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A strategic theory of international environmental assistance

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Elena V McLean
Department of Political Science, Texas A&M University, USA

Abstract

Over the past three decades multilateral financial aid has become an important institutional arrangement enabling environmental cooperation between developed and developing countries. However, previous research suggests that financial institutions are largely ineffective in achieving environmental goals. I show that financial assistance can be successful in increasing recipients' contributions to environmental programs, thereby promoting environmental protection. This positive impact of aid, I argue, should be attributed to the effects of donor-recipient interactions that can alter incentives of recipient governments and induce their cooperation rather than to capacity building through inflows of aid. I study environmental assistance by first developing a game-theoretic model of strategic interaction between the donor and aid recipients. To avoid a common methodological problem of misspecification and to unify theory with empirical testing, I then derive a strategic statistical model and conduct empirical tests using a new dataset on projects financed by the Global Environment Facility.

Keywords

Environmental cooperation; foreign aid; international organization; principal-agent model

Environmental problems, many of which are truly global in their scope, have long been used as an example of international issues that call for cooperation among countries. Mutual gains from implementing environmental measures result from the fact that problems of global environmental commons can often be ameliorated more cost-effectively in developing countries that have lower marginal costs of

Corresponding author:
Elena McLean, Department of Political Science, Texas A&M University, 2010 Allen Building, 4348 TAMU, College Station, TX 77843 4348, USA.
Email: elenamclean@pols.tamu.edu

reducing negative environmental externalities. In the area of climate change control, for instance, the European Commission calculated that the EU could reduce its abatement costs of CO_2 emission cuts by as much as two-thirds if it supported the implementation of emission reduction projects in developing countries (European Commission, 2005). In order to attain these environmental gains, countries increasingly rely on institutionalized cooperation channels and delegate to international organizations the authority to design and implement environmental programs (Keohane and Levy, 1996). In particular, international organizations that provide financial assistance for environmental protection are vested with the task of increasing the resources available to less affluent countries in order to enhance their involvement in international environmental efforts. At the same time, developed countries benefit from participating in these institutions because these countries enjoy the positive spillovers of environmental programs in the developing world, and environmental improvements are achieved at lower costs relative to similar programs in developed countries.

Financial assistance for environmental protection has not reached the scale of aid in other sectors such as poverty reduction or economic restructuring. At the same time, financial aid grows in importance as a form of environmental cooperation between developed and developing countries. For instance, one of the largest multilateral donors – the World Bank – estimated its total environmental portfolio to equal US$45 billion for the period 1990–2008, with the annual commitment of nearly US$3 billion in 2008, which brought the environmental share of the organization's overall lending to 11%.[1] As the scale of environmental assistance grows, so does the importance of understanding factors shaping its effectiveness, especially given the consensus in the foreign aid literature that aid generally fails to achieve its goals. For instance, foreign aid has been shown to do very little, if anything, to improve the economic and social environment in recipient countries: aid may not foster economic growth or be effective at alleviating poverty, it may produce a negative impact on governance and the rule of law, and it may undermine domestic savings and investment by fueling consumption (see, for example, Boone, 1996; Burnside and Dollar, 2000; Dalgaard and Hansen, 2001; Knack, 2001; Easterly, 2001; Svensson, 2003; Weaver, 2008). International organizations that channel foreign aid to environmental programs have also been criticized for numerous shortcomings: for doing too little to attract national governments' support, failing to develop national capacity to tackle environmental problems, and wasting money on poorly designed projects (e.g., Haas et al., 1993; Bowles and Prickett, 1994; Keohane and Levy, 1996; Andresen, 2007).

A closer look at this research, however, reveals that most of these critiques are based on detailed case studies rather than relying on the support of a rigorous theoretical framework or empirical analysis. This article takes a different tack. I start by developing a simple game-theoretic model of interactions between donors and recipients of environmental aid. I explicitly model the decision-making of participants in environmental programs funded by an international organization and study their interactions starting from aid allocation decisions and through the implementation of the environmental programs in order to answer the following questions about the effectiveness of environmental aid.

- How does the donor's decision regarding the amount of committed aid influence national governments' strategies?
- What considerations dominate governments' decision-making processes?
- Do all governments respond to incentives linked to environmental aid in a similar way?

Contrary to previous research that suggests that environmental aid is ineffective, I show that financial assistance to programs addressing environmental problems can be successful in attracting the support of aid recipients (i.e., national governments) for environmental protection and, consequently, can lead to environmental improvements. This positive impact of environmental aid, I argue, should be attributed to the effects of donor-recipient interactions that can alter incentives of recipient governments and induce their cooperation rather than to capacity building through inflows of aid. However, the theoretical expectation is that these incentives apply with certain limits, and my analysis using original data on environmental projects funded by the Global Environment Facility (GEF) yields empirical evidence that not every government takes these incentives into account in its decision-making process.

1. Principal–agent approach to environmental assistance

In order to explain the variation in the effectiveness of environmental assistance, I draw on the principal–agent framework, which allows me to focus on the strategic interactions between a multilateral aid donor, on the one hand, and national-level aid recipients (i.e., recipient governments), on the other. Applications of the principal–agent framework to the study of international institutions become increasingly common, especially in research on the European Union and international financial institutions (e.g., Vaubel, 1986; Sandholtz and Zysman, 1989; Garrett, 1992; Nielson and Tierney, 2003; Vreeland, 2003; Hawkins et al., 2006; Tierney, 2008; Lyne et al., 2009; Copelovitch, 2010; Schneider and Tobin, 2013). In the context of environmental projects, the donor (or the principal) attempts to direct the environmental activities of aid recipients (or agents) of aid in order to make these activities consistent with the organization's goals. The principal–agent approach has the benefit of dealing explicitly with divergent preferences of the donor and recipients as well as information asymmetries that create incentives inconsistent with the goal of environmental protection and require the donor to design measures to induce its agents to take actions it desires.

An important type of private information that recipient governments may have stems from the fact that the preferences of donors and recipients are not perfectly aligned with each other. In particular, recipients often prefer to exert less effort than donors' desired levels. While both donors and recipients are aware of their divergent preferences, donors work at an informational disadvantage vis-à-vis recipients because donors do not know the extent of the preference divergence and recipients are unwilling to reveal their private information. While donors may wish to offer a compensation for recipients' additional efforts, the difficulty arises when donors attempt to calculate the size of this compensation because the value that a

recipient attaches to environmental protection and, consequently, the level of effort the recipient is willing to exert, can only be known to the recipient government responsible for project implementation. Hence, the recipient has incentives to misrepresent its interest in conserving and improving the natural environment in order to receive larger compensations from donors.

Note that previous research generally suggests that international institutions can reduce information asymmetry for donor countries (Azam and Laffont, 2003). This argument implicitly assumes that organizations, such as the World Bank, have solved (or do not face) a principal–agent problem of their own vis-à-vis aid recipients and have perfect information. This assumption is consistent with some literature on international cooperation: for instance, Keohane (1984) argues that international institutions provide information and, thus, facilitate cooperation. However, most institutions rely on information reported by their members, and hence are unlikely to be significantly more informed than donor countries. Therefore, I do not assume international organizations' informational advantage, and investigate the effect of incomplete information on the interactions of a donor organization and recipient countries.

The principal–agent framework suggests that principals can design solutions to alleviate problems of information asymmetry. The donor can require its recipients to sign an agreement that will specify the desired project outcome and the measures to be taken in accordance with the project goal, and then disburse funding only when the recipients comply with the project agreement. New disbursements of aid are possible only once the country demonstrates its adherence to the project requirements. While conditionality does not always work as intended, because the principal experiences political pressures to relax its conditions for important agents (Stone, 2002), many international organizations rely on this solution to deal with the problem of hidden information. Lending operations of international financial institutions, such as the IMF or the World Bank, for instance, are linked to rigorous conditionality rules. Environmental aid donors, such as the GEF, do not impose similarly strict conditionality; at the same time, GEF grants are not disbursed immediately and implementing agencies can withhold subsequent disbursements, if necessary. Usually, aid disbursements compensate countries for expenses already incurred in the process of project implementation, and the GEF often refuses to extend its financing to activities that are hard to monitor, such as public awareness campaigns or equipment maintenance.

1.1. Effectiveness of environmental aid

The main goal of environmental assistance is to produce environmental improvements. However, such a statement of the assistance objective disregards a critical intermediate factor – the environmental policies of recipient nations. Foreign aid usually targets human activities and seeks to modify them in order to promote environmental changes. Therefore, a policy change must precede any environmental improvement. In addition, from a practical standpoint, it may be hard or even impossible to observe, let alone measure, the impact of environmental programs in terms of actual environmental improvements, at least in the short run.[2]

Consequently, in the absence of immediate and precise environmental indicators, researchers have examined changes in national and local economic practices, and changes in environmental policies as a proxy for environmental effects (Keohane and Levy, 1996). Previous studies of aid and its outcomes have used a number of different definitions and measures of effectiveness. Some measures are very broad and incorporate the aspects of problem-solving, compliance, economic efficiency, normative requirements and government policies (Young, 1999). Other studies focus on more narrowly specified criteria to evaluate effectiveness: for instance, cost–benefit calculations (Bernauer, 1995), or sustainability of environmental outcomes (Haas et al., 1993).

I follow the main thrust of this literature in studying the effectiveness of environmental protection efforts in that I do not define effectiveness as an actual improvement in the quality of the natural environment. Instead, I study effectiveness from the perspective of the agency theory: effectiveness refers to the ability of the principal to structure its agents' incentives in such a way as to elicit the actions that the principal wants.[3] In other words, environmental aid is effective when the aid donor succeeds at inducing national governments to contribute to costly environmental programs (Victor et al., 1998; Zürn 1998). The evaluation of such changes involves comparing the minimum level of the national government's effort that is acceptable to the donor with the government's actual contribution.

The approach of comparing a performance standard set by the donor with the actual effort level may be criticized on two counts. This conceptualization of effectiveness does not directly take into account associated changes in the environment. However, a direct evaluation of environmental outcomes may not be feasible due to the slow nature of environmental processes. In addition, each environmental sector has its own evaluation standards and techniques, which makes a comparison of effectiveness across different projects difficult. Another criticism of measuring effectiveness as the difference between the donor's requirements and the recipients' actual efforts could involve questioning the choice of the standards set by the international organization as the baseline for effectiveness evaluation. The donor may lower the performance bar for some countries to a level at which even those countries that exert the minimum effort will be able to satisfy the donor's requirements and to declare their environmental programs to be effective. Although the donor's biased approach to some countries may indeed seem to challenge this notion of effectiveness, such behavior is consistent with the logic of strategic interaction between the donor of environmental aid and influential recipient countries. In the case of less important countries, the donor will not have any incentives to be more lenient. Therefore, a measure of recipient influence (or the donor's interest in assisting the recipient country) that controls for the donor's partiality in performance evaluations is incorporated in this study to make performance assessments informative in gauging effectiveness.

2. A strategic model of environmental aid

This section builds on the insights of the principal–agent approach and presents the main argument of this article in the form of a formal model. Few studies have

applied the principal–agent approach to the study of environmental assistance, and foreign aid in general. Nielson and Tierney (2003) is one of the first works to use the principal–agent framework to explain World Bank reforms that increased the organization's environmental portfolio and decreased the number of environmentally harmful projects. However, the focus of Nielson and Tierney's research is on the interaction between member governments as principals, and international organizations as their agents. While this application of the principal–agent framework is useful for analyzing the relationship between donor countries and international organizations, the chain of delegation does not end with organizations (Gutner, 2005). Due to the focus of this article on the effectiveness of environmental assistance programs, a logical extension of the principal–agent approach is to shift the focus to project implementation and view international organizations as principals, and aid recipient as their agents.[4] I turn to game theory because it allows me to explore rigorously the foundation of my argument: strategic interactions between the donor and recipients of environmental aid. Game-theoretic modeling captures the most interesting and important factors that shape the implementation of environmental programs and their results: decision-making under incomplete information, diverging preferences, and adjustment of recipients' incentives.

2.1. Assumptions and sequence of play

There are two actors in the model of environmental assistance: an international organization providing financial support for a given project, and a national government. The sequence of their choices depicted in Figure 1 approximates implementation stages of environmental projects. The game begins with Nature's move, which introduces uncertainty into the model: Nature randomly selects a type of the government (t).[5] Government types are assumed to be distributed uniformly on the interval $[0, 1]$: governments committed to environmental protection have type $t = 1$, while governments that place no value on environmental protection have type $t = 0$. The donor, unlike the government, remains uninformed after Nature's move and is assumed to make its decision regarding the size of its project contribution on the basis of the donor's prior beliefs. Both actors' contributions are normalized so that they can be represented by the $[0, 1]$ interval. Thus, the donor commits $a \in [0, 1]$ to the environmental project. The government then has an opportunity to choose its level of financial support, or co-financing, so the government allocates $g \in [0, 1]$ to the project.[6] Following these two decisions, the donor concludes the game by choosing either to disburse the committed funds completely (the project receives a) or to suspend them (the project receives only $\frac{a}{2}$).[7]

The donor organization represents the interests of developed countries that seek to alleviate global environmental problems. Since it is the lack of funds that has traditionally been blamed for the inability of less affluent countries to tackle environmental problems, donor financing for an environmental project is expected to have a positive effect on the likelihood that the project will succeed. Consequently, the donor derives utility from disbursing environmental funding.[8] Since the donor prefers to improve the environment at a reasonable cost, the donor also benefits

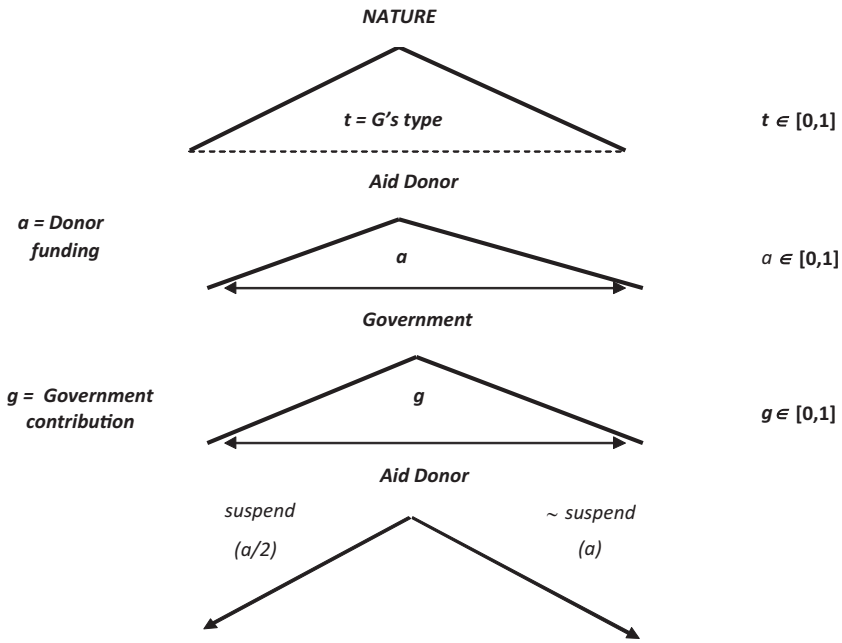

Figure 1. The environmental assistance game.

from recipient governments' project co-financing, especially when the recipients' contribution levels match the donor's own resources committed to environmental protection (Cashel-Cordo and Craig, 1990).[9] In sum, the utility function of the donor organization can be specified as follows:

$$u_D(a) = g + wa_d - (a_d - g)^2$$

where g is the amount of government funding, $w \in [0, 1]$ is the parameter that captures the donor's utility from disbursing aid to a given country, i.e., a measure of how influential the recipient country is, and a_d is the disbursed share of committed aid.

The recipient government benefits from environmental improvements produced by the project and thus receives utility from donor contributions. The government's payoff also depends on its own involvement in the environmental project. Government participation entails some costs because the donor expects that aid recipients will assume some of the expenses associated with donor-funded projects. When the government allocates money for the environmental project, it prefers to give no more than the project is really worth to the government (the higher t is, the more emphasis the government places on the environment, and hence the more value it receives from environmental improvements). Thus, the government's utility function can be specified as follows:

$$u_G(g) = -(g - t)^2 + a_d$$

where g is the government's contribution, t is the government's type, and a_d is the disbursed share of donor funding.

This is a sequential game of incomplete information: the uninformed actor (the donor) moves first. The government then makes its contribution to the project, and this contribution provides the donor with the information that the donor needs to make a decision regarding aid disbursement. The donor's choice depends on the government's effort level relative to the donor's expectation: the donor observes the government's actual contribution and incorporates this knowledge into the decision to suspend or disburse aid at the final node. Therefore, backwards induction is applied to find the outcome of the game.

2.2. Summary of results and empirical implications

Given the assumptions regarding each of the actors' utilities and the structure of the game, I derive the actors' equilibrium strategies and present observable implications of the theoretical model. I start at the final decision node, when the donor must choose either to disburse committed funds or suspend them. The donor does not suspend aid when the government's contribution (g) is acceptable to the donor, i.e., when the donor's disbursement condition holds:

$$g \geq \frac{3}{4}a - \frac{1}{2}w \equiv g^*$$

If, on the other hand, the government contributes an amount less than g^*, the donor evaluates this effort level as unsatisfactory and punishes the government by disbursing only some part of the funding committed to the project ($\frac{a}{2}$). [10]

One implication of the disbursement condition is that projects that receive more aid should be more likely to be rated as unsatisfactory. This theoretical expectation may seem counterintuitive, because improved capacity is considered to be an important factor leading to better protection of the environment. While developed countries are capable of contributing significant resources in order to address environmental problems, less affluent countries often fail to take action, as a result of their financial constraints. Thus, a positive relationship between the amount of available funds and the success of environmental activities is often accepted as common wisdom. However, my model suggests that different sources of financial support affect project performance in different ways. An increase in the size of environmental aid should reduce project effectiveness, because the donor sets higher performance expectations for larger projects. When, on the other hand, the recipient government increases the amount of funding provided for an environmental project, thereby displaying greater recipient ownership of the project (GEF, 1998), such additional resources increase the probability that the government satisfies the donor's performance standards and, consequently, should have a positive influence on project effectiveness.

In addition, the effectiveness condition suggests that a more influential recipient government is more likely to meet the donor's standards. This theoretical expectation is driven by the donor's preference to be more lenient towards more important recipients.[11] When the donor lowers a performance bar for influential recipients, they need to exert less effort than less important countries in order to receive positive project evaluations and avoid aid suspensions.[12] In sum, the donor's effectiveness condition generates the following theoretical expectations:

Expectation 1a. *Greater government co-financing increases the likelihood of a satisfactory project outcome.*
Expectation 1b. *As aid increases, the likelihood of a satisfactory project outcome declines.*
Expectation 1c. *Greater donor interest should make a satisfactory project outcome more likely.*

The government faces a more complicated decision-making problem at its node. If the government did not have any additional constraints, its preferred project contribution would be $g_p = t$. However, the government has to compare its preferred co-financing level with the donor's expectation (i.e., g_p with g^*) because the difference between the expected and actual contribution levels affects the donor's decision at the disbursement stage. Two scenarios are possible.

(a) $g_p \geq g^*$: the government gives g_p, its preferred amount, and since this level of effort is greater than the donor's requirement, the donor disburses its committed aid completely ($a_d = a$). Only governments with a sufficiently high t (i.e., $t \geq t_1^*$) will voluntarily contribute more money than the minimum amount that would satisfy the donor's disbursement condition.[13]
(b) $g_p < g^*$: although in this case the government prefers to give financial support below the donor's required contribution level (g^*), some government types choose to allocate more than their preferred amount (g_p) because this extra effort allows them to avoid the cost of the donor's punishment in the form of reduced environmental funding. Governments with preferred levels of environmental financing less than, but sufficiently close to, the threshold set by the donor organization will agree to increase their contributions (i.e., from g_p up to g^*) and will be sufficiently compensated for their efforts with disbursements of the remaining donor funds ($\frac{a}{2}$). Thus, some governments contribute g^* in spite of their preferences in exchange for the donor's agreement not to suspend aid. Such governments have t less than t_1^*, the first cut point defined above, but greater than t_2^*, the second cut point.[14] Note that the second cut point is always below the first cut point ($t_1^* > t_2^*$); therefore, the intermediate group that responds to the donor's incentives always exists.

Finally, government types below the second threshold (i.e., governments with $t < t_2^*$) provide low levels of project co-financing, and consequently receive only a share of the promised aid ($a_d = \frac{a}{2}$) from the donor. Thus, government types can be divided into 'cooperative' ($g \geq g^*$) and 'uncooperative' ($g < g^*$).

No level of external assistance can guarantee that required environmental measures will be undertaken by the government. My theoretical model suggests that larger amounts of aid will not sway 'uncooperative' government types: in fact, these governments will not increase their contribution amounts in response to increasing donor funding. On the other hand, an increase in aid does have a positive impact on the behavior of 'conditionally cooperative' governments. These governments will try to avoid the punishment in the form of funding suspension at the final decision node and consequently will contribute more, as the donor's financial commitment increases.

Because the donor becomes more demanding when it offers more aid to a country, the impact of incentives associated with this aid (i.e., the threat of aid suspension for failing to reach required contribution levels) will be felt most profoundly when the committed amount of aid is sufficiently high. In this case, the threat of funding suspension leads 'conditionally cooperative' governments to provide higher levels of support to environmental projects than could be expected in the absence of this 'stick'. Influential recipients, on the other hand, know that their aid is less likely to be suspended, because the donor sets a lower performance threshold for them. Consequently, as the recipient government's importance increases, the government's contribution to environmental projects declines.

Finally, note that governments with the highest levels of environmental concern (with t close to 1) do not respond to additional aid with contribution increases because they are in no danger of aid suspensions. These government types behave similarly to their counterparts in the 'uncooperative' range: additional donor funding does not affect these governments' environmental spending decisions. In sum, the size of donor funding is expected to have a positive effect on the government's environmental efforts only in the case of 'conditionally cooperative' types.

Expectation 2a. *The more environmentally concerned a government is, the more it contributes in project co-financing, given that the government is of the 'unconditionally cooperative' or 'uncooperative' type.*
Expectation 2b. *As the donor's interest in assisting the country increases, the government's co-financing should decrease, given that the government is of the 'conditionally cooperative' type.*
Expectation 2c. *As aid increases, the government's co-financing should also increase, given that the government is of the 'conditionally cooperative' type.*

At the first decision node, i.e., at the aid commitment stage, the donor has to choose the optimal level of its financial support for a given project. The donor uses the information on the probability distribution of government types and corresponding expected contributions from different types of governments. The optimal level of a is presented in Figure 2.

The theoretical expectation is that a positive relationship exists between the donor's interest in assisting a given country and the amount of aid that is committed to the project. In other words, the donor commits more funds to a project in a country that the donor finds more important. This theoretical result seems to be quite intuitive; however, depending on the operationalization of w, the parameter

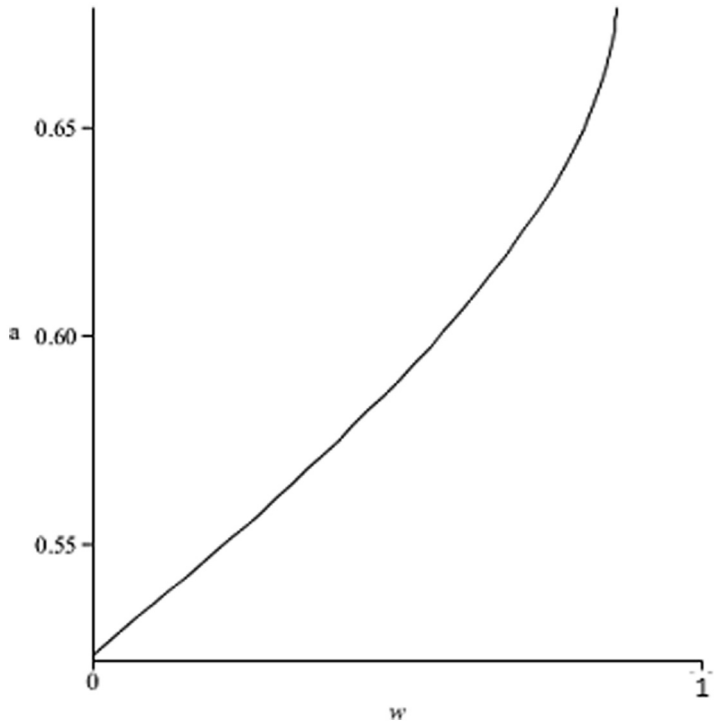

Figure 2. Aid allocation (*a*) as a function of donor interest (*w*).

that captures the donor's interest in providing financial support, this result contradicts some empirical findings in the literature on foreign aid.

Consider the case of development aid: donors of bilateral and multilateral aid emphasize their expressed interest in assisting lower income countries. The World Bank, for instance, states that its mission is 'to fight poverty and improve the living standards of people in the developing world' (World Bank, 2010). However, some scholars find that per capita GDP, a commonly used measure of economic development and living standards, is either positively related to bilateral and total aid allocation (Maizels and Nissanke, 1984), or has no statistically significant effect on the level of committed aid (Apodaca and Stohl, 1999). Recent studies of aid allocation suggest that political and strategic considerations of donor countries are better indicators of donor interest for both bilateral and multilateral aid (Schraeder et al., 1998; Burnside and Dollar, 2000; Alesina and Dollar, 2000; Alesina and Weder, 2002; Neumayer, 2003; Andersen et al., 2006; Kilby, 2006; Easterly and Pfutze, 2008; Dreher et al., 2009). Therefore, the choice of an appropriate measure is important for establishing whether the donor's interest indeed has the expected positive effect on financial assistance.

Expectation 3. *The donor is expected to make larger aid commitments as its interest level increases.*

3. Statistical analysis of the environmental assistance game

The empirical focus of this study is on the Global Environment Facility (GEF), one of the largest donors of aid for projects with global environmental benefits, and its main implementing agency, the World Bank.[15] I concentrate on one institution in order to narrow down the institutional diversity that makes a meaningful comparison of projects supported by different institutions problematic. A number of international institutions provide financial assistance for environmental programs: for example, the Montreal Protocol Multilateral Fund was established to help developing countries with phase-out of ozone-depleting substances; and PHARE was launched by the European Union in 1989 to assist Poland and Hungary during the period of their economic restructuring and political transition and later assigned broader objectives, including environmental assistance to Eastern and Central Europe. The choice of this particular institution – the GEF – was determined by its focus on problems of global environmental commons rather than more localized environmental problems (as, for example, is the case with PHARE), the availability of a relatively large number of cases with detailed studies of countries and their environmental problems, and the diversity of the GEF's portfolio that includes projects addressing a broad spectrum of problems (ranging from land degradation and biodiversity loss to ozone depletion and climate change) and encompasses a large number of countries from different parts of the world rather than from one geographic region.

The GEF's recent advent inevitably limits the number of completed and evaluated programs available for the empirical analysis.[16] 177 projects are included in the original dataset compiled for this study. The majority of the projects seek to contribute to biodiversity conservation (53%), while the second largest focal area is climate change (27%). The bulk of the data are drawn from the GEF and World Bank databases with reports on financial transfers for GEF environmental projects that the GEF approved between 1991 and 2007 and that were evaluated upon completion.[17]

3.1. Logic of strategic statistical modeling

To analyze the causal relationships consistently with the strategic model of donor–recipient interactions, the approach to statistical analysis employed in this article follows Signorino's statistical equilibrium regression models (Signorino, 1999; Signorino and Yilmaz, 2003). Since I model the donor and recipients of environmental aid as strategic actors, i.e., what an actor decides to do depends not only on the actor's preferences but also on the decisions of the other actor, my statistical model should reflect the strategic character of donor-recipient interactions. Failure to take strategic settings into account could yield the functional form of the statistical model that is inconsistent with the structure of the game developed in this article. As a result, the statistical analysis based on such a model would lead to invalid inferences due to strategic misspecification bias. Therefore, in order to assess what influences the amount of environmental aid offered by the aid donor, the size of

funds provided by the national government, and the effectiveness of environmental projects, I specify a strategic statistical model based on the results of the game-theoretic model.

3.2. Dependent variable 1: Effectiveness

The donor organization disburses aid equal to the initial commitment if the recipient government has met the donor's performance criteria, i.e., if the disbursement condition holds: $g \geq g^*$. The GEF evaluates implementation of each program on the basis of its outcome, sustainability, institutional development in the recipient country, and performance of both the recipient and the donor. Therefore, to measure project effectiveness, I code *Borrower performance* as a binary variable based on the borrower performance component in the aggregate project evaluation because it directly measures the government's contribution to the project. *Borrower performance* takes values of 0 (unsatisfactory performance) and 1 (satisfactory performance).[18] This coding is driven by the equilibrium results of the formal model: if the government's contribution to a project (g) achieves the performance standard set by the donor (g^*), i.e., $g \geq g^*$, this effort is evaluated as satisfactory. If, on the other hand, the government fails to provide sufficient funds – that is, its contribution is less than the donor's requirement – the government's performance is rated as unsatisfactory.

The effectiveness model is estimated with logit, and takes the following form:

$$Effectiveness = \alpha_1 g + \alpha_2 a + \alpha_3 w$$

where g is *Government funding*, a is *GEF grant*, and w is *Donor interest*.

3.3. Dependent variable 2: Government contribution

This variable represents the amount of financing a government allocates for a project. Government funding is measured in US dollars (logged) and corresponds to g in the formal model. The lowest government contribution amount was for Ukraine's Transcarpathian biodiversity protection project – US$80,000. On the opposite end of the co-financing spectrum are project contributions of over US$400 million each by the governments of China, India and Philippines.

The solution of the formal model specifies the equilibrium conditions that determine the government's effort level. These conditions can be summarized as follows:

$$g = \begin{cases} g_p = t & for\ t \geq t_1^* \\ g^* = \frac{3}{4}a - \frac{1}{2}w & for\ t \in (t_2^*, t_1^*] \\ g_p = t & for\ t < t_2^* \end{cases}$$

In order to estimate the government contribution model, I use a two-step procedure. I first generate interactive terms D_1, D_2 and D_3, which help to specify the correct functional relationships between the dependent variable (*Government funding*) and regressors appropriate for each government type.[19] Thus, D_1 is a binary

variable that takes the value of 1 for 'unconditionally cooperative' types, and is equal to 0 otherwise. Similarly, D_2 corresponds to 'uncooperative' types, and D_3 corresponds to 'conditionally cooperative' types. The second step is to interact the dummies with regressors associated with contribution levels for respective government types, and estimate the government contribution model. Note that the two-step procedure is incorporated into a bootstrap command to obtain standard errors. The government contribution model to be estimated with tobit takes the following functional form:

$$g = \beta_1(D_1 + D_2)t + \beta_2 D_3 a + \beta_3 D_3 w$$

where g is *Government funding*, a is *GEF grant*, w is *Donor interest*, and t is *Government type*.

3.4. Dependent variable 3: Aid allocation

The donor chooses its optimal level of financial commitment in accordance with the solution of the formal model, as Figure 2 shows. This financial commitment is represented by the size of the grant, *GEF grant*: this variable is based on the (logged) amount of financial transfers from the GEF to the recipient country. The GEF provides grants for projects of various scale, ranging from thousands to millions of US dollars. In my dataset, the lowest amount of financing (US$500,000) was committed to the Transcarpathian biodiversity protection project in Ukraine, and the largest grant (over US$40 million) funded a renewable energy project in China.

The aid allocation equation is estimated with tobit and takes the following form:

$$a = \gamma_0 + \gamma_1 w$$

where a is *GEF grant*, and w is *Donor interest*.

3.5. Regressors

The three equations specified above demonstrate the assignment of regressors. Note that two dependent variables (*Government funding*, and *GEF grant*) also serve as regressors in other equations. Two additional variables are *Donor interest* and *Government type*.

Donor interest: This variable corresponds to the parameter w in the formal model and is expected to affect project effectiveness, as well as government co-financing and environmental aid. I operationalize this parameter as the total (logged) amount of GEF funding that a country has received between 1991 – 2013.[20] In addition to the main variable (*Total GEF grants*), I measure donor interest at the level of the GEF's implementing agency, the World Bank: *Total WB aid* is the amount of IBRD loans and IDA credits extended to a country (logged; debt outstanding and disbursed [DOD], current USD, at project approval). Previous research (e.g., Stone, 2002, 2004) shows that countries that have more influence, or

viewed as more important by an international agency, are treated differently from less important countries: in particular, the international agency punishes more important countries less harshly when they do not comply with terms of their assistance agreements.

Government type: I use two measures of government type in this analysis. The first is GDP per capita, measured in constant USD at project approval. GDP per capita is a reasonable government type indicator because less affluent governments tend to be more concerned about social and economic issues rather than environmental protection.[21] The choice of this measure is consistent with the requirement of the statistical model that the government type (t) be unknown at the time when the donor makes its aid commitment, but available to a researcher at a later point in time. Based on the GEF's project development and implementation time frame, it takes on average 1,168 days, or 3.2 years, to prepare a GEF project (GEF, 2004). Therefore, there is a significant lag between the time when the donor makes its financial commitment and the implementation period when the government type affects the government's decision on the amount of project co-financing to be disbursed. Unavailable to the donor at the stage of project design, data on the recipient's GDP per capita, the variable that corresponds to the government type parameter in the formal model, can be collected ex post.[22]

The second government type measure is Δ *protected areas*, or the change in the share of a country's total area that is designated as protected by the government. Protected marine and terrestrial areas include national parks, scientific reserves that restrict public access, nature reserves and sanctuaries, and natural monuments.[23] This measure is constructed to capture policy changes that help to differentiate between governments that are concerned with environmental protection, and governments that are not. Since it requires government action to increase (or decrease) the amount of protected land, positive changes in the size of protected territory indicate government commitment to environmental protection, whereas shrinking protected areas suggest that the government has little concern for the natural environment. I calculate the difference between the size of protected areas at project completion and at project approval. In my dataset, six countries decreased the size of land designated as protected during project implementation: Belarus, Brazil, Ghana, Kenya, Romania and South Africa. Bulgaria, on the other end of the government type spectrum represented by Δ *protected areas*, granted protected status to 27% of its territory during project implementation, thereby bringing the total share of protected areas from 8.7% to 35.4%. Similarly to the *GDP per capita* variable, the use of Δ *protected areas* as a measure of government type satisfies the requirement of the statistical model that the government type (t) be unknown to the donor at the aid allocation stage; however, a researcher can later obtain this information.

4. Discussion of results

Table 1 presents the estimation results testing Expectations 1a–c, using two alternative donor interest measures (*Total GEF grants* and *Total WB aid*). In both specifications of the effectiveness model the analysis yields results consistent with the

Table 1. Effects of government and GEF funding and donor interest on project effectiveness.

	D.V.: *Borrower performance*						Expected sign
Regressors	Coef	SE	z	Coef	SE	z	
GEF grant	−0.48	0.29	−1.66	−0.52	0.26	−2.02	–
Government funding	0.28	0.16	1.73	0.43	0.18	2.33	+
Donor interest: Total GEF grants	0.26	0.20	1.30				+
Donor interest: Total WB aid				0.15	0.14	1.02	+
Number of observations	177			151			

theoretical expectations, and coefficients on two out of three regressors achieve statistical significance at conventional levels. More specifically, when governments provide more co-financing for environmental projects, project outcomes are more likely to be satisfactory (Expectation 1a). As governments increase the level of project contribution, they are more likely to reach the donor's performance standard. When, on the other hand, the donor commits more aid, recipients are less likely to comply with project objectives (Expectation 1b). This result stems from the donor's expectations of greater government contribution to larger grants, and it is harder for recipients to meet these expectations. The coefficients on the *Donor interest* variables do not reach statistical significance; therefore, Expectation 1c does not find empirical support. In sum, the empirical results lend support to the hypotheses suggesting a negative impact of larger amounts of aid and a positive effect of government contribution on project effectiveness. In addition, both model specifications generate correct predictions of government performance approximately 86% of the time.

The estimation results related to the government contribution hypotheses are reported in Table 2. The results that achieve statistical significance at conventional levels are fully consistent with the theoretical expectations and provide evidence of the hypothesized positive relationship between donor funding and government contribution for 'conditionally cooperative' governments. As expected, institutional incentives lead to increased government effort for governments of this type: the 'conditionally cooperative' type dummy interacted with the *GEF grant* variable has a positive coefficient in both specifications reported in Table 2, which suggests that these governments, i.e., governments with $t \in [t_2^*, t_1^*]$, are indeed swayed by the donor's incentives, and contribute more as the GEF commits more aid (Expectation 2c). The *GEF grant* variable also has a considerable substantive impact on the amount of government co-financing: the predicted government contribution increases by 24% when GEF assistance increases from its minimum to its maximum. Therefore, the GEF appears to be successful in providing this category of its aid recipients with incentives to exert costly environmental efforts. The second interaction term of 'conditionally cooperative' government types, measuring recipients' importance to the donor (*Total GEF grants*), fails to reach statistical significance (Expectation 2b).

Table 2. Effects of government type, GEF funding and donor interest on government contribution.

	Government type: GDP per capita			*Government type: Δ protected areas*			Expected sign
Regressors	Coef	SE	*z*	Coef	SE	*z*	
GEF grant (conditionally cooperative types)	1.01	0.50	2.02	1.03	0.14	7.54	+
Government type (uncooperative and unconditionally cooperative types)	0.00	0.00	12.77	1.32	0.23	5.77	+
Donor interest (conditionally cooperative types)	0.01	0.43	0.02	0.01	0.12	0.10	–
Number of observations	174			165			

Table 3. Effect of donor interest on GEF funding.

	Donor interest: Total GEF grants			*Donor interest: Total WB aid*			Expected sign
Regressors	Coef	SE	*t*	Coef	SE	*t*	
Donor interest	0.38	0.06	6.76	0.24	0.03	7.02	+
Constant	8.66	1.03	8.44	10.44	0.74	14.12	+
Number of observations	177			151			

Another empirical finding reported in Table 2 provides support for the theoretical expectation of a positive relationship between government type and government contribution for 'unconditionally cooperative' and 'uncooperative' governments. Each of the two measures of government type, *GDP per capita* and *Δ protected areas*, has a positive effect on government co-financing (Expectation 2a), and these results are statistically significant at conventional levels. This suggests that 'unconditionally cooperative' and 'uncooperative' governments, which do not respond to the donor's aid incentives, contribute more to environmental projects when these governments place a higher value on environmental protection. The predicted financial contribution for the greenest government type is 14 times greater than the contribution of the government type with the lowest level of commitment to environmental protection.[24] When compared to the substantive effect of the GEF assistance variable, this result is a stark demonstration of the profound difference between domestically driven motivation to contribute to environmental protection and contribution due to constraints imposed by an international organization.

Two specifications of the GEF assistance model are summarized in Table 3, which shows that both measures operationalizing donor interest have a statistically significant positive effect on the size of GEF grants. Column 1 presents regression

results with the main *Donor interest* variable –*Total GEF grants* (Expectation 3). The estimates in Column 2 serve as a robustness check demonstrating that the finding is robust to the use of an alternative donor interest measure.[25] In the regression specification in Column 1, the effect of the donor's interest one standard deviation above the mean (US$274 million in grants over 22 years) is additional US$3.2 million in committed donor financing. The scale of this additional funding becomes clearer when compared to an average GEF grant in my dataset (US$8.7 million). In addition, consistently with the equilibrium results, the coefficient on the constant is positive and statistically significant, as an approved GEF project always has a financial commitment of a GEF grant associated with it.

5. Conclusions

This article develops and empirically tests a strategic model of environmental assistance. Taking into account the strategic nature of interactions between donors and recipients allows me to define formally the category of governments that respond positively to the incentives offered by the aid donor and, as a result, increase their contributions to environmental programs. Even though the donor is aware that its incentives are effective only in the case of these governments, information asymmetries limit the donor's ability to identify and target this group.

The results presented in this article highlight motivations and constraints that affect the ability of international institutions to promote environmental protection. Aid programs often fail to deliver environmental improvements, as previous literature on environmental aid is quick to point out. Does this imply that the Global Environment Facility or any other international organization cannot hope to have an effect on aid recipients' behavior and, more specifically, encourage them to adopt and implement desirable policies? The argument advanced in this study suggests that this positive influence is possible, but the logic of strategic interaction between the donor and recipient governments often hinders the success of international cooperation. Strategic factors, such as conflicting donor and recipient motivations, and the donor's uncertainty about its recipients' commitment to project objectives, limit opportunities for effective environmental cooperation.

At the same time, even though the GEF's work is not a complete success, the financial assistance channeled through the GEF provides cash-strapped governments both with opportunities to contribute to environmental protection and with tangible (albeit sometimes insufficient) incentives to carry out pollution reduction or conservation programs. Despite all the obstacles and limitations, the institution has been able to produce not only policy changes, but also substantial and measurable environmental improvements, including the GEF's significant contribution to phasing out the production and use of ozone destroying chemicals in countries of Eastern Europe and Central Asia. Therefore, as weak as it is, the 'carrot' of additional aid disbursements can provide governments with an incentive to act in ways that benefit the global environment.

This result is encouraging from the perspective of environmental policy and is in line with the existing international relations research on institutions and their

effects. International institutions help countries to achieve mutually beneficial outcomes: this study shows that the aid donor can assist countries in addressing the problem of global environmental commons, even though the model setup incorporates several elements that make cooperation harder to achieve. For instance, I assume that the GEF suffers from informational asymmetries at the aid allocation stage and treat each GEF project as a one-shot game, which eliminates the shadow of the future. However, extensive information on the behavior of recipient governments and a long shadow of the future in repeated interactions are known to reduce the likelihood of non-cooperative actions.

These findings are relevant not only for international environmental institutions, but also for institutions providing assistance in other areas. I have focused on one organization to narrow down the institutional diversity to make cross-country and cross-project comparisons more meaningful. However, the existing empirical accounts of foreign aid show that multilateral and bilateral donors face similar incentives. Therefore, my theoretical approach can be applied to analyze donor-recipient interactions in general, as the strategic nature of their relations that this article underscores displays itself across the spectrum of donors and recipients.

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Notes

1. World Bank, 2009.
2. In the area of ozone layer depletion, for instance, the process of recovery is estimated to require decades, even under the most optimistic scenario of full compliance with the Montreal Protocol on Substances that Deplete the Ozone Layer. A recent report by the World Meteorological Organization states that ' [l]ong-term recovery of the ozone layer from the effects of ozone-depleting substances is expected to span much of the 21st century… The date when equivalent effective stratospheric chlorine at midlatitudes returns to pre-1980 levels is now calculated to be 2049, for the case of global compliance with the Montreal Protocol with no significant exceptions' (World Meteorological Organization, 2006: xxxv).
3. This approach is also consistent with Underdal (2002)'s differentiation between the behavioral change – or outcome – and the change in the state of the natural environment – or impact. In this terminology, the concept of outcome is similar to my definition of effectiveness. However, the point of reference for assessing effectiveness in my model is the donor's expectation, rather than the non-cooperative or collective optimum counterfactuals considered by Underdal. For more detailed discussions of the concept of effectiveness, see Underdal (2002) and Breitmeier et al. (2006).

4. For similar applications of the principal–agent approach, see Pietrobelli and Scarpa (1992); Killick (1997); Drazen (2002); and Martens et al. (2002).
5. The government type represents private information that the government has about its commitment to environmental protection, and that affects the government's decision regarding its spending on environmental projects.
6. Note that g is the government's disbursed financing, rather than its original project commitment because the donor cares about the actual, rather than promised, contribution level.
7. When the donor suspends aid, the government may still keep and benefit from the funds $a_d \in (0, a)$, received before the penalty is imposed. For convenience, these funds are assumed to equal $\frac{a}{2}$.
8. The donor organization may derive utility from disbursing aid for another reason: since international bureaucracies face many of the incentives typical for national-level bureaucrats, an international organization, such as the GEF, seeks to maximize its influence, increase the size of the resources at its disposal, and increase its independence (e.g., Vaubel, 1986).
9. The donor's expectation of recipient matching, or co-financing, is similar to the cost sharing principle that the US Federal Government applies to its assistance programs.
10. The GEF's project evaluation documents for projects with unsatisfactory ratings often reflect the donor's comparison of the government's actual contribution level with the donor's contribution expectation. For instance, when evaluating Ghana's Natural Resource Management Project, the GEF reports that 'The [Government of Ghana] consistently failed to provide counterpart funding on time and in the amounts estimated by the project. Of the total US$2.0 million budgeted …, only US$ 0.66 million was released by the Ministry of Finance. By February 2000, [the Government of Ghana] had only provided 10% of the counterpart funding. … The slow and untimely release of funds affected the disbursement of IDA and GEF funds' (World Bank, 2003a: 16). Overall, the government contributed approximately a quarter of the promised amount, and the GEF disbursed only US$1.8 million of its original aid commitment of US$2.1 million.
11. Stone (2002) reports a similar finding for IMF programs: the IMF is more lenient in enforcing its loans-for-policy contracts with more important countries.
12. Michaelowa and Borrmann (2006) show that evaluation is subject to distortions due to conflicting goals of the evaluation process, and the collusion between project managers and evaluators.
13. The first cut point, $t_1^* = \frac{3}{4}a - \frac{w}{2}$, defines the lower boundary for 'unconditionally cooperative' government types.
14. This cut point, $t_2^* = \frac{3}{4}a - \frac{w}{2} - \sqrt{\frac{a}{2}}$, sets the lower boundary for the intermediate group of government types, or 'conditionally cooperative' types.
15. The GEF's implementing agencies are instrumental in managing GEF projects because the GEF does not implement its own projects. The GEF works with three main agencies: the World Bank, the United Nations Development Programme, and the United Nations Environment Programme. Several other organizations can access GEF funding for project preparation: four regional Development Banks, the United Nations Industrial Development Organization, the Food and Agriculture Organization and the International Fund for Agricultural Development.
16. Note that recipient governments can restrict the publication of project documents, even when the project is closed and its outcomes have been evaluated.

17. The GEF's database is available at http://www.gefonline.org/; and the World Bank's documents are available at http://go.worldbank.org/0FRO32VEI0.
18. More formally, Effectiveness $= \begin{cases} 1 \; if \; g - g^* \equiv g - \frac{3}{4}a + \frac{1}{2}w \geq 0 \\ 0 \; if \; g - g^* < 0 \end{cases}$.
19. When estimating t_1^* and t_2^*, I specify appropriate constraints to ensure that $t_1^* > t_2^*$.
20. The donor's interest can be measured in other ways. I constructed two alternative measures using data on GEF aid: GEF aid to a given country as a share of total GEF assistance to all countries annually, and the total number of GEF single-country projects approved for a given recipient by 2013. All the alternative measures are highly correlated with the main donor interest variable (at levels ranging from 0.68 to 0.87) and produce similar estimation results.
21. The World Development Indicators dataset is the data source for the per capita GDP variable.
22. The GEF's evaluation reports indicate that significant and abrupt changes in countries' economies (captured by GDP per capita in my empirical analysis) are not unusual during project implementation, are difficult to foresee at the initial planning stage, and can have profound effects on project implementation. For example, Indonesia's Kerinci Seblat Integrated Conservation and Development Project was negatively affected by an economic crisis that occurred in the first year of the project's implementation – and 5 years after the project entered the pipeline, or the initial development stage. The Implementation Completion Report emphasizes this point: 'Economic crisis "Krismon" led to the devaluation of the rupiah …. This led to the cancellation of US$9.0 million from the loan and to the reduction of the target number of villages from 134 to 75' (World Bank, 2003b: 14). Overall, Indonesia's government contributed only 26.1% of the promised amount and the GEF disbursed only 55% of its committed grant.
23. The source of the data on protected areas is World Development Indicators.
24. The predicted contributions are based on minimum and maximum values of *GDP per capita*, while all other variables are held at their mean values.
25. I conducted an additional robustness check by constructing and including a measure of government effectiveness in the regression analysis of GEF financing. The government effectiveness variable is based on the World Bank's measure of government effectiveness, and controls for the possibility that recipient governments with better policies receive more aid. The inclusion of the government effectiveness variable does not affect the main result, and the coefficient on the effectiveness variable does not reach statistical significance.

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