002: p479) conceptualizes signature as something other than a proxy to ratification and describes it as a "symbolic gesture of a nation's support for the treaty [which] reflects mainly the preferences of the country's executive." However, signature is given no further exploration and instead is folded into the creation of a multinomial measure of treaty engagement. Signature, therefore, represents only a small component of a larger, ratification focused measure.

One possible objection to the idea that non-binding signature may play any role in changing ratification dynamics is that, in the majority of cases, signature and ratification can be separated by many years. However, when reviewing the debates surrounding the ratification

[8] According to the Vienna Convention, it "obligate[s] [the state] to refrain from acts which would defeat the object and purpose of a treaty" (Article 18).

of these treaties, it is surprisingly common for state executives to make a point of reminding the relevant actors when a signed treaty awaits their decision. For example, the US President typically attaches a letter and additional information from the State Department when submitting an environmental treaty to the Senate for ratification. These letters commonly identify if the treaty in question has been non-bindingly signed, although they tend to de-emphasize the "non-binding" aspect (Bush 1990, 1991). Interestingly, this also includes identifying the US as a signatory even when the treaty was signed by a President other than the one submitting the treaty for ratification (Bush 2007). During debates concerning environmental treaties in the UK House of Commons, an awareness of the government's signature action is often cited by one side or the other as an important condition that impels ratification. For example, Michael Howard, then Secretary of State for the Environment, went to the floor of the House of Commons in June 1992 to applaud the Prime Minister for his leadership during, and his signatures of, the *UN Framework Convention on Climate Change* (1992) and the *Convention on Biological Diversity* (1992). This appeared to be motivated, at least in part, to build momentum towards obtaining a successful ratification (*Hansard Parliamentary Debates - House of Commons* 1992).

One other possible objection to the idea that non-binding signature may play a role in changing ratification dynamics is the argument that the causal direction actually operates in reverse. In other words, the state executive decides whether or not to sign an environmental treaty based primarily on its expectation of a successful ratification. Treaties which are expected to be ratified should be signed, while those unlikely to be ratified should not. However, this contention is problematic theoretically and is not supported by previous quantitative research or an empirical test presented in this paper. First, this reversed causality assumes a considerable amount of foresight on the part of the state executive who must be able to somewhat reliably estimate the likely behavior of a sizable number of domestic actors. Second, as ratification delay is most often a question of years, the executive's expectation of ratification actor behavior must account for, what varies in this sample between 1 and

17 years of delay. Such a period will easily cross elections and, therefore, may also include changes in the underlying disposition of the ratification actors towards a specific environmental treaty, and possibly, towards environmental policy in general. Third, in many cases, and especially in democracies, the length of most ratification delays will likely mean that the executive presented with the signature decision will not be in power when the ratification decision is made. For this reversed causality argument to hold it must be that the executive is more concerned with the outcome of an action, ratification, that will not occur for many years, than with the more immediate gains identified in previous research which are available when attaching signature to an environmental treaty (Leinaweaver 2011).

Empirically testing this contention is also possible using proxies for ratification difficulty. Leinaweaver (2011) presents a model of the signature decision that includes predictors of treaty cost. If we accept that more costly treaties are less likely to be ratified, and treaties less likely to be ratified are less likely to be signed, then those tests should have demonstrated that more costly treaties were less likely to be signed. However, no such effect is identified in this sample of environmental treaties. The analysis undertaken in Section 4 of this paper identifies another possible proxy of ratification difficulty and it too fails to predict signature in this sample.

Ultimately, it is the primary argument of this paper that the state executive's opportunity to attach a non-binding signature to an environmental treaty has the capacity to dramatically impact the domestic ratification actors and their information environment because of its visibility, because it precedes the ratification decision and because it raises the public's awareness that an environmental treaty is on the agenda.

Signature and Ratification: The Informal Linkages

As established previously, this paper explores the ratification decision by focusing on three elements: the actors responsible for the ratification decision, the domestic and international institutional rules which constrain and structure their decisionmaking, and the distribution

of information available to them at the time of the decision (See Table 2).[9] Such an approach encourages a consideration of the post-negotiation activities in and by a particular state if that action has the capacity to impact on the actors or information relevant to the ratification decision. The signature decision has exactly that capacity because of its political nature, visibility, and the fact that, if it is attached, it always precedes the ratification decision. This section elaborates on three possible mechanisms by which signature may alter the dynamics of ratification. Each is rooted in one of the three threads of the ratification literature.

One thread in the ratification literature has sought to explain ratification outcomes by focusing on elements of treaty design. For some researchers, treaties which aim to protect or provide environmental goods will only be ratified if they include specific mechanisms to overcome collective action problems and dissuade free-riding. For example, minimum participation thresholds may be included that require a certain number of states ratify a treaty before the obligations in it become binding on any individual ratifier (Black, Levi and de Meza 1993, Barrett 2003). The *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (1997) includes both a numeric participation threshold of 55 states and an additional threshold requirement that the 55 states represent "at least 55 per cent of the total carbon dioxide emissions for 1990 of the Parties included in Annex I". Such thresholds are explicitly included in order to overcome any perceived first-mover disadvantage on the part of the prospective participant states (why be the first to embrace costs when no other state has shown a similar willingness?) and to ensure that a meaningful number of states will have committed themselves to the treaty before costs are incurred by any ratifier. Other examples of treaty mechanisms included to dissuade free-riding include the adoption of non-identical policy requirements (costs matched to each state's willingness or ability to pay) (Gilligan 2004), and the implementation of side-payments and institutional membership restrictions (bribe or exclude states who are unwilling to contribute to providing the environmental good) (Koremenos, Lipson and Snidal 2001, Eyckmans and Finus 2007).

[9]Many examples of such an approach exist applied to a number of different issues, for examples and elaboration see Lake and Powell (1999), Milner (1997), Lake (2011).

For other researchers focused on treaty design, ratification is a question of the extent of the costs represented by the treaty's requirements. An extensive strand in the literature has developed along these lines including the oft-cited article by Downs, Rocke and Barsoom (1996: p379) which argues that treaty costs, including those contained in environmental treaties, are typically kept quite low to ensure high levels of participation and compliance. Abbott, Keohane, Moravcsik, Slaughter and Snidal (2000: p404) then usefully pushed this cost literature forward by introducing a typology for categorizing treaties along a dimension of "legalization" from "soft" to "hard". "Soft" treaties include only "nonlegal norms" as *obligations*, "vague principles" as *precision* and the promise of continued diplomacy as *delegation*, whereas "hard" treaties establish binding rules with great precision and extensive delegation to international organizations (IOs), a secretariat or some third party actors. It has generally been accepted that, although each represents a complex story about how to find the right blend of elements across the three dimensions, "softer" treaties are more likely to be ratified. Many researchers have sought to test these dimensions and expectations (See for example: Barrett (2003), von Stein (2008), Green (2008), Bernauer, Kalbhenn, Koubi and Ruoff (2010)).

Whether the focus is on dissuading free-riding or representing the exact costliness of a treaty, both strands require a consideration of treaty design and some working knowledge of how those design mechanisms may be expected to interact or conflict with established domestic law. Acquiring such information is anticipated to be a costly and time-consuming procedure. The attachment of signature may speak directly to such design concerns on the part of the domestic ratification actors because signature precedes ratification, it has the capacity to be highly visible and because of the information asymmetry regarding treaty design which exists between the state executive, who is the chief foreign policy representative of the state, and the ratification actors, who lack such information. The state executive is assumed to have access to all relevant treaty information it may require simply because multiple avenues exist for it to acquire such information. The executive may send a repre-

sentative to the negotiation, personally participate in the negotiation or may requisition an executive summary from the appropriate executive agency or bureaucracy which reports to them (e.g., the foreign affairs ministry or State Department). Given these multiple avenues for acquiring information, and a simple assumption by the ratification actors that the state executive will be unlikely to sign a treaty which threatens serious costs due to extensive obligations, enforcement or free-riding, signature may represent a particularly attractive source of low-cost information regarding state-specific, treaty design concerns for the ratification actors.

The attractiveness of signature as low-cost information for the ratification actors is bolstered by their specific circumstances and the legislative nature of ratification in democracies. First, as is assumed in much of the literature regarding legislative behavior, domestic ratification actors are assumed to be constrained by limits to their time, resources and expertise (See for example: Downs (1957), Salisbury and Shepsle (1981), McCubbins and Schwartz (1984), Milner and Rosendorff (1996), Hall and Deardorff (2006)). If these actors are predominantly office-seeking, then the likelihood that they will allocate their limited time and resources to gaining expertise regarding a particular environmental treaty rather than on tasks more directly related to political survival (e.g., fund-raising, providing constituency services) is fairly low. However, even if they are predominantly motivated by policy-seeking, the situation remains that they are but one of many actors whose assent is required to ratify the treaty and that the opportunity to use any gained policy expertise to amend that treaty will not be an option as this would require a reopening of the international negotiation which produced it. Combined, this likely means that investing resources in acquiring treaty-specific expertise is not a valuable investment for the individual ratification actor and that an incentive exists to remain open to low-cost information provided by credible actors. Signature, as a visible endorsement by the state executive, may provide just such a credible information shortcut.[10]

[10]The sample of treaties analyzed in this paper are selected for their shared focus on addressing or constraining transboundary externalities which means that the provision / protection of environmental goods

Hypothesis 1: *The attachment of signature reduces the effect of treaty design predictors on the likelihood of ratification.*

A second thread in the ratification literature has focused on domestic state characteristics that are anticipated to correlate highly with a greater likelihood of ratification. Examples of these include predictors such as power (Beron, Murdoch and Vijverberg 2003, Milewicz, Bächtiger and Nothdurft 2009), regime type (Neumayer 2002*a*, Elsig, Milewicz and Stürchler 2010), citizen values (Recchia 2002), the influence of an environmental lobby (Fredriksson and Ujhelyi 2006), the influence of a business lobby (Bernhagen 2008) and those which attempt to incorporate a measure of the domestic complexity of the ratification procedure (Hug and König 2002, Espínola-Arredondo and noz García 2011). In general, these analyses have found some success in testing probably because they approximate aspects of the actual ratification decision, which is first and foremost, a domestic procedure.

Given a focus on domestic political mechanisms, the capacity for signature to be both visible and politically contentious opens a number of avenues by which it may possibly alter the dynamics of ratification.

On a political dimension, signature may have a strong impact within the domestic legislature responsible for the ratification decision by politicizing the environmental treaty in question. One may think of the organization of a generic legislature as containing two groups, those affiliated with or supportive of the government and those in opposition. In the absence of signature, we may assume that the ratification decision is focused particularly on the treaty itself and other constituency-based concerns (Urpelainen 2011, Bang 2011). However, the signature of the state executive, a visible action made by a political actor, may logically introduce a partisan dynamic to the ratification decision.

In the first case, it may be that signature compels supporters of the government to back a

are at stake for all sample treaties. Therefore, a consideration of treaty design in the forthcoming analysis will include mechanisms aimed at both reducing the threat of free-riding and those that establish greater costs for the state of meeting treaty requirements.

treaty they might otherwise have opposed or been indifferent towards. The example described in Section 2, citing Michael Howard speaking in the UK House of Commons, represents one of many cases in that body where the attachment of signature is identified by government supporters as an important signal of the government's environmental credentials and reason to continue their support for the government's tenure. Further, this action is often invoked as an important step, if only in a rhetorical sense, towards the eventual ratification decision.

In the second case, opponents of the government may punish a treaty they otherwise support or feel indifference toward in order to harm the state executive and deny it a political victory. Examples of partisan opponents fixating on signature as an action to criticize are not uncommon, but few are as colorful as US Republican Senator Chuck Hagel's condemnation of President Clinton's decision to sign the Kyoto Protocol, as among other things, "insane" and a "[blatant contradiction of] the will of the United States Senate" (Cushman Jr. 1988, Thompson 1998).

Whether, in the absence of signature, Michael Howard supported the UNFCCC and Senator Hagel opposed the Kyoto Protocol, is not the issue. What is important to recognize is that the signature becomes an integral part of the treaty decision itself. It galvanizes supporters and opponents in ways that the treaty negotiation never could. By attaching signature, the government has made a visible show of support for a new policy and the threat of new policy allows political actors the opportunity to try and bolster their own support or weaken that of their opponents. In sum, the signature of an environmental treaty is a political act, and goal-seeking political actors (the ratification actors) should seek to use that action to either strengthen their own party's position or to weaken the government's position with regards to political survival.

Hypothesis 2: *The attachment of signature increases the positive effect of government support on the likelihood of ratification.*

Hypothesis 3: *The attachment of signature increases the negative effect of government opposition on the likelihood of ratification.*

On the mass public dimension, signature may also play an important politicizing role by raising awareness of the environmental treaty in question. As the previous hypotheses contend, signature has the capacity to be a highly visible, public action made by a political actor and witnessed by other political actors who will react to it and seek to use it to achieve their own ends. Given this contentious and visible political dimension, it seems a plausible assumption that signature has the capacity to raise treaty awareness among the mass public. The effect that this raised awareness has on the likelihood of environmental treaty ratification may vary along a number of state characteristics, however, a particularly important one is wealth.

Within the economics literature, two approaches have developed for exploring the connections between societal wealth (development) and environmental quality (or the demand for environmental policies). In the first approach, the debate has centered on the existence of an environmental Kuznet's curve (EKC) (Among many others: Grossman and Krueger (1991), Selden and Song (1994), Grossman and Krueger (1995), Stern, Common and Barbier (1996), de Bruyn, van den Bergh and Opschoor (1998), Magnani (2000), Bhattarai and Hammig (2001), Cole, Rayner and Bates (2001), Copeland and Taylor (2003)). The EKC postulates an inverted U-shaped relationship between pollution and income or economic development. "That is, while industrialization...may initially lead to increased pollution, other factors may cause an eventual downturn, at least for some pollutants" (Selden and Song 1994: p147). In other words, beginning from a point of very little development, as a state increases its production and consumption of goods and services we should expect that the amount of pollution or waste it produces to also increase. Grossman and Krueger (1991) argue that as the level of state wealth increases, three mechanisms (scale, composition and technology) begin to alter the elasticity of production (or consumption) and reduce the production of waste. Selden and Song (1994: p147) state these in a more accessible fashion, and elaborate on them, to include technological changes in processes of production and consumption,

"increasing levels of education and environmental awareness" and moves to a more representative, or "open" political system. While the EKC debate is extensive, much of it has been centered on issues of endogeneity (development and environmental quality are deeply intertwined) and methodology (the curve only seems to hold for certain pollutants measured in certain ways).

In the second approach, the focus has been on using survey data to estimate, on the individual level, the relationship between wealth and a person's "willingness to pay" (WTP) for environmental goods. These studies have been done both in single-case designs and cross-nationally (Seip and Strand 1992, Pearce et al. 1996, Choe, Whittington and Lauria 1996, Flores and Carson 1997, Hökby and Söderqvist 2003). One could imagine the situation in a developing state where, until a family's basic needs are met regarding food, shelter and some basic employment, a concern for environmental protection will be lower on their list of priorities. However, as their basic needs are met, it is likely that environmental concerns move up the priority list and thus we establish a set of necessary preconditions before environmental issues become primary motivators of behavior or voting. Thus far, the WTP in developing states has been estimated as lower than that found in developed states, although again, serious methodological issues have been identified and much of the literature has focused on identifying better tools for measuring this individual demand for environmental policy rather than on developing large, cross-national datasets of it.

Overall, the contention here is that signature raises public awareness, and in states with greater levels of per capita wealth, this greater awareness should translate into a greater demand for environmental quality and, therefore, a greater likelihood of environmental treaty ratification. Anecdotal evidence of the signature decision threatening negative repercussions in a wealthy state may be seen in the concerns raised in a letter drafted by six Republican Senators when US President Reagan let it be known that he was considering not signing *The Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes* (1988). The letter made clear their serious fears of an "immediate and

negative" public reaction to such a choice and strongly advised the president to reconsider (Weisskopf 1988). That they felt strongly about the possible consequences of this negative public reaction is likely what motivated them to release the letter to the public so rapidly.

Hypothesis 4: *The attachment of signature increases the positive effect of wealth per capita on the likelihood of ratification.*

The third and final thread of the ratification literature has focused on the influence of international characteristics that embed the state in the international community. Examples of these dynamics include membership in international organizations (IOs) and non-governmental organizations (NGOs) (Frank 1999, von Stein 2008, Bernauer, Kalbhenn, Koubi and Spilker 2010), exposure to international trade (Neumayer 2002*b*), and behavior contingent on the behavior of other states (Bernauer, Kalbhenn, Koubi and Spilker 2010). The results of testing these measures on ratification have been fairly mixed, especially with regards to trade. This may be a logical outcome of focusing on the ratification decision alone, as the ratification actors have only a minimal presence on the global stage and are likely more concerned with constituent interests than international pressures.

However, Leinaweaver (2011) has demonstrated that signature attachment, when explored on its own, is responsive to international dynamics when Ward's (2006) concept of "network centrality" was operationalized. Ward's concept draws extensively on social network theory to describe an international system wherein a state's acceptance of particular treaties and participation in international organizations connects that state to a wider network that can "shape [that] nation's perceptions of their interests and of good behavior" (2006: p150). The greater the number of connections a state has to various international institutions, and the other states who are participants in them, the more central that state is in the international network. Interestingly, it is the very density of these network connections that begin to represent a form of enduring "social capital" which, Ward argues, "encourage[s]" states to "behave sustainably" by "channel[ing] broad environmental con-

cerns" and "allow[ing] for issue-linkage[s]" (2006: p151). Taken to its logical extremes, such an approach argues that a centrally networked state should be more willing to ratify new environmental treaties because its preferences have been transformed by the conditioning effects of "network centrality" and "social capital".

Such an effect, the transformation of preferences, may be plausible during the signature decision wherein a single actor represents the state and that actor has many opportunities to engage with other heads of state. However, the argument for a similar dynamic operating on the domestic ratification actors is difficult to accept. It is hard to imagine a legislator shifting a preference for environmental sustainability above her office-seeking motivation because her state happens to be a participant of the International Whaling Commission (IWC), the UN Economic Commission for Europe (UN ECE) or some number of other international institutions. This concern is raised, not to argue that Ward's concept is not useful for explaining ratification outcomes, but instead to offer an explanation why the established literature has found only small magnitude, positive effects of network centrality on ratification outcomes.[11]

The idea of a networked international system with connections between states and institutions does not have to imply preference transformation to achieve changes in state behavior and signature may play an important role in determining when that network is important for explaining ratification outcomes.[12] Following the logic of this mechanism, states choose to participate with international institutions (treaties and IOs) because they derive benefits from that participation (or avoid the costs of being excluded (Gruber 2001)) as many rational choice approaches would contend (Keohane 1984). Over time, this network grows and states who choose to participate become more centrally located in the network. In essence

[11]Bernauer, Kalbhenn, Koubi and Spilker (2010) demonstrate a well-designed test of this dynamic and identify just such a small magnitude effect. They argue that the magnitude size is related directly to the rare-event nature of ratifications in their dataset. This is a plausible explanation although the test performed here offers an alternative. It should also be noted that their theoretical story of this dynamic also invokes a liberal institutionalist component.

[12]This mechanism operates at a different level of analysis than the previous two, and that is one important reason that the following analysis is multilevel in nature.

then, the "social capital" created by each state's "network centrality" may simply represent the framework for a persistent form of international reputation. As these states derive ever greater benefits from being involved with many institutions, the danger of being seen to be a "bad" international actor likely increases. With "bad" summarized as not meeting one's pledges and the "danger" being a denial of access to the benefits derived from participating in those institutions or access to future benefits in other networked institutions.

The contention here is that signature operates as a pledge on the international level. Signature is an internationally visible action which may connect a state's reputation to the new institution. In the absence of that action, a state's obligation to the network to join new institutions is much more amorphous. In other words, being centrally located in the network should not necessarily motivate action, unless signature, acting as an international pledge that creates expectations on the part of other networked states, is attached. Such a dynamic may also reach down to the individual legislator level as the benefits derived from network centrality may be those that are most important to a legislator's constituents and therefore, remaining on good terms with those institutions, would be the correct strategy for maximizing her political survival.

As this paper focuses on how signature alters the dynamics of ratification, the question stands, if signature represents a pledge on behalf of the state to ratify an environmental treaty, then does the power of this pledge vary with a state's level of "network centrality"? Anecdotal evidence of the importance of such a signature-pledge can be seen in the controversy that preceded the Earth Summit in Rio, 1992. Prior to the conference's beginning, the US signaled it would not sign the Biodiversity Convention which was planned to be one of the major accomplishments of the forthcoming conference. Following this announcement, many participating, developing states began to indicate that "they might pull out of other agreements in retaliation" (Reuters-CP 1992). This back-and-forth exposed a sizable rift between, what is often referred to as, the global "north" and "south" concerning issues of development and responsibility for environmental protection. Interestingly, these threats

were made over one important state's threat to not sign the convention, which as established previously, is an action that does not create binding international obligations. The US decision to not make an international pledge created ripples that threatened to disrupt other parts of the wider institutional network.

Hypothesis 5: *The attachment of signature increases the positive effect of network centrality on the likelihood of ratification.*

Empirical Analysis

This section briefly describes the sample selection procedure and the operationalization of the hypotheses introduced in the previous section before ending with a discussion of the results. Summary statistics are provided in Table 3 for all predictor variables discussed in this section and utilized in the analyses.

The Sample

The analysis performed in this paper selects treaties from Mitchell's *IEA Database Project* (2002) that are either globally or regionally focused, multilateral, agreed between 1980 and 2000, and which meet a specific definition of "environmental": that they aim to address, constrain or compensate for the costs imposed by a present transboundary externality. The definition of "environmental" is included because it is a contested concept (Mitchell 2003: p.433) and a failure to do so would introduce considerable unit heterogeneity into the sample. For example, Mitchell's database includes the *Treaty on the Non-Proliferation of Nuclear Weapons* (1968). While the threat of nuclear war and unconstrained weapons proliferation is an abstract danger for the environment, the ratification decision regarding that treaty is likely focused more on security issues than a treaty like the *Montreal Protocol on Substances That Deplete the Ozone Layer* (1987) which was designed to reduce certain emissions in

order to address the hole in the ozone layer.[13] See Appendix C for a list of the included sample treaties.

The observations in the dataset are binary time-series-cross-sectional (BTSCS) in form (Beck, Katz and Tucker 1998) and organized as state-treaty dyads repeated per year beginning with the year the treaty was agreed and ending with the year of a successful ratification or at which the data was right-censored for lack of future observations. As the focus of this paper is on exploring the effect of non-binding signature on the ratification decision, state-treaty dyads were removed if the state failed to meet the necessary signature eligibility criteria during the period of the signature window (e.g., state not yet in existence, state not party to necessary convention or international organization (IO)).

The process to remove states for whom the *de jure* ratification process was controlled by the state executive necessitated a review of the institutional treaty ratification rules for all sample states from 1980 to the present. I began by reviewing the available data from the *Comparative Constitutions Project* which includes variables addressing treaty approval mechanisms by state (Elkins, Ginsburg and Melton 2010). However, in many cases this data served only as a starting point as it did not include information for states which lack a codified constitution and because it had released information concerning only their sample states' current constitutions. As my dataset covers 30 years, further investigation was required to acquire older constitutions and ratification laws where available. In the end, only 9 states were removed due to an inability to find conclusive evidence of the ratification procedure used (Kiribati, Nauru, Niue, Pakistan, Saint Lucia, Samoa, San Marino, Singapore and the Solomon Islands).

In order to also exclude states for whom the *de facto* ratification decision belongs solely to the state executive I utilized Vanhanen's operationalization of Dahl's disaggregation of democracy into two components, competition and participation, and followed Vanhanen's

[13]Additionally, the NPT promises assistance in the development of civilian nuclear power programs in participating states that request it, which means the NPT also contributes directly to the production of greater levels of waste which also makes it different from the treaties specified by the earlier condition.

lead by excluding all states which scored lower than or equal to a 5 on his combined index of democracy (Dahl 1971, Vanhanen 2000).[14] In the end, this created a dataset of 119 states (out of 193 in the original sample), 49 treaties and 7,588 state-treaty dyads by year.[15]

The Variables

The dependent variable in the following analyses is *Ratified* and is a dummy variable with a value of 1 if the state ratified the treaty in question (captured in a specific year) and a 0 for all preceding years. The variable *Signed* is a dummy with a value of 1 if the state signed the treaty in question. The data for these two variables was first taken from Ronald Mitchell's database (2002) and the United Nations Environment Programme's register of international treaties (2005). However, as the UNEP listing only includes updates up to 2005 and the Mitchell database holds preliminary, unverified information in many cases, all signature and ratification data was cross-checked using whatever was available from the secretariats or depositors of each international treaty so as to be sure that the most current and accurate data has been collected.

Hypothesis 1 focus on the ratification actors lack of information regarding specific treaty design mechanisms. Operationalizing treaty design is performed using five variables which capture aspects of treaty design that vary across the treaties in the sample and were constructed by hand-coding the treaties in my sample. As hand-coding can introduce problems of inter-coder reliability I have chosen to capture treaty design using dummy variables where possible. The first three predictors capture elements of treaty design to dissuade free-riding, and so, should increase the likelihood of ratification while the final two capture elements of treaty cost, and so, should decrease the likelihood of ratification. The definitions for the two cost dummies are adapted from the work being done by Bernauer, Kalbhenn, Koubi and

[14]The main regression results are robust to alternative cut-point selection of this measure.

[15]This removal of *de facto* cases does not remove Westminster systems like that found in the UK if the system creates an opportunity for the legislature to stop a treaty from being ratified. These cases represent the lowest threshold for ratification amongst democracies, however, the capacity exists and so these states are included.

Ruoff (2010).

The first, *Participation Threshold*, represents the number of states which must ratify the treaty before its obligations are considered binding on any of the participants.[16] The second, *Added Threshold*, is a dummy variable that captures whether conditions, in addition to a participation threshold, have been included as was discussed previously using the Kyoto Protocol as an example. The third, *Reservations Prohibited*, is a dummy variable capturing whether the treaty has explicitly forbidden the use of reservations when a state deposits its ratification instrument. Reservations have been used by some states as a loophole creator, allowing them to bind themselves to the treaty but only after specifying how some aspect of it does not apply to them or how they will choose to meet their obligations. The fourth, *Obligations* is coded 1 where a quantitative target is specified (e.g., a 30% reduction, the explicit requirement that a pollutant or action be completely eliminated) or where an explicit legal liability for some action is created. This does not include treaties which pledge to "reduce or eliminate" some pollutant as a principal or goal set for the future. 57% of the sample treaties meet this definition of obligation. The fifth, *Enforcement* is coded 1 when a treaty includes explicit compliance mechanisms at either the domestic or international level. 43% of the sample treaties meet this definition of obligation.[17]

[INSERT TABLE 3 HERE]

Hypotheses 2 and 3, partisan support and opposition, are both drawn from the World Bank's *Database of Political Institutions*. Partisan support is operationalized using *Government Seats* which "records the total number of seats held by all government parties" in the legislature and partisan opposition is operationalized using *Opposition Seats* which "records the total number of seats held by all opposition parties" in the legislature (Beck et al. 2001, Keefer 2009: p10-1). These measures are normalized by the year-specific size of each state's

[16] This is operationalized as the percentage of necessary states to account for differing membership sizes across treaties in the sample.

[17] While the creation of legal liability appears in both the *Obligation* and *Enforcement* dummies, overall they are not highly correlated (.3) and both include it in order to capture different aspects of the treaty. Treaties which create or require explicit legal liability should absolutely be considered treaties which carry meaningful obligations whereas the opposite will only sometimes be true.

legislature so that the value per year is an indicator of the proportion of the total legislature represented by either the government or the opposition.[18]

Hypothesis 4, *log(GDP PC)*, is operationalized using a logged measure of state wealth per capita taken from the World Bank's *World Development Indicators* database and is indexed to year 2000 US dollars (2010).

Hypothesis 5, network centrality and reputation, is operationalized using data from version 2.3 of the *Correlates of War 2, International Governmental Organizations Data Set* which aims to "capture state memberships in the network of international governmental organizations" and varies by state and by year (2004). As it has been constructed in the literature (von Stein 2008, Bernauer, Kalbhenn, Koubi and Spilker 2010), *IO Membership* is a count of the number of international organizations (IOs) to which a state is either a "member" or an "associate" per year in the dataset.

Finally, three control variables are included in the analysis. The first, *Regional*, is a dummy variable that indicates whether the treaty's intended membership size was regional in scope as opposed to being open globally to any state who wishes to become a member. This variable is included because, as discussed by Olson (1971: p33-36,48), larger groups have great difficulties in providing certain types of public goods for a few reasons. Specifically, the larger the group the smaller the benefit each member receives which means the smaller the incentive to provide some small amount of the good either acting alone or with a subset of interested others and the larger the group the greater the organizational costs of eventually providing any of the desired good. As the environmental treaties in this sample focus on the provision or protection of environmental goods by addressing a transboundary externality, this dynamic should mean that global treaties are less likely to be ratified than regional ones.

The second control variable, *Negotiating State*, is included to capture whether a state participated in the negotiation that wrote the environmental treaty in question. This predictor was constructed following an extensive review of the source documents related to the

[18]In the cases of Belize, Mexico, Philippines and the US this variable is edited to report totals related to their upper houses of the legislature (Senate in all cases) where the ratification power is exercised.

negotiation of my sample treaties. These included notes filed with the secretariat or depositor of the treaty, reports drafted by participating NGOs or IOs and academic works which discuss a particular negotiation in detail. Ultimately, the necessary information was located concerning better than 86% of the state-treaty dyads in the dataset. For the purposes of this predictor, a state needed only to send a representative to the conference at which the final treaty was agreed to be counted as a negotiating state. In cases such as the large UN negotiations accompanying the creation of treaties like the Kyoto Protocol, where treaty language was refined and debated over a number of years and a number of Conferences of the Parties (COPs), participation at any one of these relevant conferences qualified a state as a negotiator for this analysis. It is expected that having participated in the negotiation demonstrates an interest and an awareness of the treaty issue on the part of the state. However, an hypothesized direction of effect on the likelihood of ratification is not specified because it may be expected that some states choose to negotiate specifically to try and slow down or stop a treaty from progressing (e.g., Saudi Arabia's participation at the negotiation of many global climate change treaties). Overall, as regards the sample of 49 environmental treaties analyzed here, negotiating states ratified 72% of the treaties they participated in, while non-negotiating states ratified 45%.

The final control variable, *log(Population)*, is also taken from the World Bank's *World Development Indicators* database and represents the logged population of each sample state by year. This is included as previous ratification studies have argued that larger states (either as a component of a measure of power or simply as a measure of size) are more likely to ratify environmental treaties (Frank 1999, Fredriksson and Gaston 2000, Boockmann 2001, Neumayer 2002*a*,*b*, Miles and Posner 2008, Milewicz, Bächtiger and Nothdurft 2009).

Results

The aim of this analysis is to test, using the dataset described thus far, the hypothesized effects of signature on the observed ratification outcomes. At its core, the analysis uses a logit

model (because ratification is a binary dependent variable) which interacts signature with the primary predictors of interest. This analysis does not purport to offer a complete model of ratification outcomes, rather, its intention is to explore whether or not the attachment of signature alters the estimated effect of the ratification predictors in line with the hypotheses.

A few methodological decisions were made in order to select a statistical model that fits the contours of the data appropriately. First, as the sample selection process includes environmental treaties that vary both in their particulars and in the states which are eligible to participate in them, the logit is performed using a multilevel specification with random effects included to account for state and treaty level variance. The aim here is not to accurately model each individual state or treaty but rather to derive an average model fit which partially pools the data using the information contained in these predicted random effects. Second, as the time between treaty agreement and a successful ratification outcome can take many years, the model needs to account for any temporal dependence that exists across the dyads. Put most simply, if it is the case that treaties are more likely (or less likely) to be ratified as time progresses, regardless of the effect of other predictors, then the model must control for this effect so as not to over-estimate the magnitude of individual coefficients. Following Carter and Signorino (2010) I have included a cubic polynomial of time (t, t^2, t^3) to account for this temporal dependence. Their work has demonstrated that the cubic polynomial approach is more effective than time dummies and equally as effective as splines although much easier to use and interpret. Each state-treaty dyad begins with $t = 1$ as its first observation and the value is increased each year until the dyad is successfully ratified or the data is right-censored.[19]

[INSERT TABLE 4 HERE]

Table 4 presents the results of the fully specified model in a streamlined, three column format, that focuses on evaluating the proposed hypotheses. Column 1 presents the untransformed logit coefficients in the absence of signature, column 2 presents the coefficients

[19]To be clear, this analysis is not an event history approach. The aim is to explore whether ratification is obtained while controlling for temporal dependence, not to explain the time to ratify.

for those predictors following a non-binding signature and the final column represents the difference between the two measures including a significance test for that difference.[20] As my focus is primarily on the effect of signature on each predictor, column 3 is especially important for evaluating the hypotheses. It should be clear from the theoretical section that the expectation of this testing is not that any of the predictors should switch sign in the presence of signature, instead each hypothesis describes an effect where signature either significantly reduces or increases the effect of each predictor. The main findings conveyed by this table include support for the contention that signature provides low-cost information (H1) and support for the contention that signature increases the positive effect of per capita wealth on the likelihood of ratification (H4).

Hypothesis 1 argued that signature could provide low-cost information to the ratification actors, who are constrained in time, expertise and resources. Beginning with the treaty design mechanisms included to dissuade free-riding, the effects of *Participation Threshold*, *Added Threshold* and *Reservations Prohibited* are all significantly reduced following signature, and the magnitude of this reduction, as a proportion of their effects in the absence of signature, are sizable. In this sample, *Participation Threshold* and *Added Threshold* were not estimated with enough precision to significantly distinguish them from what would be expected if the actual effect were zero, however, such a situation fits the expectations of this hypothesis. Following signature, the effect of these design mechanisms is reduced considerably. One surprising finding is that, in this sample, the larger the included *Participation Threshold* the less likely is ratification. While participation thresholds are included to reduce the likelihood of free-riding, this negative effect may indicate that such thresholds are only included in treaties which are anticipated to be difficult to ratify.[21]

[20] Full regression results are in the appendix. The "unsigned" and "signed" columns are taken from Model 2 in Table 7 (*Government Seats* taken from Model 1 in the same table). The "difference" column is taken from Model 6 in Table 6 (*Government Seats* taken from Model 5 in the same table). These tables are provided for those who wish greater detail on the models themselves and also include estimates of the control variables, the model fit, the average random effects and the temporal dependence.

[21] If we accept such a correlation, then *Participation Threshold* may represent another possible test for the reverse causality objection raised in Section 2 (ratification likelihood determines signature). As was done in that section, the model of signature tested by Leinaweaver (2011) was adapted to include *Participa-*

As for the treaty design mechanisms related to cost, the *Obligations* predictor provided the expected negative effect on the likelihood of ratification in the absence of signature, while, as hypothesized, the attachment of signature appears to reduce this negative effect considerably. The effect of signature on *Enforcement*, on the other hand, could not be sufficiently estimated by the models utilized here. Following signature, *Enforcement* has a significantly negative effect on the likelihood of ratification (-11%) as is expected, but estimates of its effect in the absence of signature or of a difference between the two estimates, were both insignificant preventing any similar conclusion being drawn based on the data in this sample.

The politicization mechanism was operationalized in three ways. In the first two, the focus was on the partisan dynamics in the legislature (H2 and H3), however, the models used and data tested here failed to provide support for such a dynamic. Alternatively, the third operationalization (H4), focused on societal wealth per capita and is supported by these analyses. In the absence of signature, *log(GDP PC)* does not reach standard levels of significance, however, following signature the effect is significant and positive as is the estimated difference between the two coefficients. Based on the sample analyzed here, signature appears to activate the positive effect expected to link societal wealth and the demand for environmental policy, a linkage I argue that represents signature raising public awareness of the environmental treaty.

Interestingly, models 1 and 4 in Table 6 omit the wealth predictor and, in each, they identify a strong, positive effect of signature on the likelihood of ratification. This indicates that, because signature and ratification are not formally linked, some important, informal linkage was being omitted. When *log(GDP PC)* is included, *Signed* loses significance and magnitude which, I argue, both bolsters my contention that the wealth proxy is an important one and that it captures a significant portion of the impact that signature has on ratification.

From this table it is also clear that insufficient support is found for the centrality and

tion Threshold, although it too failed to demonstrate a significant effect of *Participation Threshold* on the likelihood of signature.

reputation hypothesis (H5). *IO Membership* has a positive effect on the likelihood of ratification in model 4 of Table 6 when it is tested on its own, however, the interaction with signature is insignificant (although positive) even in this reduced form test. One other significant effect of note from that table is the positive effect of *Negotiating State* in models 1, 5 and 6. Participating in the negotiation does, by this sample and model, increase the likelihood of ratification.

[INSERT TABLE 5 HERE]

[INSERT FIGURE 1 HERE]

Table 5 and Figure 1 provide an estimate of the substantive effect of these predictors in the presence, or absence, of signature. The values are average predicted comparisons which are derived using a procedure that identifies the effect of a given predictor evaluated using the actual observations in the dataset rather than holding all other predictors at their mean.[22] Table 5 displays the percentage change in the probability of ratification given a specified unit change in each predictor in the case where the treaty has not been signed (column 1) versus when it has (column 2), and Figure 1 provides a graphical representation of the shrinkage in the predictors' effects given signature. Overall, these comparisons provide further support for the argument that signature alters ratification by weakening treaty design predictors and by strengthening the societal wealth per capita predictor.

Figure 2 uses the estimates of the cubic polynomial for time taken from Table 6, model 5, to display a plot of the baseline temporal dependence. This baseline hazard is constructed by plotting the effect of time on the likelihood of a successful ratification holding all other predictors at their means (or modes in the case of binary predictors) and assuming the attachment of signature. The curve is clearly increasing non-monotonically. That the cubic polynomial method proposed by Carter and Signorino (2010) can adapt to a non-parametric baseline hazard such as this is one of the strengths of the approach. This figure indicates

[22] Average predicted comparisons provide a number of benefits over evaluating predictor effects at the mean of the logit model such as omitting the need to define means of binary or categorical variables and by considering the underlying distribution of the data. See Gelman et al. (2007: p466-470) for a more in-depth discussion of the method.

that the likelihood of a successful ratification increases for approximately 7 years, declines for the next 7 years and then increases at a greater rate after 14 years. Plotting the dependence in the absence of signature provides a similar shaped curve, although one much reduced in magnitude.

[INSERT FIGURE 2 HERE]

A number of robustness checks were performed to demonstrate that the main results were robust to alternate variable specifications, sample selection rules or choice of estimation procedure. As regards variable selection, Vanhanen's index of democracy was replaced by Marshall, Gurr and Jaggers (2010) *Polity2* measure to ensure that a particular definition of the contested concept "democracy" was not introducing some problematic bias. As regards sample selection, the sample was re-selected using different cutpoints for the Vanhanen measure and using different cutpoints of the *Polity2* measure. Additionally, a stability analysis was performed wherein the main model was repeatedly estimated, each time removing one of the treaties from the sample, to ensure that no single treaty was biasing the results. Finally, regarding estimation procedures, the main model was performed as a one-level logit model and, because ratification is a rare event, using the Relogit tool created by Imai, King and Lau (2007) in order to handle bias in rare events situations. In the case of the alternative estimation procedures, the support for the argument that signature provides low-cost information was strengthened considerably in each case, while the support for the societal wealth effect was maintained. Interestingly, the "Relogit" procedure made the signature interaction with *Enforcement* significant and in the correct direction to support H1, although "Relogit" does not account for the multilevel structure of the data.

Overall, these results provide support to the contention that non-binding signature changes the dynamics of the ratification decision by providing reliable, low-cost information to the domestic ratification actors and by activating public awareness of the environmental treaty, as demonstrated by the positive effect of societal wealth on the likelihood of ratification.

Conclusion

The current literature which explores ratification has developed along three somewhat distinct paths. The first, inspired by the collective action problems and cost issues anticipated to complicate any attempt to achieve international environmental cooperation, has focused on treaty design mechanisms. The second, recognizing that ratification is ultimately a domestic decision undertaken by actors constrained by domestic institutions, has focused on state characteristics which might describe a more or less inviting atmosphere for the creation of global environmental policy. The third, recognizing that an environmental treaty is an international act and must therefore be influenced to some degree by international relationships, has focused on the state's embeddedness in the international community. All three are logical approaches built on reasonable assumptions, however, all have assumed that ratification is a decision independent of other state actions regarding a particular treaty.

However, modern environmental treaties provide for two mechanisms by which a state may indicate its support, non-binding signature and ratification, and it is the central argument of this paper that these two actions are informally linked. Given the existence of these mechanisms, it is useful to reconsider our approach to the analysis of ratification outcomes by focusing on the actors, the institutions and the distribution of information particular to each. In short, non-binding signature is the purview of the state executive acting in a fairly unconstrained manner with practically complete treaty information whereas the ratification decision, for the sample explored here, is the responsibility of a larger set of actors typically operating within a legislative body and lacking treaty specific information. Testing of a newly constructed dataset of 49 multilateral, environmental treaties demonstrated that the attachment of non-binding signature by the state executive significantly reduces the effect of treaty design and increases the effect of societal wealth on the likelihood of ratification.

These findings raise a few interesting policy implications. First, we must acknowledge that while non-binding signature appears, by definition, to be formally costless and relatively unimportant during the process which leads to a state's decision whether or not to ratify

an environmental treaty, the fact of the matter is that signature is substantively important in determining the level of information held by the domestic ratification actors and the level of awareness of the treaty among the mass public (or at least the belief that such support exists by political elites anticipating the desires of the mass public). This means that state executives are more relevant to domestic ratification games than the literature has previously assumed and, further, that groups interested in a particular environmental treaty's ratification outcome should consider expending some political resources (e.g., lobbying) on the executive alongside the domestic ratification actors. It may be that such a focus on the executive's decision, as it precedes the ratification stage, may structure the ratification dynamics in a larger and less costly way then by targeting the many veto players involved in the ratification decision.

One possible objection to the interpretation presented here might be that no causality is actually present. Instead it may simply be that some omitted variable increases the likelihood of both signature and ratification, with no meaningful link between the two. However, such an argument is problematic for a few reasons. First, it requires us to assume away both the impact of signature, a visible, political action, on domestic interests and the plausible story regarding information asymmetries between the state executive and the ratification actors. Second, the literature has not yet identified an omitted variable with the necessary characteristics. Such a variable would need to strongly impact both the state executive and the ratification actors (overcoming any partisan differences in receiving the signal and conflicts in their individual goals), the effect of the variable would need to persist across time (signature and ratification are often separated by years) and it would also need to vary across time to explain the 41% of cases in the sample where signature was possible but unattached and ratification was attained (did the executive miss the signal or did it change?). Ultimately, even if such a variable was identified, the characteristics of signature discussed in this paper make clear that multiple pathways exist for it to effect the dynamics of ratification, and it is those pathways which are analyzed here.

Moving forward, this paper raises the possibility that non-binding signature is a strategic choice and a useful next step in this exploration would be to endogenize it. Our current models of the signature decision focus on signature as a value-claiming device for the state executive, however, the question remains as to whether the state executive is aware of the effects of signature on the ratification decision and whether the attachment of signature introduces reputation costs for the state executive if ratification is not achieved. If aware, then the signature decision has characteristics of a two-level game in that the state executive must simultaneously weigh its desire to achieve benefits from its signature attachment at the international game board against the knowledge that the domestic ratification game will play out differently because of that action (Putnam 1988, Milner 1997).

The simplest form of endogenous signature would be where the state executive recognizes the power of the signal and attaches it to any treaty it wishes to see ratified. However, signature, in this sample at least, is not attached so cavalierly and the possibility remains that the signal may be more costly than otherwise suspected. For example, the executive may fear that a failure to achieve ratification after signature will be somehow costly to its reputation or political survival. In such a case, modeling will need to focus on what criteria determine whether or not the risk is acceptable and, if cases exist, where the signal proved conclusively important in moving a treaty from the unlikely to the likely to be ratified category.

Despite this intriguing possibility, we should not rush to assume that the case for endogenous signature is not, by itself, problematic. The oftentimes extended period of time that exists between signature and ratification present a serious challenge to the idea that a fear of failed ratification plays a role in the executive's decisionmaking. As time passes, voters may forget the delayed treaty and elections will come and go. It may even be that ratification often happens well after an executive has left office. In such an instance the reputation costs would have to be considered reduced considerably and one has to wonder to what degree those fears play a role in the signature decision if such delays are common.

In sum, it is hoped that by conceiving of signature and ratification as a strategic game played by different actors facing distinct institutional rules where signature has the capacity to alter ratification dynamics, may help us to fold the previous literatures' findings into a single framework. Those scholars who seek evidence of an international influence on ratification will find those dynamics at work on the non-binding signature decision, while those who focus on the ratification decision will need to consider domestic predictors, treaty design predictors and the effect signature appears to have in weakening those predictors. Additionally, such a strategic approach to modeling ratification outcomes may provide us greater leverage over questions this paper has only begun to answer. How strong is the effect of signature as compared to the main predictors discussed in the literature? Is it the case that non-binding signature may push through a successful ratification where a better informed set of ratification actors might have vehemently disapproved? Are there instances where the state executive passes on the short-term gains of attaching signature because it prefers the treaty not be made binding domestically? Such questions should help us to clarify the role played by the predictors identified in the literature and, ultimately, to improve our ability to explain the ratification outcomes we are primarily concerned with.

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	Signed	**Not Signed**
Ratification	82%	34%
	(583)	(276)
No Ratification	18%	66%
	(127)	(534)

1,520 State-Treaty Dyads

Table 1: *Outcomes Observed*: For present purposes, the data set omits state-treaty dyads where the state was ineligible to sign because it failed to meet the necessary criteria during the period of the signature window (e.g., state not yet in existence, state not party to necessary convention or international organization (IO)). It also excludes states that do not empower ratification actors beyond the state executive and those states which are non-democracies.

	Signature	**Ratification**
Actors	The State Executive	Domestic Ratification Actors
Institutional Rules	Time Limited	No Time Limit
	Very Minor Obligations	Legal Constraints Established
	Veto Players $= 1$	*Veto Players* > 1
Treaty Information	Extensive	Limited

Table 2: *Signature and Ratification: An Institutionalist Framework*

Treaties Overall (49)	N	Mean	sd	Min	Max
Breadth					
: Regional	38 (78%)				
Obligations	28 (57%)				
Enforcement	21 (43%)				
Participation Threshold	49	12.6	10.9	0	55
Added Threshold	6 (12%)				
Reservations Prohibited	12 (24%)				
State-Treaty Dyads (1,520)					
States	119				
Treaties	49				
States per Treaty		31	33	2	110
Negotiating State	1,302 (70%)				
Signed	758 (50%)				
Ratified	919 (60%)				
State-Treaty Dyads by Year (BTSCS) (7,588)					
(IO Membership)/100	7,588	.7	.2	.1	1.3
Government Seats	6,792	0.6	0.2	0.0	1.0
Opposition Seats	6,792	0.4	0.2	0.0	1.0
log(Population)	7,570	15.7	2.0	10.6	20.7
log(GDP pc)	7,493	8.1	1.5	4.8	10.8
Negotiating State	6,534 (66%)				
Regional	7,588 (40%)				
Obligations	7,588 (61%)				
Enforcement	7,588 (44%)				
Participation Threshold	7,588	11.9	10.7	0.0	55.0
Added Threshold	7,588 (25%)				
Reservations Prohibited	7,588 (28%)				
Signed	2,959 (39%)				
Ratified	683 (9%)				

Table 3: *Summary Statistics*: Variables described in different subsets, however, they enter the regressions as binary-time-series-cross-sectional observations (state-treaty dyads per year). All treaties are multilateral (> 2 invited participants) although due to the democracy constraint some treaties appear in the data set to have only 2 possible members. Percentages are included for binary and categorical variables to indicate the proportion of the total in each category.

	Unsigned	Signed	Difference
Treaty Design			
Participation Threshold	-0.06*	-0.03	0.03*
	(0.02)	(0.02)	(0.01)
Added Threshold	2.21*	0.06	-2.16*
	(0.78)	(0.73)	(0.43)
Reservations Prohibited	3.80*	1.36*	-2.44*
	(0.56)	(0.48)	(0.37)
Obligations	-1.20*	-0.34	0.86*
	(0.55)	(0.44)	(0.40)
Enforcement	-0.85	-1.14*	-0.28
	(0.56)	(0.45)	(0.42)
Politicization			
Government Seats	0.38	4.06	3.68
	(5.75)	(4.68)	(7.07)
Opposition Seats	-0.10	-0.03	0.07
	(0.59)	(0.50)	(0.75)
log(GDP pc)	0.04	0.29*	0.25*
	(0.11)	(0.10)	(0.11)
Centrality & Reputation			
(IO Membership)/100	1.44	0.33	-1.10
	(0.96)	(0.75)	(0.92)

*$p < 0.05$

Table 4: *The Impact of Non-Binding Signature on the Dynamics of the Ratification Decision*: Results taken from a series of multilevel logit models with random effects to capture the variance at the state and treaty level and a cubic polynomial to capture temporal dependence. Values are the untransformed logit coefficients. Full regression results are in the appendix. The "unsigned" and "signed" columns are taken from Model 2 in Table 7 (*Government Seats* taken from Model 1 in the same table). The "difference" column is taken from Model 6 in Table 6 (*Government Seats* taken from Model 5 in the same table).

	Unsigned (%)	Signed (%)
Signature provides low-cost information		
Participation Threshold		
Min to Max	-17	-15
Mean to Max	-9	-6
Min to Mean	-9	-8
Added Threshold		
0 to 1	+14	+1
Reservations Prohibited		
0 to 1	+25	+15
Obligations		
0 to 1	-6	-4
Signature politicizes an environmental treaty		
log (GDP pc)		
Min to Max	+1	+17
Mean to Max	+1	+10
Min to Mean	+1	+8

Table 5: *Average Predicted Comparisons*: Average predicted comparisons provide estimates of the effect of a given predictor evaluated using the actual observations in the dataset rather than holding all other predictors at their mean. The table displays the percentage change in the probability of ratification given a specified unit change in each predictor in the case where the treaty has not been signed (column 1) versus when it has (column 2).

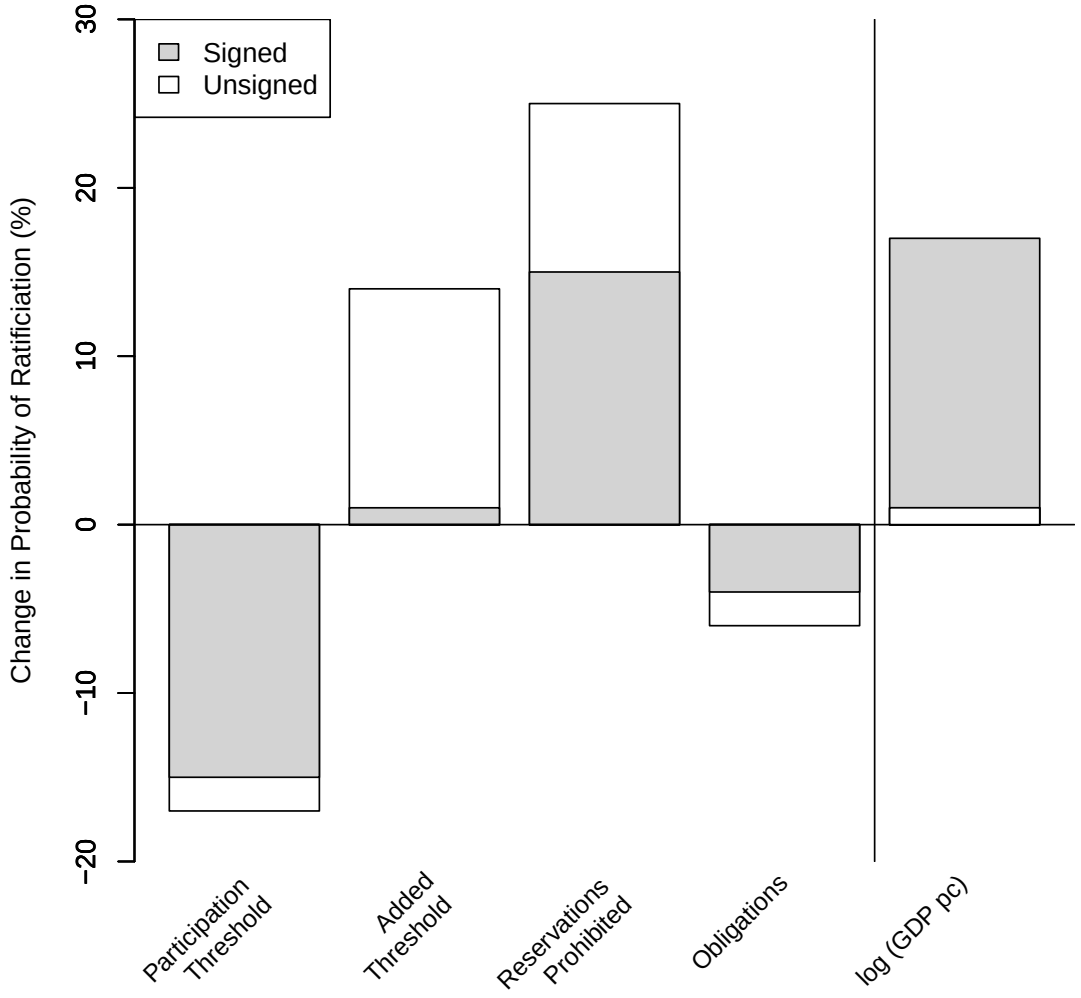

Figure 1: *Average Predicted Comparisons*: This figure presents the results from Table 5 graphically. *Added Threshold*, *Reservations Prohibited* and *Obligations* are dummy variables and the bars represent a change in the predictors for *Participation Threshold* and *log (GDP pc)* from their minimum to maximum values.

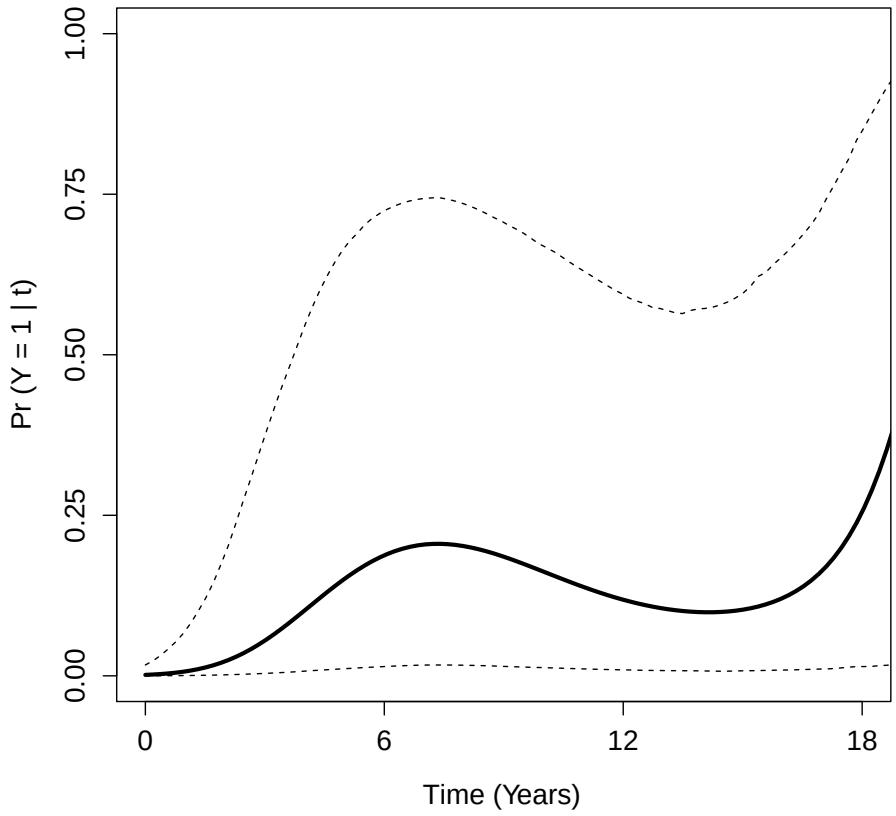

Figure 2: *The Baseline Hazard*: Displays the underlying temporal dependence of the ratification decision holding all other predictors at their means (or modes if binary). The curve incorporates signature attachment so that the non-monotonically increasing nature of the dependence is made clearer. The dashed lines represent 95% confidence intervals.

Appendix A: Full Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
Signed	1.86*	-0.72	-0.97	1.30*	0.56	0.79
	(0.31)	(0.93)	(0.82)	(0.47)	(1.07)	(0.94)
Treaty Design						
Participation Threshold	-0.07*				-0.06*	-0.06*
	(0.02)				(0.02)	(0.02)
x Signature	0.04*				0.03*	0.03*
	(0.01)				(0.01)	(0.01)
Added Threshold	2.22*				2.22*	2.21*
	(0.78)				(0.81)	(0.78)
x Signature	-2.09*				-2.17*	-2.16*
	(0.42)				(0.43)	(0.43)
Reservations Prohibited	3.51*				3.82*	3.80*
	(0.53)				(0.56)	(0.56)
x Signature	-2.27*				-2.46*	-2.44*
	(0.34)				(0.37)	(0.37)
Obligations	-1.25*				-1.21*	-1.20*
	(0.53)				(0.55)	(0.55)
x Signature	0.97*				0.86*	0.86*
	(0.38)				(0.40)	(0.40)
Enforcement	-0.78				-0.85	-0.85
	(0.54)				(0.56)	(0.56)
x Signature	-0.34				-0.28	-0.28
	(0.40)				(0.42)	(0.42)
Politicization						
Government Seats		0.44			0.38	
		(0.54)			(5.75)	
x Signature		-0.18			3.68	
		(0.67)			(7.07)	
Opposition Seats			-0.46			-0.10
			(0.55)			(0.59)
x Signature			0.44			0.07
			(0.71)			(0.75)
log(GDP pc)		0.01	0.01		0.04	0.04
		(0.09)	(0.09)		(0.11)	(0.11)
x Signature		0.29*	0.29*		0.25*	0.25*
		(0.10)	(0.10)		(0.11)	(0.11)
Centrality & Reputation						
IO Membership				1.42*	1.39	1.44
				(0.70)	(0.96)	(0.96)
x Signature				0.33	-1.04	-1.10
				(0.67)	(0.92)	(0.92)
Controls						
Negotiating State	0.50*	0.28	0.28	0.22	0.44*	0.44*
	(0.18)	(0.18)	(0.18)	(0.18)	(0.20)	(0.20)
log(Population)	0.05	0.06	0.06	-0.06	0.04	0.04
	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
Regional	0.24	0.02	0.01	0.08	0.23	0.22
	(0.66)	(0.62)	(0.62)	(0.63)	(0.67)	(0.67)
Time	1.71*	1.74*	1.74*	1.72*	1.70*	1.70*

Continued on next page

	(1)	(2)	(3)	(4)	(5)	(6)
	(0.14)	(0.15)	(0.15)	(0.14)	(0.15)	(0.15)
$Time^2$	-0.18*	-0.18*	-0.18*	-0.18*	-0.18*	-0.18*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$Time^3$	0.57*	0.58*	0.57*	0.59*	0.54*	0.54*
	(0.08)	(0.09)	(0.09)	(0.08)	(0.09)	(0.09)
(Intercept)	-8.30*	-8.83*	-8.36*	-7.31*	-9.54*	-9.40*
	(1.19)	(1.40)	(1.29)	(1.00)	(1.72)	(1.62)
DIC	2,926.2	2,730.6	2,730.8	3,002.8	2,638.4	2,639.1
N	6,516	5,788	5,788	6,516	5,788	5,788
Average Random Effects						
States	22%	18%	18%	20%	19%	19%
Treaties	29%	40%	40%	41%	29%	29%

*$p < 0.05$

Table 6: *Model Regression Results*: A series of multilevel logit models with random effects included to capture the variance at the state and treaty level and a cubic polynomial of time to capture time dependence. $Time^3$ and *IO Membership* are scaled by 100 and *Government Seats* is scaled by 10 to aid estimation convergence.

Appendix B: Regressions Used to Construct Table 4

	(1)	(2)
Signed	0.56	0.79
	(1.07)	(0.94)
Treaty Design		
S x Participation Threshold	-0.03	-0.03
	(0.02)	(0.02)
NS x Participation Threshold	-0.06*	-0.06*
	(0.02)	(0.02)
S x Added Threshold	0.05	0.06
	(0.73)	(0.73)
NS x Added Threshold	2.22*	2.21*
	(0.78)	(0.78)
S x Reservations Prohibited	1.36*	1.36*
	(0.48)	(0.48)
NS x Reservations Prohibited	3.82*	3.80*
	(0.56)	(0.56)
S x Obligations	-0.34	-0.34
	(0.45)	(0.44)
NS x Obligations	-1.21*	-1.20*
	(0.55)	(0.55)
S x Enforcement	-1.13*	-1.14*
	(0.45)	(0.45)
NS x Enforcement	-0.85	-0.85
	(0.56)	(0.56)
Politicization		
S x Government Seats	4.06	
	(4.68)	
NS x Government Seats	0.38	
	(5.75)	
S x Opposition Seats		-0.03
		(0.50)
NS x Opposition Seats		-0.10
		(0.59)
S x log(GDP pc)	0.30*	0.29*
	(0.10)	(0.10)
NS x log(GDP pc)	0.04	0.04
	(0.11)	(0.11)
Centrality & Reputation		
S x IO Membership	0.35	0.33
	(0.75)	(0.75)
NS x IO Membership	1.39	1.44
	(0.96)	(0.96)
Controls		
Negotiating State	0.44*	0.44*
	(0.20)	(0.20)
log(Population)	0.04	0.04
	(0.07)	(0.07)
Regional	0.23	0.22
	(0.67)	(0.67)
Time	1.70*	1.70*

Continued on next page

	(1)	(2)
	(0.15)	(0.15)
$Time^2$	-0.18*	-0.18*
	(0.02)	(0.02)
$Time^3$	0.54*	0.05*
	(0.09)	(0.01)
(Intercept)	-9.54*	-9.40*
	(1.72)	(1.62)
DIC	2,638.4	2,639.1
N	5,788	5,788
Average Random Effects		
States	19%	19%
Treaties	29%	29%

*$p < 0.05$

Table 7: *Regression Results to Construct Table 4*: The multilevel logit models used to construct Table 4. $Time^3$ and *IO Membership* are scaled by 100 and *Government Seats* is scaled by 10 to aid convergence. Signed (S), Unsigned (NS).

Appendix C: Sample Treaties and Signatures Attached

Treaty
Protocol For The Protection Of The Mediterranean Sea Against Pollution From Land-Based Sources (1980)
Convention For The Protection Of The Marine Environment And Coastal Area Of The Southeast Pacific (1981)
Agreement On Regional Cooperation In Combating Pollution Of The Southeast Pacific By Hydrocarbons And Other Harmful Substances In Cases Of Emergency (1981)
Convention For The Protection And Development Of The Marine Environment Of The Wider Caribbean Region (1983)
Protocol Concerning Cooperation In Combating Oil Spills In The Wider Caribbean Region (1983)
Protocol For The Protection Of The Southeast Pacific Against Pollution From Land-Based Sources (1983)
Supplementary Protocol To The Agreement On Regional Cooperation In Combating Pollution Of The Southeast Pacific By Oil And Other Harmful Substances In Cases Of Emergency (1983)
Protocol On Long-Term Financing Of The Cooperative Programme For Monitoring And Evaluation Of The Long-Range Transmissions Of Air Pollutants In Europe To The Convention On Long-Range Transboundary Air Pollution (EMEP) (1984)
Convention For The Protection Of The Ozone Layer (1985)
Convention For The Protection, Management And Development Of The Marine And Coastal Environment Of The Eastern African Region (1985)
Protocol Concerning Cooperation In Combating Marine Pollution In Cases Of Emergency to the Convention For The Protection, Management And Development Of The Marine And Coastal Environment Of The Eastern African Region (1985)
Protocol On The Reduction Of Sulphur Emissions Or Their Transboundary Fluxes By At Least 30 Per Cent To The Convention On Long-Range Transboundary Air Pollution (1985)
Convention For The Protection Of The Natural Resources And Environment Of The South Pacific Region (1986)
Protocol For The Prevention Of Pollution Of The South Pacific Region By Dumping (1986)
Protocol Concerning Cooperation In Combating Pollution Emergencies In The South Pacific Region (1986)
Montreal Protocol On Substances That Deplete The Ozone Layer (1987)
Protocol Concerning The Control Of Emissions of Nitrogen Oxides Or Their Transboundary Fluxes To The Convention On Long-Range Transboundary Air Pollution (1988)
Convention On The Control Of Transboundary Movements Of Hazardous Wastes And Their Disposal (Basel Convention) (1989)
International Convention On Oil Pollution Preparedness, Response And Cooperation (1990)

Treaty
Convention On The Ban Of The Import Into Africa And The Control Of Transboundary Movement And Management Of Hazardous Wastes Within Africa (Bamako Convention) (1991)
Protocol Additional To The Convention For The Protection Of The Rhine From Pollution By Chlorides (1991)
Protocol Concerning The Control Of Emissions Of Volatile Organic Compounds Or Their Transboundary Fluxes To The Convention On Long-Range Transboundary Air Pollution (1991)
Convention On The Transboundary Effects Of Industrial Accidents (1992)
Convention On The Protection Of The Black Sea Against Pollution (1992)
Convention On The Protection Of The Marine Environment Of The Baltic Sea Area (1992)
Protocol On Cooperation In Combating Pollution Of The Black Sea Marine Environment By Oil And Other Harmful Substances In Emergency Situations (1992)
Protocol On The Protection Of The Black Sea Marine Environment Against Pollution From Land-Based Sources (1992)
Protocol On The Protection Of The Black Sea Marine Environment Against Pollution By Dumping
United Nations Framework Convention On Climate Change (UNFCCC) (1992)
Convention For The Protection Of The Marine Environment Of The North East Atlantic (1992)
Convention On The Protection And Use Of Transboundary Watercourses And International Lakes (1993)
Protocol On Further Reduction Of Sulphur Emissions To The Convention On Long-Range Transboundary Air Pollution (1994)
Protocol For The Protection Of The Mediterranean Sea Against Pollution Resulting From Exploration And Exploitation Of The Continental Shelf And The Seabed And Its Subsoil (1994)
Convention To Ban The Importation Into The Forum Island Countries Of Hazardous And Radioactive Wastes And To Control The Transboundary Movement And Management Of Hazardous Wastes Within The South Pacific Region (1995)
Convention On The International Commission For The Protection Of The Oder (1996)
International Convention On Liability And Compensation For Damage In Connection With The Carriage Of Hazardous And Noxious Substances By Sea (1996)
Protocol On The Prevention Of Pollution Of The Mediterranean Sea By Transboundary Movements Of Hazardous Wastes And Their Disposal (1996)
Protocol To The Convention On The Prevention Of Marine Pollution By Dumping Of Wastes And Other Matter (1996)
Convention On The Law Of The Non-Navigational Uses Of International Watercourses (1997)
Protocol Adopting Annex VI - Regulations For The Prevention Of Air Pollution From Ships To The International Convention For The Prevention Of Pollution From Ships (1997)

Treaty
Protocol To The United Nations Framework Convention On Climate Change (Kyoto) (1997)
Protocol On Heavy Metals To The Convention On Long-Range Transboundary Air Pollution (1998)
Protocol On Persistent Organic Pollutants To The Convention On Long-Range Transboundary Air Pollution (1998)
Convention On The Protection Of The Environment Through Criminal Law (1998)
Convention On The Protection Of The Rhine (1999)
Protocol On Water And Health To The Convention On The Protection And Use Of Transboundary Watercourses And International Lakes (1999)
Protocol Concerning Pollution From Land-Based Sources And Activities (1999)
Protocol To Abate Acidification, Eutrophication And Ground-Level Ozone To The Convention On Long-Range Transboundary Air Pollution (1999)
Protocol On Liability And Compensation For Damage Resulting From Transboundary Movements Of Hazardous Wastes And Their Disposal (1999)

Table 8: *Sample Treaties and Signatures Attached*