

Toward a Transactions Cost Theory of Environmental Treaties: Substantive and Symbolic Environmental Agreements*

1. – *Introduction*

The thesis of this paper is that the problems which must be overcome in treaty negotiation and the cost of alternative treaty forms have direct implications for the content of environmental treaties. The analysis developed below suggests that establishing international institutions to monitor and implement the terms agreed to will be at least as evident in treaty language as specifications of terms of environmental trade. Moreover, the analysis suggests that symbolic and procedural treaties will be more common than substantive ones. Historical evidence from environmental treaties consummated in the last four decades is consistent with these and other hypotheses developed below.

Substantive environmental treaties specify terms by which changes in one country's rules or procedures are to be traded for those of another country's as a means of securing expected improvements in environmental quality¹. In the latter respect, environmental treaties attempt to achieve an end similar to that espoused in domestic environmental legislation. Suitable changes in legal constraints are expected to generate desired changes in the effluent outputs

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¹ See Black [1958, p. 152] for an early public choice perspective on international treaties. Tollison and Willet [1979] model international agreements as a method of realizing mutual gains from exchange (or treaty terms) in a setting where national governments act as perfect agents for their respective citizenry. It would be more accurate to say that decisive members of national governments necessarily *expect to gain* from any treaties consummated. Baldwin [1989] discusses the GATT treaty as a device for internalizing externalities. Sykes [1991] provides a public choice based contractual explanation of the article xix of GATT, the so called escape clause. None of these papers, however, emphasize enforcement problems associated with negotiating trade treaties or attempt to explain the variety of trade and other treaties that one would expect to observe.

of firms and consumers. However, the problem addressed is, in another sense, fundamentally different in as much as the problem directly addressed attempts to solve externality problems among government actions rather than polluters. International treaties attempt to coordinate the regulatory behavior of governments, and only indirectly affect the behavior of private decision makers. This indirect approach is largely a result of the sovereignty of the contracting parties, and the consequent absence of standing international organizations with enforcement authority.

The absence of standing external enforcement mechanisms implies that treaties must establish monitoring and enforcement mechanisms if agreed to regulatory reforms are to be fully implemented. In order to give treaty obligations the force of domestic law, agreements struck by negotiators are ratified by each signatory country's respective legislative body. In many cases, implementing domestic legislation is also required. The actual enforcement of new environmental rules remains a domestic matter. Even with domestic ratification, alternative interpretations of treaty language often allow considerable discretion over how treaties are implemented². The analysis below argues that 'domestic incentives for noncompliance continue to exist throughout the life of a given treaty'³.

In other respects, environmental treaties are very much like ordinary long term contracts between consenting parties. As in other long term contracts, attempts to coordinate domestic and international environmental regulations are only partly motivated by immediately observable changes in environmental quality and/or real income. Future environmental improvements are not directly observable and can not be known with certainty at the time that a treaty is signed. The consummation of, and adherence to environmental treaties occur because of indirect effects that such treaties have on the expectations of political decision makers in the signatory countries⁴.

Substantive environmental treaties affect expectations by committing signatory governments to enacting and enforcing generally more stringent domestic environ-

² International treaties are not voluntary in the usual individualistic sense. For example, the terms reached at the conclusion of a war are often imposed by the victorious party. Moreover, agreement at the level of government does not assure agreement at the level of the citizenry. However, environmental treaties are one case where theoretical gains from trade are likely to exist (see below) and bargains seem to have been struck rather than imposed.

³ See Helfand [1991] for a discussion of the various properties of alternative standards. See Buchanan and Tullock [1975] for a discussion of domestic political aspects of the choice of standards versus taxes. Neither of these discussions mentions the problem of enforcement. To the extent that fines of one kind or another are used to encourage adoption of a standard or to enforce property rights, both of these regimes are actually variations on Pigovian taxes. The fines are the behavior changing mechanism rather than the standards or property rights. What a tradable standard does is to reduce the range over which a «tax» will be imposed to ones deviating from the standard (engaging in trespass). Under a standard Pigovian tax, all would pay the tax rather than those deviating from a particular level.

⁴ The long-term nature of environmental problems is a consequence of the cumulative nature of the processes involved. Uncertainty is a consequence of the complexity of the natural processes involved and the state of scientific knowledge concerning those processes.

mental regulations. However, a treaty may affect the expectations of the relevant political decision makers without fully specifying terms of regulatory exchange. The commitments reached must be creditable, although they need not be substantive. For example, signatories to symbolic treaties make commitments to draft and adopt substantive regulations at some point in the future. Rather than specify time tables for meeting effluent targets, such treaties generally establish institutional arrangements and/or some process which makes substantive regulations more likely than would otherwise have been the case. In this manner, symbolic and procedural treaties may alter environmental expectations and advance political ends without themselves specifying changes to environmental law.

The remainder of the paper is organized as follows. Section 2 characterizes the economic advantages that can be realized by coordinating environmental policies. Section 3 discusses the enforcement problems that must be overcome if environmental treaties are to be substantive and fully implemented. Section 4 demonstrates that transactions costs and the temporal aspects of negotiation imply that symbolic treaties will be more common than substantive treaties. Section 5 examines the history and content of environmental treaties consummated during the last forty years. The environmental treaties observed are broadly consistent with the transactions cost based analysis developed below. Section 6 summarizes the results and suggests extensions.

2. – *The international environmental coordination problem*

Essential features of the regulatory externality problem can be illuminated by focusing on the environmental choice of a typical pivotal government decision maker. Consider the regulatory choice of the pivotal decision maker, Mr. j , in the i^{th} affected country with an indirect utility function defined over environmental quality, E , ordinary economic income, Y , and time into the future, t .⁵ Environmental regulations affect the anticipated flows of income and effluents, and thereby expected environmental quality.

Let P be the subjective probability density function of environmental quality conditioned on total effluents in the region of interest, F , and time into the future, t . The latter allows the possibility of environmental lags, which characterize most environmental problems. The analysis follows Hoel [1991] insofar as the international environmental regulation and bargaining process is modeled as a Nash game played between governments⁶. Expected utility for the time period

⁵ In a well functioning democracy, the pivotal governmental decision maker is an individual who advances the pivotal voter's interest. In deterministic voting models, the pivotal voter is the median voter [DOWNS, 1957]. In stochastic voting models, the pivotal voter is generally the average voter [COUGHLIN and NITZAN, 1981]. In less than perfectly functioning democracies, the pivotal governmental decision maker is the marginal special interest group. See Peltzman [1976] or Austin-Smith [1987].

⁶ The analysis developed below uses the Hoel [1991] assumption that relations between states can be modeled as if nations were single agents. Although not the focus of this paper, it bears not-

of interest is the integral of utility associated with possible pollution levels at various times weighted by their probabilities through time and discounted by the individual's marginal rate of intertemporal substitution. (This is implicitly done here by including time in the utility function). The relevant time horizon is assumed to be infinite, as in many over-lapping generations models. This assumption does not affect the principal results of interest here which are future but not infinite time horizon dependent.

The pivotal decision maker selects domestic regulations to maximize expected utility subject to personal and national economic and environmental constraints.

$$U_{ij} = \int_{0-}^{+} \int^{+} p(E|F, t) u(Y_{ij}, E, t) dE dt \quad (1.0)$$

with

$$F = \sum F_i \quad (1.1)$$

$$F_i = f(Y_i, R_i, t) \quad (1.2)$$

$$Y_i = y(R_i, t) \quad (1.3)$$

$$Y_{ij} = a(Y_i, t) \quad (1.4)$$

Subscript i denotes a country and subscript ij denotes value for the pivotal decision maker in the country of interest. The effluents generated by the i^{th} country, F_i , are a consequence of its aggregate production level and the stringency of its own regulations. The opportunity cost of adopting more stringent environmental regulations is reduced economic income for the time period of interest⁷. Measures required to reduce effluent output increase other production costs, and thereby reduce the real economic income of the pivotal decision maker by increasing the cost of consumer goods, other than environmental quality. The pivotal decision maker of country i 's own income, Y_i , is assumed to be an increasing function of national income.

Mr. j 's choice determines the stringency of country j 's local regulations. Initially we adopt the Nash assumption that Mr. j takes the environmental regula-

ing that government decision makers are not always, or even generally, perfect agents for their citizenry. If citizens are well informed and vote according to their environmental and economic interests, any treaties or protocols agreed to will tend to maximize the utility of the median or average voter [MUELLER, 1989]. On the other hand, political constituencies, for example the green movement or polluting firms, may be able to capture key positions on international delegations and implement more or less stringent regulations than typical voters would have agreed to. In cases where citizens are not well informed or lack the ability to sanction government officials, the resulting agreements will be in the interest of pivotal government officials or their immediate sponsors rather than the median or average voter [PELTZMAN, 1976]. This is clearly the case for authoritarian regimes where only the interest of the autocrat is necessarily advanced. In either case, Hoel's efficiency result would be true only at the level of pivotal government decision makers and not for the affected citizenry as a whole.

⁷ Congleton [1991] demonstrates that for individuals who consider both income and environmental quality to be goods, all the utility maximizing levels of environmental quality lie along downward sloping segments of the environmental quality/measured economic income choice set.

tions of other countries, and their associated effluent output levels, as given during the period of interest. Let R be the vector of the regulations for the environmentally affected countries over the period of interest for the affected countries. Combining constraints, the optimization problem faced by the pivotal decision maker of country i can now be rewritten as maximize,

$$U^e = \int_{0-}^+ \int_{-}^+ P(E|R,t) U(Y(R_i), E) dE dt \tag{2}$$

Differentiating equation 2 with respect to R_i yields the first order condition for the expected utility maximizing local regulatory environment:

$$\int_{0-}^+ \int_{-}^+ [P_{R_i} U(Y(R_i), E) + P(E|R_i, t) U_Y Y_{R_i}] dE dt = 0 \tag{3}$$

The optimal local regulatory regime from the point of view of the pivotal political decision maker sets the present value of the marginal increase in utility from improved environmental quality equal to the present value of the marginal decrease in utility caused by the decline in ordinary measured economic income. Note that the regulatory regimes of other countries affect country i 's choice insofar as they affect the probabilities of environmental quality associated with changes in country i 's own regulatory regime. However, the external effect of country i 's regulatory environment on other countries is not accounted for at this equilibrium.

The implicit function theorem allows equation (3) to be used as a basis to describe country i 's preferred environmental regulation, R_i^* , as a function of exogenous choice parameters, here the regulatory regimes of the other affected countries, and time.

$$R_i^* = r_i(R_1, R_2, \dots, R_{i-1}, R_{i+1}, \dots, R_N, t) \tag{4}$$

Similar functions can be determined for each of the affected countries. Interpreted as best reply functions, or Nash reaction functions, this series of functions can be used as the basis for describing the Nash equilibrium in domestic environmental regulations for the region of interest. In equilibrium, every country will be on its own best reply function simultaneously. None of the affected countries takes direct account of the effects of their own regulations on the welfare of other governments at the Nash equilibrium.

The first order condition for Pareto optimal regulations at the level of governments requires the effects of each country's regulations on the welfare of other governments to be taken account of. For example, country i 's regulations should be set at the level which sets:

$$\sum_{n=1}^N \int_0^+ \int_{-}^0 [P_{R_i} U(Y(R_n), E) dE dt + \int_0^+ \int_{-}^0 P(E|R_i, t) U_Y Y_{R_i} dE dt = 0 \tag{5}$$

The first term of equation 5 differs from equation 3 which describes country i 's choice. Unless the sum of spill-over effects on other countries is zero at the margin, the domestic environmental regulations characterized by equation 3 will

differ from those described by equation (5), and the Nash equilibrium will fail to realize all potential gains from coordinating environmental regulations⁸.

While it is possible for domestic regulations to be set at a Pareto optimal level for each government, as would be the case when dealing with strictly local matters, this is unlikely in cases where there are significant international externalities. Here, the conditions for Pareto optimal domestic regulations will tend to be violated by *every* affected country. In this case, governments that coordinate (exchange) environmental regulations with other affected countries will be able to achieve uniformly more desirable solutions to international pollution problems.

3. – *Treaty compliance*

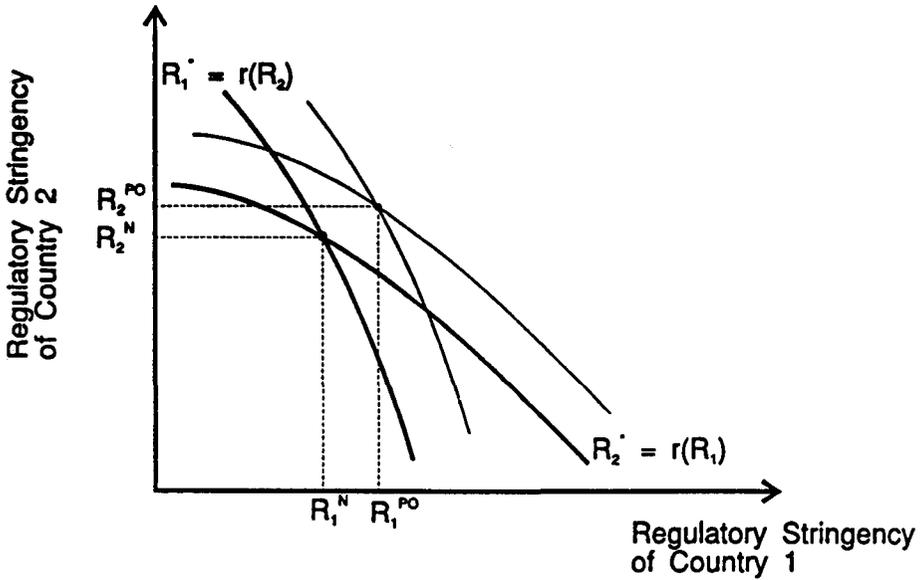
The institutional aim of treaty negotiation is to solve the monitoring and enforcement problems associated with realizing the gains from coordinating environmental regulations outlined above. The long term nature of environmental problems implies that monitoring and decision making problems are so long term and have to be solved as part of any international environmental agreement. While coordinating environmental regulations is likely to increase the welfare of pivotal governmental decision makers, the required policies are not themselves utility maximizing choices for the pivotal decision makers of the signatory countries.

Fig. 1 illustrates this conflict between self interested behavior at a Nash equilibrium and the Pareto optimal regulatory mix for the two country case. Pareto optimal coordinated policies, (R_1^{PO}, R_2^{PO}) , require regulations above and to the right of each country's reaction function. Regulations in this range increase utility relative to the original Nash equilibrium, (R_1^N, R_2^N) , but being above each country's reaction function do not maximize utility given the other country's policy. Each nation benefits if the other country reduces its effluent output, but does not profit from further reducing its own. The former confers environmental benefits without direct costs and the later exacts a greater sacrifice of domestic national income than it returns in environmental quality. Consequently, self-enforcing and continuous monitoring mechanisms will be necessary to assure that the contracting parties adhere to the reign of mutual gains.

It bears noting that many self-enforcing mechanisms are not available at the level of governments. For example, posting a monetary bond, or some other physical form of hostage, requires a formal method of transferring title after a contracting party reneges on its commitments. In domestic arrangements the domestic court system can enforce a transfer of title called for by contract. In in-

⁸ This would, of course, be true for special cases of international pollution. For example, the adoption of more polluting technologies may reduce production costs in the polluting nation by exactly the same rate that it imposes damages on countries further down stream.

FIGURE 1



ternational affairs a disinterested third government might perform this duty, if one could be found. However, not only are disinterested parties often difficult to find in international affairs, but establishing self-enforcing contracts with third parties is itself a costly and problematic process. The absence of credible international enforcement agencies causes essentially all peaceful international treaties to be enforced by continuous dealings. In such contracts, the «bond» posted consists of gains that might be lost from future dealings with the other signatory nations. Such treaties require no external agency to enforce them, and pose a credible threat to potential violators as long as non-violators are better off without a contract than with an unreliable «trading» partner.

This is clearly the case in settings where there are only two parties involved and environmental concerns are transparent, simultaneous, and reciprocal. In this case, a series of short term treaties is sub-game perfect in cooperation⁹. Similar results can be obtained with a single long term contract that includes

⁹ The logic is straightforward. Each treaty arrangement in the sequence is necessarily in the interest of each participant. Since each party in a bilateral treaty only has an interest in observing the treaty if the other party adheres to treaty terms, return to the pre-treaty state is a credible threat. Thus, expected net gains from breach are negative for each party at every instant. See Telser [1980] for an overview of the theory of self-enforcing contracts.

a provision for termination on breach by one or more parties. (Most environmental treaties include formal methods for ending obligations.) In other multinational settings, credible threats are somewhat more cumbersome to implement.

Enforcement problems for multilateral treaties are problematic because the advantages of continued compliance do not generally disappear if a single country reneges on its treaty obligations¹⁰. This problem can be partly resolved by formally linking several issues in a single treaty. Issues over which individual countries have a relatively large interest in of treaty arrangements can be used to target penalties at non-complying nations, without requiring the complying nations to give up the benefits of continued compliance in other areas. A similar enforcement mechanism exists for groups of countries that are bound to each other through other existing long term treaties. Countries will hesitate to sacrifice their reputation for compliance, and risk exclusion from future treaty arrangements, unless the benefits of treaty breach are relatively large.

In any event, it is clear that sequential, multilateral and multi-issue treaties require more complex, continuous, and costly relations than would have been required in the absence of compliance problems. Moreover, the institutional solution to these problems will clearly affect not only the willingness of signatory nations to adhere to the terms of environmental trade once a treaty is consummated, but also the range of terms they will find acceptable. Establishing arrangements for monitoring and implementing international agreements will be as time consuming and central to the negotiation process as agreeing to effluent targets.

Analysis of environmental treaties as self-enforcing contracts has clear implications about the content of a typical treaty. 1) The voluntary and self interested nature of every contractual agreement implies that treaties will explicitly attempt to realize mutual gains that can be realized from coordinating domestic environmental regulations. 2) Environmental treaties will be short term or specify periodic review and renewal in order to establish continuous dealings as an enforcement mechanism in spite of their long term subject matter. 3) Formal decision making processes created to implement and/or modify treaty obligations will approximate unanimous agreement at the level of governments in order to assure continued and continuous mutual advantage from treaty arrangements. 4) In so far as transaction costs are significant, relatively modest bilateral treaties will be more common than more stringent multilateral treaties between many countries, other things being equal.

¹⁰ Similar problems are associated with bilateral arrangements where the mutual advantages are not continuously symmetrical. For example, more complex treaties will be required if only one of the parties benefit from stricter regulations. This tends to be the case in most proposed solutions to acid rain. Here the voluntary nature of compliance with international treaties will require linkages to other policy matters of mutual (and asymmetric) interests. Bilateral agreements on environmental matters can only be motivated from self interest only if there are mutual advantages from stricter regulations, as tends to be the case for shared boundary waters.

4. – *The negotiation costs of symbolic and substantive treaties*

Transaction costs also affect the likely mix of symbolic and/or substantive environmental treaties that will be consummated. Substantive and symbolic treaties are fundamentally similar in that both affect expected future environmental quality¹¹. Under substantive treaties, detailed time tables and targets provide the basis for revised expectations about future income and environmental quality. Substantive treaties require agreement about enforcement and monitoring institutions as well as detailed terms of trade in environmental regulations. Symbolic treaties do not specify targets or time tables, but rather formalize a commitment to a post-treaty process of negotiation or coordination on environmental matters. Here the basis for new expectations involves perceived changes in the prospects for future substantive arrangements. Symbolic treaties require only a consensus about the existence of potential gains that might be realized by coordinating domestic environmental policies. Since, the latter is a necessary prerequisite for substantive agreements, symbolic treaties are necessarily less costly to negotiate and consummate than substantive environmental treaties are.

Moreover, agreement about the existence of potential gains to trade necessarily precedes every negotiation regarding environmental terms of trade. Consequently, sufficient conditions for symbolic treaties are always reached *en route* to a substantive agreement. An implication of this is that symbolic treaties will be more common than substantive agreements. There will be more symbolic than substantive treaties observed because at any moment in time both existing substantive agreements and those not yet consummated will be preceded by symbolic treaties. Moreover, it will occasionally be the case that symbolic treaties are in the interests of governments although substantive agreements are not. Here, the additional negotiation costs required to consummate substantive arrangements are decisive and exceed the net gains expected from substantive agreements. (The appendix develops the mathematical structure of a negotiation game in a world with positive transaction costs.)

Political regimes have an interest in both symbolic and substantive treaties to the extent that pivotal government officials expect to benefit from changes in *expected* environmental quality achieved by coordinating environmental regulations¹². The largely intangible future-oriented aspect of environmental remedies implies that substantive and symbolic treaties are politically similar in that the bulk of their net benefits are expectational and subjective at the

¹¹ This is often accomplished by establishing institutions by which continuing negotiations are assured.

¹² Relative price effects generated by environmental regulations may be politically as important as the regulations themselves. I focus on environmental quality throughout this paper largely to simplify the analysis. Political agency issues are only indirectly analyzed in this paper insofar as decisions are cast in terms of the interests of pivotal government decision makers. These may not assure domestic Pareto optimality.

moment a treaty is implemented. Consequently, the main political import of a treaty is its value as a signal of mutual intent. If, as argued above, substantive treaties between large numbers of negotiators are more costly to consummate than symbolic treaties between two parties, relatively simple bilateral symbolic treaties will be more common than more complex substantive multilateral arrangements.

5. – Evidence from recent environmental treaties

While environmental matters have long been a matter of at least passing concern, most environmental treaties in force have been signed in the post-war period¹³. The *United Nations Treaty Series* and the *U. S. Treaties and Other International Agreements* series catalogue international agreements on a variety of topics. International environmental and pollution treaties are separately indexed and document the evolution of treaty arrangements. Table 1 lists all of the treaties on environmental matters ratified during the period from 1969 to 1985 presently included in these two treaty series. (More recent treaties have not yet been tabulated.) The table reports signatories, date signed, focus, and principal action taken under each of the treaties¹⁴.

This historical evidence is consistent with the analysis of treaties developed above. All of the treaties prominently mention the anticipated mutuality of treaty benefits. Ten of the treaties empower international commissions to monitor and coordinate information about pollution in the relevant area (generally a specific body of water) and to make policy recommendations to the respective national legislatures for improving the environmental quality of the body of water regulated. All of these treaties are bilateral. Many of them are continuations or extensions of treaties negotiated at an earlier date. Consistent with Con-

¹³ For example, the 1909 Boundary Waters treaty between Great Britain (Canada) and the United States establishes an International Joint Commission of the United States and Canada which «shall have jurisdiction over and shall pass upon all cases involving the use or obstruction or diversion of the waters» within the described in the treaty (Articles VII and VIII). «No use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it». Water for domestic and sanitary purposes is given the highest precedence followed by uses for navigation, power and irrigation.

¹⁴ There have also been several multilateral agreements negotiated over this time period, not included in the treaty volumes available at this time. For example, under United Nations auspices, two agreements on CFCs were negotiated. A convention was negotiated in Vienna in 1985 and a substantive protocol in Montreal in 1987. The Vienna convention may be regarded as a symbolic agreement (an agreement to continue negotiating) and the Montreal treaty as a substantive agreement insofar as it set specific time tables and targets for those nations which elected to sign it. The European Economic Community also promulgates environmental directives from time to time. For a discussion of the coordinating efforts of the EEC, see Smith and Kromarek [1989] or Ashworth and Papps [1991]. Generally, the policies require member nations to «set up programmes for handling, storing and eliminating waste in all forms» [Smith and Kromarek, p. 113]. However these directives of 1982 «are differently implemented by member countries» (p. 113).

TABLE 1

<i>Signatory Signatory</i>	<i>Year</i>	<i>Focus</i>	<i>Action</i>	<i>Responsibility</i>
UK WGermany	1969	Oil slicks	Coordination	Inform each other of existing or potential oil spills
France Switzerland	1971	Lake Geneva	Commission formed	Recommend policies and monitor water pollution
USA USSR	1972	General	Commission formed	Exchange of scientific information, joint conferences
Italy Switzerland	1972	Border Lakes	Commission formed	Recommend policies and investigate pollution sources
USA Canada	1972	St. Johns River	Commission	Monitor water quality and coordinate policies
USA WGermany	1974	General	Cooperatin	May harmonize policies and share information
Poland Czechoslovakia	1975	Air Pollution	Commission (Plenipotentiaries)	Coordinate monitoring and exchange information
Denmark Sweden	1975	Oresund Sound	Commission	Recommend policies and coordinate research
USA Canada	1978	Great Lakes	Commission	Recommend policies and report on treaty programs
USA Mexico	1980	Maritime Boundaries	Contingency plan	To coordinate a joint response to hazardous substance spills
USA Canada	1980	Air pollution	Commission	Recommend policies and coordinate and share research
USA Mexico	1983	Border area pollution	Commission (2 coordinators)	Coordinate policies and meet at least once a year
USA Canada	1984	St. Johns River	Continuation of 1972 agreement	Monitor water quality and recommend targets
USA Mexico	1985	Hazardous Substances	Contingency plan	Coordinate responses to accidents along the border

gleton [1992], all but two of these treaties are agreements between democracies. Twenty seven of the thirty signatories are electoral democracies.

Only two of the treaties listed may be regarded as substantive treaties insofar as they explicitly list effluents, targets or establish an independent regulatory commission empowered to implement such regulations. This ratio of substantive to symbolic treaties allows us to easily reject the hypothesis that substantive and symbolic treaties are equally likely at the .001 level of significance¹⁵. The two substantive exceptions are the *Oresund Sound Treaty* and the *1978 Great Lakes Water Quality Treaty* which clearly specify which effluents are to be controlled. However, only the Great Lakes Treaty mentions specific target levels for targeted effluents and hazardous materials (from Acetaidehyde to Zirconium Tetracloride), although even it does not include specific time tables.

The treaties between the U.S. and Germany, and between the U.S. and the former U.S.S.R. are examples of low cost symbolic treaties. In these treaties, the agreements do not concern environmental regulations or targets, or even processes by which such agreements might be negotiated, but rather agreement that environmental problems exist and that advantages from cooperation might be realized. Article 1 of the U.S.-U.S.S.R. agreement states that, «The Parties will develop cooperation in the field of environmental protection on the basis of equality, reciprocity and mutual benefit (*United Nations Treaty Series*, 1972, I:12212)». Similar language is found in Article 1 of the U.S.-Germany agreement. The contracting parties «will maintain and enhance bilateral cooperation in the field of environmental affairs on the basis of equality reciprocity and mutual benefits (*United Nations Treaty Series*, 1976, I-14629)». In effect, such treaties announce the beginning of a process that might lead to gains to environmental trade.

Other treaties classified as symbolic treaties for the purposes of this paper establish institutional arrangements by which substantive agreements or policy coordination might be achieved at some point in the future. These are procedural treaties. No specific environmental targets are mentioned, but rather a formal process of negotiation is agreed to. Generally, these treaties increase the likelihood of future substantive arrangements by establishing a standing commission responsible for proposing substantive regulations to the respective legislatures at some point in the future¹⁶. For example, Article 3 of the 1972 Convention on Italo-Swiss Waters between Switzerland and Italy establishes a commission empowered to: «a) [...] consider all matters relating to the pollution of the Italo-Swiss waters or to any other degradation thereof. b) [...] organize and cause

¹⁵ The probability of obtaining a mix of 32 symbolic and 2 substantive treaties from a binomial process the probability of symbolic and substantive treaties is actually the same is:

$$34 \cdot 33 \cdot 0.5^{34} = 6.53 \text{ e-8.}$$

¹⁶ Standing commissions not only assure that substantive recommendations will be forthcoming but also tend to minimize rent-seeking costs [CONGLETON, 1984], while the rules for staffing and funding such commissions assure continued domestic control by legislatures. See Weingast and Moran [1983] or Shughart, Tollison and Goff [1986].

to be carried out such investigations as are necessary to determine the source, nature and extent of pollution, and shall make use other data obtained. [...] e) [...] propose to the Contracting Governments draft regulations for ensuring the cleanness of Italo-Swiss waters». Similarly, Article 8 of the treaty of environmental cooperation between the U.S. and Mexico specifies that «each Party designates a national coordinator whose principal functions will be to coordinate and monitor implementation of this Agreement and make recommendations to the Parties, and organize the annual meetings referred to in Article 10». While such treaties are not substantive in that no commitments to specific environmental goals or regulations are made, they none-the-less clearly increase the probability that substantive rules and regulations will be agreed to at some point in the future.

The mutuality of benefits from the processes established are ensured by the decision rule imposed on the commissioners, often unanimous agreement, and the fact that final decisions are made by national legislatures. For example, Article 2 of the Italo-Swiss Waters convention establishes a «Mixed Commission for the Protection of Italo-Swiss Waters against Pollution», which Article 4 states will be «composed of two delegations [...] appointed by its government». The commission will «establish its own rule of procedure». Similar language can be found in the other procedural and substantive treaties. However, the commissions established are not empowered to impose regulations but rather to make proposals to the signatory governments. Article 8 requires the contracting governments to «consider the proposals of the Commission and decide how the measures necessary to implement them may be taken». Moreover, *ex post* mutual benefits are assured in most of the treaties by explicitly calling for periodic review and by specifying procedures for formally ending treaty obligations¹⁷.

It bears noting that the process of ratification is by no means rapid or assured. The 1972 *Lake Geneva* agreement between France and Switzerland was formally an «exchange of letters constituting an agreement between France and Switzerland on the implementation of the convention of 16 November 1962 (*United Nations Treaty Series*, 1974, 13152)». Ratification of the 1962 convention took ten years.

The two substantive agreements in this list are the result of negotiation efforts begun many years earlier which have generated a series of increasingly substantive treaties. The 1974 *Oresund Sound Treaty* between Denmark and Sweden replaced non-binding protocols signed in 1960 (*United Nations Treaties Series*, 1975, 13823). The 1978 *Great Lakes Water Quality Treaty* superseded and expanded a similar treaty negotiated in 1972 with roots in the *Boundary Waters*

¹⁷ Somewhat surprisingly, given Sykes [1991] analysis, none of the treaties formally include an escape clause similar to that of the GATT agreements. This may reflect the generally symbolic and procedural nature of most of the environmental treaties consummated during the period of study. If a treaty does not commit governments to specific policies, there would seem to be less reason to insure against possible long term political costs associated with general adherence to treaty terms.

Treaty of 1909. In all of these cases, successive treaties led to more rigorous monitoring of the common pool resource of interest and to more concrete duties and obligations between the contracting parties.

A large portion of the text of substantive treaties is taken up with specification of the duties and authorities of international commissions established (or modified) to oversee the implementation of treaty obligations. One third of the text of the *Oresund Sound Treaty* (Articles 5, 6, 7, 8 and 9) characterizes the duties and powers of the Danish-Swedish Committee established by the treaty. Nearly every article of the *Great Lakes Treaty* mentions duties or powers of the International Joint Commission. Characterizing commission duties takes up about half of the relatively lengthy *Great Lakes Water Quality Agreement* of 1978 between the United States and Canada. However, although commission duties are specified in relatively great detail, little authority is actually delegated to either of the commissions. Article 8 of the *Oresund Sound Treaty* states that «Proposals made by the Commission in accordance with article 7, a) to d) shall be submitted to the Governments of the two countries or to competent authorities in the two countries». Final approval of any policy recommendations made by the International Joint Commission established by the *Great Lakes Treaty* also resides with the signatory governments. Article 10 states that the governments «shall consult on the recommendations contained in [the commission's] report and consider such action as appropriate». To assure that mutual advantages continue, the governments «shall conduct a comprehensive review of the operation and effectiveness of this Agreement following the third biennial report of the Commission». The formal review mechanisms codify the continuous dealings nature of treaty arrangements.

The history and substance of multilateral treaties parallels that of bilateral substantive treaties. Multilateral environmental treaties are also generally predated by a series of non-substantive treaties rather than being the results of a single round of negotiations. For example, a series of successively more stringent treaties were negotiated concerning maritime pollution over the last fifty years¹⁸. In 1948, the *Convention on the Intergovernmental Marine Consultative Organization* was negotiated, and ratified in 1958 by the agreed to 21 states to take effect, by which time it had been delegated «bureau powers» by the 1954 Oil Pollution Conference. Finally in 1983, a fairly stringent treaty took effect, the *Convention on the Prevention of Pollution from Ships (Marpol)*. [CADWELL, 1990, p. 84]. By 1990, 49 countries had ratified the convention (*World Resources 1990-91*; Table 25.1)¹⁹.

¹⁸ One could argue that the actual treaty series began in 1926 when an international conference of major oceanic nations was held in Washington D.C. Seven maritime nations accepted a fifty mile discharge prohibition zone for nontankers in coastal waters near major sea ports [M'GONIGLE and ZACHER, 1978, pp. 81-83].

¹⁹ The evolution of environmental treaty obligations is often fairly complex. The roots of *Marpol*, may be traced back to an unsuccessful conference sponsored by the U.S. in 1926 dealing with dumping waste oil in the ocean by ships [M'GONIGLE and ZACHER, 1979, Ch. 4]. Shortly after the confer-

Appeals to international organizations generally do not yield regulations or penalties which restrain those deemed the source of environmental damages, but can facilitate treaty negotiations by posing an agenda and reducing transactions costs. During the last decade, two major agreements on CFC emissions were negotiated, the *Vienna Accord* (1985) and the *Montreal Protocol* (1987) under United Nations auspices. The Vienna Convention is a symbolic agreement that established a process by which future substantive arrangements could be achieved, but did not call for specific effluent targets. Article 6 of the Vienna Convention established a «Conference of the Parties» which «shall keep under continuous review the implementation of this convention, and, in addition, shall [...] consider and undertake any additional action that may be required for the achievement of the purposes of this convention». The substantive *Montreal Protocol* was an outcome of the process established. The signatory nations include essentially all of the industrialized West who produce the bulk of the targeted effluents. Although, the United Nations was unable to obtain unanimous agreement among all potential signatories, it clearly reduced the transactions cost of a significant multi-lateral treaty. Of the more than 150 UN member nations, about a third had ratified treaty terms by the end of 1990²⁰.

In general, the record of treaties consummated during the past two decades is consistent with a Coasian (1960) analysis, augmented by consideration of transactions costs. The treaties consummated are based on the expectation of mutual benefits at the level of government decision makers, but in addition to specifying terms of «trade» treaties establish institutional arrangements to solve associated enforcement and monitoring problems. The most common environmental treaties are bilateral treaties to explore matters regarding the coordination of future environmental regulations and exchange scientific studies. The costs of two-party negotiations are as small as international arrangements permit, and agreements to initiate or continue a process of negotiation are clearly below those of long term commitments to specific effluent targets and/or regulations. That such treaties none-the-less increase prospects for future substantive agreements is evidenced in the fact that the few substantive treaties consummated are fruits of earlier non-substantive agreements.

ence, the British government appealed to the *International Shipping Conference* to adopt a 50 mile discharge prohibition zone. The ship owners of seven countries agreed to implement this prohibition. During the 1930's the League of Nations promoted an accord on oil pollution control. After the second World War, the 1948 *Convention of the Intergovernmental Maritime Consultative Organization* was negotiated under United Nations auspices in 1948. This convention did not itself mention pollution or environmental matters but the organization founded by it was assigned bureau powers for the conventions negotiated at the 1954 Oil Pollution Conference. These conventions gave it the responsibility to monitor international agreements regarding intentional oil spills (previously a normal part of the process of ship maintenance). This authority was extended to unintentional spills after the Torrey Canyon spill in 1967. In 1973 a separate *Convention on the Prevention of pollution from Ships (Marpol)* was negotiated under United Nations Auspices which was subsequently revised in 1978. As of 1990, the 49 contracting parties to *Marpol*, as negotiated in 1978, include all major maritime countries: the major Western industrialized nations, Korea, China and the U.S.S.R.

²⁰ Table 25.1 of *World Resources 1990-1991*.

6. – *Overview and conclusion*

This paper has developed a positive theory of international environmental treaties based on an analysis of the institutional prerequisites of treaty enforcement. Peaceful solutions to international externality problems are limited to voluntary self-enforced contracts, consummated as treaties between the governments of affected parties. This contrasts with domestic environmental concerns which can be addressed with a wide range of coercive policies²¹. Although the United Nations and the World Court give international affairs a federal appearance, there are no world or regional legislatures empowered to pass laws that are completely binding on member governments. Consequently, only self-enforcing contractual solutions can be directly applied to environmental problems that span national boundaries. International environmental treaties resemble Coasian [1960] contracts in the sense that potential gains to trade are realized by contracting parties in the form of reduced externalities achieved via voluntary agreements. However, environmental treaties depart from the Coasian perspective because the presence of a variety of transactions costs associated with implementing contractual obligations necessitates the creation of supra-national institutional arrangements to monitor treaty implementation²².

Consistent with this analysis, all the environmental treaties examined mention prominently the expected mutuality of benefits. And, all but the most symbolic treaties establish or augment standing international institutional arrangements. Generally, the institutional portion of environmental treaties empower an international commission to make policy recommendations and report on treaty progress to the contracting governments. In substantive treaties these commissions are explicitly given responsibility for monitoring and implementing treaty obligations. No treaties establish environmental standards or goals without specifying institutional arrangements for monitoring and implementing treaty obligations. Moreover, most of the agreements negotiated have been symbolic and bilateral rather than substantive and multilateral.

²¹ Domestic legislative solutions include Pigovian taxes (or fines) targeted over the full range of externalities, and «standards» where fines are imposed on deviation from a technology mandate or effluent levels beyond some targeted level. In addition, individuals can pursue a variety of remedies within national courts. Torts can be filed against firms or individuals responsible for the pollution, or, contracts may be negotiated between the damaged parties and those responsible for undesired outputs. So long as environmental problems are entirely within the jurisdiction of a national government, recourse to national legislatures and courts can ameliorate environmental concerns in a variety of ways.

²² Environmental treaties also depart from the Coasian perspective in that the contracting parties are governments, rather than individuals, who may or may not promote the interests of their citizenry by aiming for Pareto optimal domestic and international policies. See Bagwati [1988], McGee [1989] or Vaubel and Willet [1991] for examinations of government incentives in the negotiation of international trade arrangements. Environmental treaties have not been subject to similar scrutiny. A preliminary look at incentives faced by dictatorships and well-functioning democracies in signing environmental treaties is developed in Congleton [1992].

Every substantive agreement was preceded by a symbolic agreement. Environmental matters have been incorporated into multilateral treaties on other matters.

Although treaties are a more cumbersome method of solving externality problems than other regulatory solutions that might be imagined, contractual methods are not necessarily inferior to other supranational solutions. Contractual means guarantee that all negotiating parties (here governments) benefit from the regulations finally adopted. The fact that environmental treaties generally delegate relative little authority to the institutions established implies that governments are well aware of political agency problems²³. Such policies reduce the likelihood of «capture» whereby interest groups unduly influence regulatory agencies to promote their own narrow ends. Legislative oversight of treaty implementation does not rule out such influence, but does bake extreme outcomes less likely inasmuch as legislatures can not freely ignore the electorate's welfare²⁴.

APPENDIX

The international negotiation game

A minor extension of the initial model allows us to examine the case where treaties are negotiated and/or enforced via a *costly* process. Suppose that no treaty can be consummated without an investment of transactions cost T which reduces the level of non-environmental income available for other uses. The magnitude of negotiation and enforcement costs vary with the kind of treaty negotiated. A long term treaty that details substantial obligations for many parties will be more costly to negotiate and guarantee than a short term treaty that obliges two parties to pursue general goals, «progress», on the problem of interest.

The existence of transactions costs imply that initiating negotiations initially shifts

²³ Analysis of the internal operation of the various international organizations established by both procedural and substantive environmental treaties is left for future analysis. Analysis of other international organizations (see Vaubel and Willet [1991]) suggests that principal-agent problems at the government-commission level of analysis are likely to occur. Even without policy making powers, environmental commissions may have a substantial impact on the agendas of domestic governments through their ability to make policy recommendations and by their superior knowledge of environmental detail in their area of responsibility.

²⁴ Future international environmental treaties are likely to resemble those of the past inasmuch as responsibility for sanctioning environmental laws is likely to remain a domestic responsibility. Transfer of enforcement power from domestic governments to an international organization tends to deprive national government officials of much of their discretionary power, reducing their stature and, often, their incomes. Even without domestic political agency problems, uncertainties associated with forming federal governments, whereby independent national electorates place a significant part of their national resources at the disposal of unknown future international majorities, are very difficult to justify as indicated by the recent Danish rejection of the Maastricht amendments. Moreover, granting power to make binding decisions to an international body often requires amending national constitutions, a generally difficult and costly process.

each nation's production possibility frontier, equation (1.3), slightly towards the origin.²⁵ On the other hand, the process of negotiation may further several ends. For example, negotiation clearly advances the time at which gains from coordinated regulation can be realized. Negotiation may also increase the range of coordinated policies by broadening the scope of the treaty or the increasing number of countries involved as signatories. It may also improve the treaty terms for a given country by reducing its future costs or increasing benefits by encouraging other countries to adopt more stringent restrictions.

A country's investment in negotiations maximizes the pivotal decision makers expected welfare from the resulting treaty, R^* . The treaty becomes binding at time S . Prior to that, the situation under the previous Nash international regulatory regime, R , obtains. As a first approximation of this process, it is assumed that as more resources are committed to the negotiatin process by a country, the expected treaty becomes more desirable for its pivotal decision maker, other things being equal. This is the Nash assumption applied to a bargaining game. Efforts by countries with apposing interests diminish the attractiveness of the treaty for each other.²⁶ A country's effort at negotiation can, thus, be modelled as an attempt to maximize expected utility given the negotiation efforts of other participating countries and negotiation costs:

$$U_i^e = \int_0^S \int_{-}^{+} P(E/R, t) U(Y_i(R_i), E) dE dt + \int_S^+ \int_{-}^{+} P(E/R^*, t) U(Y_i(R_i)E), dE dt \quad (6.0)$$

with

$$Y_i = y(R_i, t) - T_i \quad (6.1)$$

$$S = f(T) \quad (6.2)$$

$$R^* = r(T) \quad (6.3)$$

T is the vector of negotiation efforts by the effected countries. T_i is country i 's effort. S is the time at which the treaty agreement is to become effective, which is assumed to be a decreasing function of the vector of country efforts. The expected treaty specifying regulatory obligations for the countries involved is vector R^* . Participation in the negotiation process implies that domestic environmental restrictions are partly endogenous.

²⁵ The resource cost for the pivotal decision maker tends to be larger than its direct affect on GNP. Insofar as time available to coordinate negotiation processes is scarce, the rate or return from alternative areas of negotiation may tend to be greater than in the economy at large. That is, environmental negotiations may replace trade negotiations rather than the production of widgets. Coase [1937] and Williamson [1979] use similar reasoning in their theories of the firm.

²⁶ Negotiation efforts in such cases are analogous to participation in a rent-seeking game. In such games, negotiation efforts may increase to the point where gains from policy coordination are eliminated. Bargaining efforts may also deviate from Pareto optimal levels. However, rationality implies that negotiations will only be entered if there are positive net expected benefits from the negotiation process for the pivotal decision makers of the participating countries. It also bears noting that groups of countries with similar interests may coordinate their negotiation efforts to reduce transactions costs. See Rowley, Tollison and Tullock [1988] for a recent overview of the rent-seeking literature.

The effect of negotiation costs is to reduce the extent of the potential gains from international treaties because the net benefits of coordinating domestic regulations are now weighed against the transactions cost and likely outcome of a formal coordination process. The greater T is the smaller is the net advantage of a given reciprocal change in domestic regulations. Conditions that characterize the optimal investment in negotiations for country i , should such efforts appear to be warranted, can be found by differentiating equation (6) with respect to T_i and setting the result equal to zero.

$$\int_{-}^{+} P(E/R^*, S)U(Y(R_i), E) dEt - \int_{-}^{+} P(E/R, S)U(Y(R_i)E), dE + \tag{7.0}$$

$$\int_{S}^{+} \int_{-}^{+} P_T U(Y(R_i), E)dE dt = \int_{S}^{+} \int_{-}^{+} P(E/R^*t)U_Y(-1 + Y_{R_i} R_{iT})dE dt$$

Equation (7.0) describes the planned negotiation effort of country i given the efforts of other participating parties. Negotiations should be carried on to the point where the expected marginal increase in the present value of treaty benefits from earlier coordination of more stringent regulations equals the marginal decrease in the expected value of future income generated by the negotiation process and more stringent domestic regulations.

At the Nash equilibrium to this bargaining game, the efforts of all parties will satisfy similar conditions, and the final treaty reflects the efforts of all participating parties. Whether or not negotiations should be joined in the first place is a matter of whether equation (6) evaluated at this equilibrium yields greater utility than the original Nash equilibrium of the domestic regulation game. This, in turn, depends on the magnitude of environmental gains anticipated from treaty negotiations, the opportunity cost of resources invested in the negotiation process, and the economic output loss of the new domestic regulation.²⁷

REFERENCES

ASHWORTH, J. and PAPPS, I., «Equity in European Community Pollution Control», *Journal of Environmental Economics and Management*, 20, 1991, pp. 46-54.
 AUSTIN-SMITH, D., «Interest Groups, Campaign Contributions, and Probabilistic Voting», *Public Choice*, 54, 1987, pp. 123-39.
 BALDWIN, R., *Trade Policy in a Changing World Economy*, Chicago, University of Chicago Press, 1989.
 BHAGWATI, J. N., *Protectionism*, Cambridge, MIT Press, 1988.

²⁷ Although the resources used in the negotiation process are relatively small, the negotiating team could have been used to negotiate other treaties, and/or to the time and resources committed to passing enabling domestic legislation devoted to other legislative matters, the value of which may be substantial. The limited negotiation and legislative agendas possible for a given political administration is analogous to assumed limited pool of entrepreneurial ability used to derive a firm's U-shaped long run average cost curves. The information processing and time constraints of top negotiators and administrators implies the existence of what might be called a legislative production frontier.

- BEVANS, C. I., *Treaties and Other International Agreements of the United States of America*, Department of State Publication 8761, 1974.
- BLACK, D., *The Theory of Committees and Elections*, Boston, Kluwer Academic Publishers, 1987 (1958).
- BUCHANAN, J. M. and KAFOGLIS, M., «A Note on Public Goods Supply», *American Economic Review*, 53, 1962, pp. 403-414.
- BUCHANAN, J. M. and TULLOCK, G., «Polluters' Profits and Political Response, Direct Control Versus Taxes», *American Economic Review*, 65, 1976, pp. 139-147.
- CALDWELL, L. K., *International Environmental Policy*, Durham NC, Duke University Press, 1990.
- COASE, R. H., «The Nature of the Firm», *Economica*, 4, 1937, pp. 386-405.
- COASE, R. H., «The Problem of Social Cost», *Journal of Law and Economics*, 3, 1960, pp. 1-44.
- CONGLETON, R. D., «Committees and Rent-Seeking Effort», *Journal of Public Economics*, 41, 1983, pp. 441-448.
- CONGLETON, R. D., «Political Regimes and Pollution Control», *Review of Economics and Statistics*, August, 1992, pp. 412-421.
- COUGHLIN, P. and NITZAN, S., «Electoral Outcomes with Probabilistic Voting and Nash Social Welfare Maxima», *Journal of Public Economics*, 15, 1981, pp. 113-122.
- DEMSETZ, H., «Towards a Theory of Property Rights», *American Economic Review*, 57, 1967, pp. 347-360.
- DOWNS, A., *An Economic Theory of Democracy*, New York, Harper and Row, 1957.
- GELFAND, G. E., «Standards Versus Standards: the Effects of Different Pollution Restrictions», *American Economic Review*, 81, 1991, pp. 622-634.
- HOEL, M., «Global Environmental Problems: The Effects of Unilateral Actions Taken by One Country», *Journal of Environmental Economics and Management*, 21, 1991, pp. 55-70.
- MAAGEE, S. P., *Black Hole Tariffs and Endogenous Trade Policy Theory*, New York, Cambridge University Press, 1989.
- MALONEY, M. T. and MCCORMICK, R. E., «A Positive Theory of Environmental Quality Regulation», *Journal of Law and Economics*, 25, 1982, pp. 99-123.
- M'GONIGLE, R. M. and ZACHER, M. W., *Pollution, Politics, and International Law*, Berkeley, University of California Press, 1979.
- MUELLER, D. C., *Public Choice II*, Cambridge, Cambridge University Press, 1989.
- OLSON, M., *The Logic of Collective Action*, Cambridge, Mass., Harvard University Press, 1965.
- PELTZMAN, S. «Toward a More General Theory of Regulation», *Journal of Law and Economics*, 19, 1976, pp. 211-240.
- ROWLEY, C. K., TOLLISON, R. D. and TULLOCK, G., *The Political Economy of Rent Seeking*, Boston, Kluwer Academic Publishers, 1988.
- SYKES, A. O., «Protectionism as a Safeguard a Positive Analysis of the GATT Escape Clause' with Normative Speculations», *University of Chicago Law Review*, 58, 1991, pp. 255-304.
- TELSER, L., «A Theory of Self-Enforcing Agreements», *Journal of Business*, 53, 1980, pp. 27-44.
- TOLLISON, R. D. and WILLETT, T. D., «An Economic Theory of Mutually Advantageous Issue Linkages in International Negotiations», *International Organization*, 33, 1979, pp. 309-346.
- SMITH, T. T. JR. and KROMAREK, P., *Understanding US and European Environmental Law*, Boston, Martinus Nijhoff, 1989.

- SHUGHART, W. F., TOLLISON, R. D. and GOFF, G. L., «Bureaucratic Structure and Congressional Control», *Southern Economic Journal*, 52, 1986, pp. 962-972.
- VAUBEL, R. and WILLETT, T. D. (eds.), *The Political Economy of International Organizations*, Boulder, Westview Press, 1991.
- WEINGAST, B. R. and MORAN, M. J., «Bureaucratic Discretion or Congressional Control», *Journal of Political Economy*, 91, 1983, pp. 765-800.
- WILLIAMSON, O. E., «Transaction-Cost Economics: The Governance of Contractual Relations», *Journal of Law and Economics*, 22, 1979, pp. 223-261.