International Public Goods and

Agency Problems in Treaty Organizations[1]

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Abstract. This paper analyzes the extent to which international public goods and agency problems are present in international organizations. A noncooperative model of the funding choices of donor countries and the subsequent policy choices of an international agency is used to develop hypotheses about the behavior of ideal and problematic international agencies. The analysis suggests that international agencies are likely to be underfunded and undermonitored relative to that which maximizes the joint interest of signatory countries. The funding and policy implications of the model are tested using data from the Global Environment Facility (GEF). The statistical results suggest that (i) treaty obligations affect behavior of Annex 1 and non-Annex 1 countries, (ii) GEF's allocation of grants generally advances the international environmental agenda, and (iii) significant free-riding and agency problems exist in GEF as it is presently organized. Overall, the empirical results suggest that treaty organizations may be relatively effective, if not perfect, instruments of international public policy.

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I. Introduction: the Globalization of Public Policy

Globalization is a consequence of several related processes, many of which have policy implications for national governments. Some of these processes are economic in nature. For example, as personal wealth accumulates, interest in international products and experiences tends to increase insofar as these are superior goods. This causes the number of international transactions to increase as more people, goods, and services cross national boundaries. Innovations in products, lifestyles, and production techniques also create new opportunities for international transactions that were not considered in previous times. And, as the technology of international transactions improves, the marginal cost of international transactions declines and more extended trade, communication, and social networks become economically viable.

Other aspects of globalization are political in nature. Changes in the pattern of economic life tend to affect the distribution of political interests within nation states. Demands for public services that facilitate international transactions tend to increase and improved highways, train lines, airports, seaports, and communication systems may be financed through taxation and government-backed loans or promoted through new regulations. New interest groups may form that specialize in lobbying for policies that enhance or counter economic globalization. As a consequence, new trade regulations, subsidies, and training programs may be adopted. In some policy areas, however, independent national policies are not sufficient to address problems associated with globalization, because the policy choices of several governments must be coordinated to achieve the desired results. In such cases, the globalization of public policy also takes place.

The globalization of public policy is of special interest for political economy, because international policy tools are more limited and the problems faced are often more complex than in domestic politics. For the most part, international solutions are products of voluntary Coasian agreements among nations—treaties, which in many cases create international organizations to advance the shared interests of signatory countries. With one or two well-known exceptions, however, treaty organizations lack enforcement and tax powers and, consequently, public policies remain fundamentally those of independent nation states, rather than of a powerful international legislature or regulatory agency. A

government that reneges on its funding commitments cannot be arrested by tax authorities for failure to provide its agreed share of agency resources; nor can an injured party normally sue in an international court to assure performance of treaty obligations or obtain compensation for damages that result from breaching international treaties.

Nonetheless, dozens of international governmental organizations address policy issues that extend beyond national boundaries. Existing treaty organizations attempt to improve international law enforcement, decrease prospects for international warfare, and coordinate trade, environmental, immigration, and labor law. However, creating an effective international organization to advance shared interests requires more than a substantive Coasian contract, because a wide variety of public goods and agency problems must be addressed after a treaty is signed and ratified.

II. A Model of International Agency Problems: Funding and Allocating International Grants

Treaty organizations confront more types of agency problems than do a typical firm or domestic government. First, as in any organization, the agents charged with running an international organization may have interests that are not fully aligned with their organization. As ordinary men and women, members of international organizations have the usual interests in wealth, fame, status, travel, comfort, and leisure that often conflict with both their national and international responsibilities (Niskanen 1971). Second, international organizations face agency problems as a consequence of the joint responsibilities of many of the agents within international organizations. Agents that diligently advance their own nation's interests may "dutifully" neglect the mission of the international agency at which they work. Similar effects may be present when international agencies share personnel if the various organizational interests differ.

Third, incentives for member states to free ride do not disappear when a treaty is signed and ratified and a treaty organization is formed (Vaubel and Willett 1991). This tends to increase the previous problems insofar as the task of monitoring agency performance falls largely on national governments. This aspect of organizational design occurs, in part, because the pivotal decisionmakers of national governments recognize the

risks of granting coercive power to international agencies established to advance common interests (Congleton 2004). Consequently, both contributions to and oversight of international organizations tend to be voluntarily produced public goods for the member states.

To analyze interdependencies among country contribution levels, agency oversight, and agency performance, a model of member country–agent behavior is developed below. The model explores the subgame that emerges after an international agency has been formed. At this point, national legislatures decide how much money to contribute to the organization and the extent to which resources are devoted to monitoring the agency's performance.[2] The international agency is assumed to be charged with increasing the production of an international public good, such as environmental quality, but may spend its annual budget more or less as it wishes, subject to sanctions imposed collectively by member states.

Treaties often create different financial obligations and duties for different signatory states. That is to say, nation states often, in effect, sign different international treaties when they agree to the same formal document. For example, one group of signatories may be singled out as donor states and another group as recipient states. Donor states accept obligations to contribute resources and monitor agency outputs. Recipient states become eligible for grants or other transfers when they sign the same treaties. This paper models behavior under such a treaty and focuses most of its attention on donor states and the treaty organization charged with allocating the funds collected from donor states. The model is tested in section IV using data from the Global Environment Facility.

A. A Model of Donor State Contributions

The pivotal political decisionmaker of each donor state is assumed to maximize a similar utility function defined over personal consumption, C_i, and the level of some in-

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[2] Delegation of policymaking authority to an international organization, in effect, reduces national sovereignty in the policy areas addressed by international agencies. In practice, this shift of control often reduces the ability of politically active persons, parties, and interest groups to advance their domestic political agendas. It is for this reason, as well as other agency problems (Congleton 2004), that international agencies are generally granted relatively little discretion on policy formation, although they nonetheless have considerable discretion on their agency's budget.

ternational public good, *E, $U_i = u(C_i, E)$*. The income of the pivotal decisionmaker of the donor state is characterized as a constant fraction, α_i, of his country's post-contribution national income, X_i, and national income is assumed to be independent of international public goods problem addressed by the treaty organization. This allows country type to be characterized by national incomes and political organization, as in Congleton (1992). In a dictatorship, the pivotal decisionmaker receives a relatively large share of national income and, consequently, has a relatively large α_i, whereas the pivotal decisionmaker in democracies, the median voter, has a relatively low α_i.

Donor country *i* makes voluntary contribution D_i to the international organization and uses M_i of its X_i national resources to monitor agency output and sanction international agents. Contributions and monitoring expenditures also reduce resources available for ordinary consumption. The private consumption of the pivotal decisionmaker in country *i* can be characterized as $C_i = \alpha_i(X_i - D_i - M_i)$, which allows the pivotal decision-maker's utility function to be written as:

$$U_i = u(\boldsymbol{E}, \boldsymbol{a}_i(X_i - D_i - M_i)) \qquad (1)$$

where the level of the international public "bad," E, is controlled at the margin by the international agency.

The behavior of the regulatory agency is affected by aggregate levels of contributions and monitoring, and these effects are taken into account by pivotal decisionmakers when selecting national contribution and monitoring levels.

B. The effect of contributions and monitoring on agency performance

The international organization is staffed by individuals with approximately the same interest in personal consumption and the international public goods as pivotal policymakers in the member countries, $U = u(E,C)$, but have different personal budget constraints and areas of control. Agents are paid tax-free salary, W, in accordance with international labor markets. The agency collects $\boldsymbol{S}D_i$ contributions from donor countries and allocates those funds between efficiently promoting the agency's mission and using those resources somewhat less efficiently to advance the interests of the agents themselves.

Let β be the fraction of agency resources that are efficiently used to advance the agency's mission, $E = e(\beta SD_i)$, and $1-\beta$ be the fraction of resources not used to promote that mission—including expenditures on office amenities, travel, and projects of particular interest to the agents. Insofar as international salary scales are determined in competitive markets for diplomatic and managerial services, the latter can be regarded as a rent associated with employment in the agency of interest. These unnecessary expenditures, are, naturally, regarded as a form of shirking by sponsors and are assumed to be taken away by the donor countries when discovered.

Both monitoring by member countries and the relative size of office rents tend to increase the probability that agent rents will be discovered and lost, $P = p(\beta, SM_i)$. If the rents are discovered, the agent's personal consumption is $C' = W$; if not, personal consumption is $C'' = W + (1-\beta)SD_i$. The chief executive of the agency selects β to maximize the expected utility of its senior workforce

$$U^e = P\,u\,(\,e(bSD_i)\,,\,W\,) + (1-P)\,u\,(\,e(bSD_i)\,,\,W + (1-b)SD_i\,) \qquad (2)$$

which, denoting utility without and with rents as U' and U'', respectively, implies that β^* satisfies:

$$U^e{}_b = P_b\,[U' - U''] + (SD_i)[P\,U'_E E_D + (1-P)\,(U''_E E_D - U''_C\,)] \ = 0 \qquad (3)$$

Equation 2 in conjunction with the implicit function theorem allows β^*, which is inversely related to the size of the agency problem, to be characterized as a function of international wage rates, agency funding, and monitoring by member states:

$$b^* = b(W, SD_i, SM_i) \qquad\qquad\qquad\qquad (4.1)$$

The level of the international public good is:

$$E^* = e(b^* SD_i) \qquad\qquad\qquad\qquad (4.2)$$

C. Equilibria of the International Agency Game

Signatory countries are well aware of agency problems that they confront and take them into account when choosing contribution and monitoring levels.[3] Analytically, the countries as a group are Stackelberg leaders in the donor state–agency game.

Modeling the interaction of member states, however, is less straightforward, because both SD_i and SM_i are determined jointly by member state budgetary decisions. At one extreme donor states may independently monitor and contribute to the agency in response to their own domestic politics without much consultation among member states—as in a standard model of voluntary contributions to producing a public good (Hoyle 1991, Cornes and Sandler 1996). In such cases, the overall level of contributions and monitoring effort can be modeled as the Nash equilibrium of noncooperative game. At the other, the amount given to the agency by the donor states may be represented as the result of a joint optimization of the donors, in which case the international result would closely resemble that of a single nation state. The latter may reflect the explicitly cooperative nature of the treaty enterprise or an unmodeled solution to joint agency problems as often assumed by the common agency literature (Dixit, Grossman, and Helpman 1997).

Casual observation, past evidence, and new evidence developed below suggest that the contributions and monitoring efforts of independent nation states more closely resemble the Nash equilibrium of a noncooperative contribution and monitoring games than coordinated solutions to a joint optimization problem.[4] Consequently, for the pur-

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[3] Indeed, some degree of agency problems may be accepted by donors, because it allows donors to use their contributions as a control device (Weingast and Moran 1983). On the other hand, as long as some discretion on the budget remains, a single control device is likely to be a less than perfect method of aligning agency and public interests (Congleton 1980).

[4] The cooperative common agency models are plausible for profit-maximizing organizations in which there is an agreed quantifiable measure of performance (profits) for the agent(s) who can be held personally responsible for the organization's performance. However, the common agency model provide a less plausible representation of international organizations run by international committees. Although treaty organizations require a common interest to be created, treaties rarely, if ever, bind future government decisions as completely as private contracts bind those of their signatories. Few international treaties include explicit enforcement mechanisms. Empirical work on the effects of environmental treaties often find little evidence that countries significantly change their domestic environmental policies after signing and ratifying environmental treaties (Sandler and Murdock 1997).

poses of this paper, donor states are assumed to independently choose monitoring and contribution levels, although this exaggerates somewhat the degree to which national policies are actually made independently of one another.

In this case, contributions and monitoring effort maximize utility for the pivotal decisionmakers in each country.

$$U_i = u(\mathbf{E^*}, \mathbf{a}_i(X_i - D_i - M_i)) \qquad (5)$$

The contributions and monitoring effort of country i can be characterized by differentiating equation 5 with respect to D_i and M_i and setting the result equal to zero:

$$U_E E^*_D - \mathbf{a} U_C = 0 \qquad (6.1)$$

and

$$U_E E^*_M - \mathbf{a} U_C = 0 \qquad (6.2)$$

Equation 6.1 indicates that donors contribute up to the point at which the marginal value of the increase in environmental quality generated by the agency equals the marginal cost for the pivotal decisionmaker in the country of interest.

Note that the extent of agency problems confronted by donor states affects both monitoring and contribution levels, because agency problems partly determine E^*_D and E^*_M. If agency problems are small, the organization effectively advances its mandate, and E^*_D will be relatively large. In this case, relatively more money will be contributed to the agency. Similarly, if a country's monitoring effort has a substantial effect on the agency's effectiveness, E^*_M will be large, and relatively more monitoring will be undertaken by member states.

Together with the implicit function theorem, equations 6.1 and 6.2 imply that a country's contributions can be represented as a function of its national income, the share of national income that accrues to its pivotal decisionmaker, specific national circumstances that affect local demand for the international public good, and the contribution and monitoring levels of all other countries, which for country i are denoted D_i^o and M_i^o

respectively. Country i's contribution to the agency and monitoring of its decisions can be represented as:

$$D_i^* = d_i(\mathbf{a}_i, X_i, Z_i, D_i^o, M_i^o) \qquad (7.1)$$

$$M_i^* = m_i(\mathbf{a}_i, X_i, Z_i, D_i^o, M_i^o) \qquad (7.2)$$

Continuity of the game payoffs (utilities) and agency production function imply that functions d_i and m_i are differentiable.[5]

Together with the boundedness of the strategy sets $(0 \le M_i \le Y_i$ and $0 \le D_i \le Y_i)$, the continuity assumptions also imply that a Nash equilibrium to the donor state game exists at which the pivotal decisionmaker in each of the countries are simultaneously on their best reply functions:

$$D_i^{**} = d_i(\mathbf{a}_i, X_i, Z_i, D^{*o}, M^{*o}) = d_i^{**}(\mathbf{a}, X, Z) \qquad (8.1)$$

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[5] The implicit function differentiation rule implies that the partial derivatives of the donor country's contribution function, D_i^*, are:

$$D^*_X = [\alpha U_{EY} E_D - \alpha^2 U_{YY}] / [-U_{DD}] > 0 \qquad (7.3)$$

$$D^*_\alpha = [(X_i - D_i)U_{EY}E_D - \alpha(X_i - D_i)U_{YY} - U_Y] / [-U_{DD}] <> 0 \qquad (7.4)$$

$$D^*_{Do} = [-\alpha U_{EY} E_D + \alpha^2 U_{YY}] / [-U_{DD}] < 0 \qquad (7.5)$$

$$D^*_Z = [U_{EE}E_Z E_D + U_E E_{DZ} - \alpha U_{YE}E_Z] / [-U_{DD}] > 0 \qquad (7.6)$$

The denominator of these derivatives is the second order condition for the optimization problem, which is assumed to be strictly concave and, hence, less than zero. Three of four numerators can be unambiguously signed. Country i will donate more to the international agency as national income increases and as perceived environmental risks increase, but less to the international agency as the total contributions of other donors increase. The effect of the portion of the relative income received by the pivotal decisionmaker is ambiguous, because an increase in α has two effects. First, it increases the pivotal voter's income, which tends to increase his interest in making contributions to the international environmental agency, but, under the assumptions applied here, it also increases the price of those contributions, because he or she is assumed to pay a constant fraction of the cost of those contributions. If the relative price effect dominates the income effect, contributions will fall as the share of national income realized by the pivotal voter increases.

$$Mi^{**} = d_i(\mathbf{a}_i, X_i, Z_i, D^{*o}, M^{*o}) = m_i^{**}(\mathbf{a}, X, Z) \tag{8.2}$$

(α, X, and Z denote vectors of the national governmental types, income levels, and risk factors, respectively.)

The agency problem and level of the international externality level at the Nash equilibrium are:

$$(1 - \mathbf{b}^{**}) = 1 - b(W, \mathbf{SD}^{**}_i, \mathbf{SM}^{**}_i) = 1 - b^{**}(\mathbf{a}, X, Z) \tag{9}$$

$$E^{**} = e(\mathbf{b}^* \mathbf{SD}^{**}_i) = e^{**}(\mathbf{a}, X, Z) \tag{10}$$

At the Nash Equilibrium, the pattern of contributions and monitoring efforts of the member states is determined by the vector of nation types, income, and risk factors—which also determine the extent of agency problems and the extent to which the agency's policy agenda is advanced.[6]

D. Public Goods and Agency Problems

That $(1-\beta^{**})$ tends to be larger than optimal for the signatory nations, and E^{**} lower than optimal is a consequence of the multilateral nature of treaty organizations. To maximize the joint interest of pivotal members of the member countries, national monitoring and contributions would have be chosen to maximize:

$$W = \mathbf{S} U_i = \mathbf{S} u(\mathbf{E}^*, \mathbf{a}(X_i - D_i - M_i)) \tag{11}$$

which requires the pivotal decisionmaker from country i to select Ei and Mi to satisfy:

$$\mathbf{S} U_E E^*_D - \mathbf{a} U_{Ci} = 0 \tag{12.1}$$

and

$$\mathbf{S} U_E E^*_M - \mathbf{a} U_{Ci} = 0 \tag{12.2}$$

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[6] In a more complete analysis, the relationship between donor countries and international agencies would be modeled as a sequential game in which member countries design and fund international organizations through time. The subgame perfect equilibria of such repeated games, however, generally require the conditions developed below to be satisfied. To be effective, the initial treaties must be self-enforcing Coasian contracts (Telser 1980; Congleton 1995).

The additional terms in the first order conditions for joint optimization are the positive marginal benefits generated for other member states by an individual state's expenditures. These policy externalities are neglected by individual national pivotal voters who choose both their monitoring effort and contribution levels to advance their own domestic interests, as they are understood within the countries of interest.

The existence of positive domestic policy externalities implies that jointly optimal levels of contributions and monitoring are larger than those chosen by the signatory countries. As a consequence, the international public good is underprovided. This occurs partly because donor countries all free ride a bit at the margin and partly because international agents are able to use more of the contributions received to advance personal interests. At interior solutions, $\beta^{**} < 1$, and $1-\beta^{**} > 0$ of the agency's resources are diverted to purposes at odds with the agency's mission. The effect of these agency problems will be evident in the level and allocation of agency resources.

III. An Illustrating Application: Allocating Funds to Improve International Environmental Quality

To illustrate how the above model can be applied to existing international agencies, we now focus on the operational methods through which an international agency can promote its regulatory agenda. In most cases, an international organization does not directly produce goods or services, but rather encourages independent nation states to increase their production of the outputs or regulations of interest. It is such effects that are summarized in equation 4.2 above.

There are two general methods by which an international externality problem can be addressed by the international agency. The agency can allocate its budget (βSD_i^{**}) to maximize the direct *economic effect* of its resources by investing its resources in countries where the externality can be decreased at least cost. Alternatively, the agency can attempt to maximize *political support* for the international policy agenda by using its resources to generate additional support for the desired policies within recipient states at least cost. In most cases, an agency's allocation of resources differs according to the method used.

Consider, for example, the case of an international environmental agency charged with reducing total emissions of a troublesome effluent.

A. Allocating Direct Environmental Grants

Environmental grants from the international organization address environmental problems directly by increasing the total resources available to domestic environmental agencies, as suggested by the "fly paper" literature in public finance. In such cases, a recipient country's environmental quality, E_i, can be written as a function of its national output, X_i, government type α_i, country-level environmental risks, Z_i, and the environmental grant given to country i, G_i,

$$E_i = e(G_i, X_i, \mathbf{a}_i, Z_i). \tag{13}$$

Recall that effluents tend to increase with the production of goods and services and tend to fall with the extent to which a country is democratic, because democratic countries are inclined to adopt relatively strict environmental laws (Congleton 1992; Murdock and Sandler 1997; Fredriksson, Neumayer, Damania, and Gates 2005).

A two recipient country case is sufficient to illustrate the general properties of interest here. Given the contribution level from the donor states, D^{**}, an international agency that attempts to improve environmental quality directly will allocate its resources among countries to maximize an index of environmental quality, $E = \Sigma E_i$.

In the two recipient country case, the agency's policy agenda can be written as:

$$E = e(G_1, Y_1, \mathbf{a}_1, Z_i) + e(\mathbf{b}D^{**} - G_1, Y_2, \mathbf{a}_2, Z_i) \tag{14}$$

Differentiating with respect to G_1 allows the environmental quality–maximizing allocation of grants to country 1 to be characterized as:

$$E_{1G1} - E_{2G2} = 0 \tag{15}$$

which implies that:

$$E_1^* = e(\mathbf{b}D^{**}, X_1, \mathbf{a}_1, Z_1, X_2, \mathbf{a}_2, Z_2) \tag{16}$$

Grants should be allocated so that the marginal increase in environmental quality among countries is equalized for the last dollar spent.

The effects of national characteristics on the environmental grant received can be determined by differentiating equation 16:

$$G^*_X = [E_{GY}] / - [E_{1G1G1} - 2E_{1G1}E_{2G2} + E_{2G2G2}] > 0 \qquad (17.1)$$

$$G^*_a = [E_{Ga}] / - [E_{1G1G1} - 2E_{1G1}E_{2G2} + E_{2G2G2}] > 0 \qquad (17.2)$$

$$G^*_Z = [E_{Gz}] / - [E_{1G1G1} - 2E_{1G1}E_{2G2} + E_{2G2G2}] > 0 \qquad (17.3)$$

These results imply that economic environmental grants should be targeted at relatively developed countries with relatively authoritarian regimes and special environmental risks. (Recall that authoritarian regimes differ from democratic ones, because authoritarian regimes normally have pivotal voters who receive relatively higher shares of GDP as personal income.)

B. Buying Political Support

Political grants have indirect effects on environmental quality by increasing support for specific domestic policies, possibly including support for the international agency itself. In this case, a nation's support for desired policies increases, because the grants improve the welfare of its pivotal decision,

$$S_i = s(u(E_i, a(X_i + G_i) - u(E^0_i, aX_i)). \qquad (18)$$

A political grant-making agency uses its environmental budget βD^{**} to maximize, $S = \Sigma S_i$.

Again the two-country allocation problem is sufficient to illustrate the factors that determine the environmental agency's allocative choice. Total political support for the environmental agenda can be represented as:

$$S = s(u(e(G_1, Y_1, a_1), a_1(X_1 + G_1) - u(E^0_1, a_1X_1)) +$$

$$s(u(e(bD^{**} - G_1, Y_2, a_2), a_2(X_2 + bD^{**} - G_1) - u(E^0_2, a_2X_2)) \qquad (19)$$

Differentiating with respect to G1 yields an expression characterizing the optimal allocation of grant money to country 1.

$$S_{D1} (U_E E_{G1} + \boldsymbol{a} U_{Y1}) - S_{D2} (U_E E_{G2} + \boldsymbol{a} U_{Y2}) = 0 \qquad (20.1)$$

An agency that attempts to promote environmental quality through political grants allocates its funds to equalize the *marginal gains in support,* rather than marginal gains in environmental quality, per se.

In the special case in which the marginal gain in support generated by an increase in pivotal decisionmaker welfare is approximately the same, $S_{\Delta1} = S_{\Delta2}$, which allows equation 12.1 to be rewritten as:

$$(U_{E1} E_{G1} + \boldsymbol{a} U_{Y1}) - (U_{E2} E_{G2} + \boldsymbol{a} U_{Y2}) = 0 \qquad (20.2)$$

or

$$(U_{E1} E_{G1} + \boldsymbol{a} U_{Y1}) = (U_{E2} E_{G2} + \boldsymbol{a} U_{Y2}) \qquad (20.3)$$

In this case, grants equalize the marginal advantages of the pivotal decisionmakers. Equation 12.3 suggests that the political allocation of grants is only partly based on environmental effects. In addition to environmental effects, there are effects on national income that are relevant for the pivotal decisionmaker. The implicit function theorem implies that political grants vary with national environmental, economic, and political characteristics and those of other countries eligible for the grants.

$$G_1^* = g(\boldsymbol{b}D^{**}, X_1, \boldsymbol{a}_1, Z_1, Y_2, \boldsymbol{a}_2, Z_2) \qquad (21)$$

C. Difference between environmental and political allocation of grants

Equation 16 and equation 21 appear to be very similar insofar as they direct attention to the same country characteristics. However, the effects of national income and government type in the political support–maximizing allocation of grants differ from that of the environmental quality–maximizing allocation. The difference can be demonstrated by differentiating equation 21 with respect to national income, X_i, income share, α_I, and environmental risk factor, Z_i:

$$G_X^* = [(\boldsymbol{a} U_{EY} E_G + U_E E_{GY} +$$

$$\boldsymbol{a}^{2}(U_{YY} + U_{YE}E_Y) \,] \, / - [S_{G1G1}] < 0 \qquad (\text{if } x \text{ dominates}) \qquad (22.1)$$

$$G^{*}{}_{\boldsymbol{a}} = [(X+G)U_{EY}E_G + U_Y + \boldsymbol{a}\,(X+G)U_{YY} +$$

$$U_{EE}E_Y E_G + U_E E_{GY} + \boldsymbol{a}U_{YE}E_Y] \, / - [S_{G1G1}] > 0 \quad (\text{if } x \text{ dominates}) \qquad (22.2)$$

$$G^{*}{}_{\boldsymbol{z}} = [U_{EZ1}E_{G1} + U_{E1}E_{GZ1} + \boldsymbol{a}\,U_{YZ1}) -$$

$$(U_{EZ2}E_{G2} + U_{E2}E_{GZ2} + \boldsymbol{a}\,U_{YZ2})] \, / - [S_{G1G1}] > 0 \qquad (\text{if } Z_1 > Z_2) \qquad (22.3)$$

Only the effect of environmental risk on grants can be signed unambiguously. Other things being equal, noneconomic environmental risk factors affect the allocation of resources, because they determine the extent to which pivotal decisionmakers benefit from political grants in support of domestic environmental policies.

   If environmental risks are greater in country 1 than in country 2, country 2 should receive more resources, other things being equal. However, in contrast to economic grants, neither the effect of national income nor the regime type are unambiguously determined for political grants. The income and environmental effects work more or less in opposite directions in this case. In the case in which the income effects (x) of transfers dominate the effects of environmental quality for pivotal decisionmakers, wealthier countries should receive *smaller* grants than poorer countries. Moreover, in the case in which agency resources are used to produce political support, a full equilibrium to a repeated international regulatory game requires equations 21, 8.1, and 8.2 to be simultaneously satisfied. (Political feedback is not necessarily present in the economic model of environmental support.)

   The above analysis suggests that at least two general patterns of grants are consistent with the aim of increasing the supply of international environmental quality. First, conditional grants may directly promote output of those goods in countries where supply responses tend to be greatest. Such environmental output grants are targeted at relatively rich authoritarian regimes with high environmental risks. Second, conditional environmental grants may indirectly increase the supply of international public goods by increasing political support for the domestic and international public goods production.

IV. Empirical Evidence from Rio: Who Gives and Who Gets?

Agency problems exist when the observed distribution of grants follows neither the economic nor political patterns. In such cases, grants may be devoted to projects of special interest to agency decisionmakers or used to advance the career interests of agency officials in their home countries by directing relatively large grants to their own countries, irrespective of the extent to which those grants promote the agreed international policy goals. The empirical relevance of the model is explored below using data from environmental grant programs initiated by the Rio environmental treaties. The evidence supports the economic over the political allocation model.

The "Earth Summit" in Rio de Janeiro in 1992 finalized treaties on climate control, biodiversity, and sustainable forest management. As true of the earlier chlorofluoro-carbon (CFC) agreements, the Rio treaties specified different environmental and economic obligations for the developed (Annex 1) and less developed countries (Annexes 2 and 3). That is to say, developed and undeveloped countries effectively signed *different* environmental treaties. Generally speaking, Annex 2 and 3 countries accepted relatively minor changes in their future environmental standards in exchange for technology transfer, where technology transfer included better access to unpublished scientific results and to environmental grants funded by the developing nations. Annex 1 countries generally accept more significant treaty obligations and agree to contribute funds for environmental grants to the less developed countries. In terms of the above model, Annex 1 countries are donor countries and the Annex 2 and 3 countries are recipient countries.[7]

In terms of Congleton (1995), the Rio treaties were largely procedural and symbolic documents rather than substantive treaties. Treaty language was imprecise in the environmental sections and no institutions were adopted to enforce the commitments of

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[7] Promises of financial and technological aid are given much attention in both the convention on climate control and the biodiversity treaties negotiated in Rio. For example, Article 4 sections 3–5 of the United Nations Framework Convention on Climate Change specify the transfer obligations of developed nations. The developing countries shall "provide such financial resources, including for the transfer of technology needed by the developing country Parties to meet the agreed full incremental cost of implementing measures covered in paragraph 1 of this article . . . " It bears noting that the environmental (regulatory) obligations of developing countries are also more limited than for developed countries.

signatory nations. For example, there are no explicit penalties for failure to make contributions to the Rio trust funds, nor a clear statement of the methods by which those funds would be allocated among countries. The treaties did, however, include substantive parts, under which signatory nations agreed to provide modest financial support for technology transfers to annex 2 and 3 countries. Compliance with this substantive part of the treaty can be directly observed as contributions to and disbursements from the Rio trust funds. Technology transfer programs have been funded at modest levels by the signatory countries, and grants have been distributed to qualifying countries. Whether the treaty-induced contributions increase overall international environmental expenditures is not obvious, but such an increase was not part of the treaty obligations.

A. GEF: the Global Environment Facility

At approximately the same time that the Rio treaties came into force (1994), the Global Environment Facility was reorganized to serve as the agency for managing international environmental projects for the World Bank, U.N. Environment Program (UNEP), and U.N. Development Program (UNDP). The Instrument for the Restructured Global Environment Facility (IRGEF) called for GEF to manage projects on climate change, biological diversity, international waters, and ozone layer depletion (section I 2). The revised GEF has a formal decisionmaking structure with an assembly, council, and secretariat (section III). The council is composed of 32 members, 14 from developed countries, 16 from developing countries, and 2 from former members of the Soviet alliance. Council members are appointed by groups of member states called constituencies and are responsible for developing policies and programs for GEF-funded activities (section III 15). Council decisions are made by a "double-weighted" super majority (section IV 25c) to be used when consensus cannot be achieved. Passage requires a 60 percent majority of council members accounting for at least 60 percent of GEF funding.

One of the main responsibilities of the reconstituted GEF is to manage the "financial mechanisms" of the Rio treaties regarding climate change and biodiversity (section 1.6). That is to say, the GEF council is ultimately responsible for allocating the resources contributed to the Rio trust fund(s).

B. The Data and Estimates

Fairly complete data on GEF's funding and its allocation of environmental grants are reported in the 2001 GEF regional reports used in Congleton (2002) and these are updated in the 2004 GEF annual report used in the present study. The annexes of these reports list grants made to individual countries under the Rio biodiversity and climate control treaties for 1991–2001 and for all programs during 1991–2004 in millions of U.S. dollars. Regional and global projects are also listed, although not how those expenditures are allocated among countries. Consequently, only the national grant data are used below. These provide the most direct evidence of GEF's allocative decisions.[8]

Data about national income, population, and area are collected from the World Bank's 2006 World Development Indicators (WDI) for the year 2004. Data on government type in 2004 are developed from the Freedom House indices of political and civil liberties. Countries that receive the two worst levels of each are coded as dictatorships. Countries with the most political liberties are coded as liberal democracies, *dem1*. Countries with civil and political liberties in the highest two categories are coded as democracies, *dem2*. Although many studies use the Freedom House index as a continuum, political economy models of the intermediate categories are not well developed. That is to say, it is not clear how intermediate forms of government affect domestic demands for public policy. (A significant difference between *dem1* and *dem2* is evident in the estimates reported below.) As a proxy for noneconomically based environmental risk, population density is computed using the WDI data set.

The data allow us to determine whether contributions to GEF vary with the country characteristics focused on in the model, whether GEF grants are allocated to promote economic or political methods of advancing the international political agenda, and the extent to which the allocation of grants promotes an environmental agenda. Equations 7.1, 16, and 21 are estimated for GEF to determine whether GEF resources are raised

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[8]   The theoretical part of the present paper is a major extension of a paper previously published in the *Journal of Public Choice and Public Finance* (Congleton 2002). The empirical section uses a new and somewhat more extensive data set to show how the extended model can be used to analyze GEF. The results, however, are broadly consistent with the earlier paper.

and allocated in a manner consistent with the predictions of the model of donor country and agency behavior developed above. The extent to which nations undercontribute to GEF cannot be directly tested without estimating an environmental joint-benefit function, which is left for future research. Table 1 summarizes the data used for the estimates.

Table 1			
Data Set of 2004 values: Sample Characteristics and Sources			
Variable	Sample Mean	Sample Variance	Source
Gross National Income (atlas, in dollars)	2.13 e11	1.01 e12	World Development Indicators (2006)
Population	3.38 e7	1.28 e8	World Development Indicators (2006)
Area	7.21 e5	1.96 e6	World Development Indicators (2006)
Civil Liberties	3.33	1.79	Freedom House (2006)
Political Rights	3.4	2.15	Freedom House (2006)
Contributions to GEF (1991 to 2005)	1.53 e5	2.60 e5	GEF Annual Report (2004) (paid by 38 countries)
Receipts from GEF (1991 to 2005)	23.631	47.716	GEF Annual Report (2004) (148 countries recipients)

C. Estimated Contribution Schedule

The donor model implies that contributions from donor countries at the Nash equilibrium tend to rise with income and with perceived environmental risks. Column 1 of Table 2 estimates a quadratic form of equation 7.1, using per capita gross national income (GNI) as a proxy for the income of the pivotal decisionmaker and the countries' population density as a proxy for his or her perception of environmental risk. Although the estimates are consistent with the model insofar as the estimated coefficients have plausible signs, the environmental demand model accounts for relatively little of the variation in country contributions. Only the constant term and the *dem1* binary variable are statistically different from zero.

There are two possible institutional explanations for this relatively poor fit. First, it may be the case that only relatively democratic countries have demands for environmental quality that are easily captured empirically, because the income and environmental risk assessments of political elites in nondemocratic countries may be quite different from average income and domestic population density. This possibility is examined in column 2, which focuses on the contributions in democracies (*dem2*). In this case the demand model explains contributions approximately twice as well as in the complete sample. The demand variables (average income and average income squared) have plausible signs, although population density again is not statistically significant and has the wrong sign.

Another possibility is that the Annex 1 countries have accepted explicit obligations to make contributions under the Rio treaties and, therefore, actually provide most of the support for GEF programs. That is to say, the Annex 1, 2, and 3 signatories of the Rio treaties all affirm their common interest in environmental quality, but do not necessarily accept a common responsibility to contribute resources to the common enterprise. The estimates reported in column 3 explore this possibility. Note that the column 3 estimates account for approximately ten times as much of the variation in contributions as the general public goods model of column 1, which suggests that *treaties matter* and that donor countries accept different treaty obligations than other signatory countries under the Rio treaties. Less than 10 percent of the non-Annex 1 countries make contributions to GEF.

As predicted by the donor model, contributions rise with treaty obligations, average income, and liberal democracy, as previously found by Congleton (1992), Murdoch and Sandler (1997), and Fredriksson, Neumayer, Damania, and Gates (2005) for other international environmental policies. These results provide new evidence of treaty effects that contrast somewhat with those found in Murdoch and Sandler (1997).

Table 2
Least Squares Estimates of National Contribution Schedules

	All Country Contributions to GEF through 2004	Democracy-2 Contributions to GEF through 2004	Annex 1 Contributions to GEF through 2004
C	41191.03	81097.07	53464.75
	(2.64)***	(2.20)**	(1.49)
Gross national income per capita^2	-5.209	-10.86	-7.950
	(-1.44)	(1.95)*	(-1.45)
	1.02 e-4	0.00021	0.00023
	(1.19)	(1.72)*	(2.26)**
Democracy (1)	81925.56	105520.6	40685.83
	(1.99)**	(1.99)**	(0.756)
Dictatorship	-32503.65		
	(-0.82)		
Population density	-3.228	-91.363	-212.42
	(-0.14)	(-0.82)	(-1.41)
R-squared	0.04	0.1	0.33
F-Statistic	1.32	1.68	4.00**
Number of Observations	165	64	37

* denotes statistical significance at the 0.10 level, ** at the 0.05 level, and *** at the 0.01 level.

D. Estimated GEF Allocation Schedule

The allocation of resources by an international environmental agency is described by equation 8, if the agency pursues the economic method of advancing environmental quality and by equation 13 if the agency adopts the political method of advancing the international environmental agenda. In either case, the environmental grant received by a country will increase with its environmental risks. Under the economic method, the grants also tend to be larger for dictatorships and relatively industrialized countries. In contrast, the political method implies that poorer countries will receive relatively larger grants than richer countries.

Columns 1 and 2 of Table 3 report estimates of GEF's allocation function for grants across all countries in the sample for 1991–2004. Columns 3 and 4 restrict the sample to non-Annex 1 countries. The estimates are largely consistent with the predic-

tions of the economic model of environmental support insofar as grants rise with income and are relatively more generous to dictatorships than to democracies. However, the estimated coefficient for population density again has the wrong sign, although the coefficients cannot be distinguished from zero at conventional levels of significance.

	All Country GEF Grants	All Country GEF Grants	Non-Annex 1 GEF Grants	Non-Annex 1 GEF Grants
Table 3 Estimated Pattern of GEF Rio Grants 1991–2004				
C	19.518 (4.81)***	16.844 (3.88)***	11.92 (5.84)***	10.61 (5.29)***
GNP-PPP	4.49 e -11 (4.86)***	5.68 e -11 (5.38)***	2.41 e -10 (10.91)***	2.20 e -10 (9.89)***
$(GNP\text{-}PPP)^2$	-3.74 e -24 (-4.51)***	-4.50 e -24 (-5.09)***	-2.95 e -24 (0.22)	8.17 e -24 (0.63)
Dictatorship	20.571 (1.71)*	17.32 (1.47)	-8.36 (-1.46)	-8.82 (-1.61)
Democracy	-33.100 (-3.59)***	-20.71 (-2.01)**	-12.13 (1.96)**	-11.94 (2.01)**
Population Density	-0.004 (-0.65)	-0.004 (-0.67)	-0.0057 (-1.99)**	-0.0051 (-1.85)*
GEF Council Member		-34.79 (2.03)**		
Non Annex 1 Council Member		64.31 (3.18)**		16.74 (3.23)***
Annex 1 Country		-3.80 (-0.38)		
R-squared	0.17	0.24	0.84	0.87
F-Statistic	6.925***	6.241***	158.43***	144.09***
Number of Observations	165	164	127	127

* Denotes statistical significance at the 0.10 level, ** at the 0.05 level, and *** at the 0.01 level.

The estimates show clear differences in the treatment of Annex 1 and non-Annex 1 countries, which implies that the Rio treaties have significant effects on the council's allocative decisions. The estimates reported in the last two columns account for nearly 90 percent of the distribution of GEF grants during the period of interest, nearly five times that of the column 1 and 2 estimates that include Annex 1. 2 and 3 countries. Donor countries are clearly treated differently than recipient countries by GEF's decisionmakers.

Evidence of agency problems is also present. As net contributors, with relatively strong domestic regulations, and sophisticated waste handling in their own countries, Annex 1 countries are unlikely to be recipients of technology transfer grants. On the other hand, membership on the GEF Council allows Annex 2 and 3 countries to exercise some direct control of the allocation of grants, which evidently favors the countries represented. Annex 1 countries receive smaller grants than non-Annex 1 countries. Non-Annex 1 GEF Council members receive somewhat larger grants than other non-Annex 1 countries, other things being equal. The latter is direct evidence of one type of international agency problems. Council members evidently advance national as well as global interests. Whether the latter is a traditional "agency problem" or a free-rider problem depends on whether the GEF Council members are regarded to be agents of the global community or of their home countries.

Overall, however, these estimates suggest that monitoring by member states is sufficient to induce GEF Council members to advance environmental goals. Insofar as the indicators chosen are reasonable measures of international environmental risks generated by the countries in the sample and such international environmental problems are significant aims of the signatory countries. Grants rise with national income and decline with liberal democratic governance. Approximately 90 percent of the distribution of international environmental grants advances environmental aims. This last result contrasts with Congleton (2002) in which the formal treaty distinction between Annex 1 and non-Annex 1 countries was not as fully explored and much more of the pattern of grants was left unexplained. The relatively high explanatory power of the estimated allocation model for grants to non-Annex 1 countries suggests that environmental problems are central to

GEF's allocation decision, although evidently some nonenvironmental agendas are also being advanced by GEF's decisionmaking body.

V. Conclusions

Economic theory suggests that treaty organizations and other international organizations perform less well than other organizations, because they confront relatively more difficult political agency and free-riding problems. And the tools available for controlling international agencies tend to be somewhat more limited and more cumbersome to apply. As a consequence, treaty organizations could well be very ineffective institutions for promoting common international interests. International agencies are predicted to be underfinanced, undermonitored, and undersanctioned.

The statistical results of this paper affirm the existence of such agency problems, although they are not as large as might have been expected. The nations directly represented on GEF's decisionmaking bodies receive more grant money than environmental factors can account for, and about 10 percent of GEF grants are allocated in a manner that cannot be explained by relatively coarse indices of environmental risk. Nonetheless, nearly 90 percent of GEF's environmental grants are consistent with improving environmental quality. The latter suggests that efforts to address agency problems have been undertaken successfully by member states; although the former suggests that more could be done in the future.

If the empirical results also apply to other policy areas and treaty organizations, they suggest that relatively weak, voluntary international agencies can be used to advance common international interests, even if they are less than perfect instruments of international public policy.

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