The Structure of an Environmental Transaction: The Debt-for-Nature Swap

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ABSTRACT: The structure and occurrence of debt-for-nature swaps are examined empirically. Contracts executing debt-for-nature swaps are studied to assess the role of transaction costs in determining how these agreements are structured. The emerging contract form is a product of weak enforcement of legal claims to environmental resources in developing countries, high costs for delineating and monitoring environmental outcomes, and nominal government ownership of the resources involved. The occurrence of swaps in individual countries is significantly related to host country attributes, including the presence of tropical land and threatened species, democratic political institutions, and large debt burdens. (JEL Q28, Q20, K22)

I. INTRODUCTION

On July 13, 1987, Conservation International (CI), an environmental organization based in the U.S., signed an agreement with the Government of Bolivia canceling $650,000 of the latter's debt in exchange for certain resource conservation measures to be undertaken in Bolivia (Cody 1988, 29–30). Those who negotiated this first ever debt-for-nature swap faced the following contracting problems: (i) as a commodity, "resource conservation" is vague, difficult to define, and subject to interpretation; (ii) the natural assets targeted for protection often are vast and remote, and hence difficult to monitor and control; and (iii) typically one party to such transactions is a sovereign nation. The CI-Bolivia swap resulted in disagreement and dissatisfaction between the parties and political unrest in the host country. The structure of subsequent swaps has evolved, however, in ways that mitigate these problems.

A debt-for-nature swap is a transaction between two or more parties to enable conservation or the provision of environmental services. All exchanges involve transaction costs and impose risks on the parties involved, and contracts presumably evolve to mitigate these costs. One of our central aims is to learn how debt-for-nature contracts deal with these barriers. One transaction cost barrier is the task of monitoring and enforcing how environmental assets are used. It can be particularly high in debt-for-nature swaps because the resources involved typically are forests and other economically marginal lands in developing countries. Monitoring and controlling the use of forests can be difficult because forests often are large, complex, remote, and have many access points. Additional transaction costs arise because the resources involved usually are owned by a sovereign nation. Debt-for-nature swaps also subject the parties involved to risks concerning the degree of environmental protection achieved and the possibility of default. The data used in our assessment of debt-for-nature contract structure are the contracts and related documents that spell out terms for several debt-for-nature swaps.

Our second goal is to learn what factors determine the potential gains from debt-for-nature swaps. Swaps have occurred in some countries but not others, and this presumably reflects either cross country differences in the perceived benefits and costs of environmental protection, or cross coun-

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try differences in transaction costs. We postulate a simple model that treats the benefits and costs of a swap, and the associated transaction cost, as functions of observable attributes of countries. The propensity of a given country to participate in debt-for-nature swaps then depends on the attractiveness of its environmental resources to international conservation groups, its debt burden, and certain economic and political attributes. This portion of the study uses data on the occurrence of swaps, as well as environmental, economic, and political variables for a cross section of countries.

Historically, the cost of enforcing ownership claims to the developing world’s forests has outweighed the benefits to any potential owner. This is changing, however, for several reasons. Growing concern over atmospheric carbon dioxide has raised the perceived benefit of establishing ownership, since standing forests sequester carbon dioxide in their biomass. Recent advances in biochemistry have added impetus by making it easier to screen natural life forms for useful drugs and agricultural agents, thus increasing the value of the genetic information found in tropical forests. (Sedjo 1992, 211.) Better information and widespread publicity on the biodiversity found in tropical forests has amplified the developed world’s expression of existence values and moral objections to species extinction. For all of these reasons the benefits of ownership are rising relative to costs, and ownership is being established or strengthened where it formerly was weak or nonexistent.

The debt-for-nature swap is one manifestation of this phenomenon, and a better understanding of how these swaps work may facilitate other approaches to establishing ownership. A better understanding of how such swaps work is also necessary for evaluating public policy toward them. Past swaps have received much media coverage, but the information presented is largely obtained from the conservation groups supporting them. The U.S. government clearly favors trading debt for nature as a matter of policy, but few among the academic community or lay public seem to understand how such swaps work.

The remainder of this paper sketches the history of debt-for-nature swaps, analyzes how the structure of debt-for-nature contracts is affected by transaction costs and risk, and empirically examines the occurrence of debt-for-nature swaps. Two qualifications are in order. First, no attempt is made to evaluate whether debt-for-nature swaps are desirable in a global benefit-cost sense. While the participants obviously find them beneficial, there may be third party effects. Second, we offer no detailed examination of why the quid pro quo in these transactions is debt rather than, say, food, military hardware, or cash.

II. BACKGROUND INFORMATION

As of December 1992, 23 “private” debt-for-nature swaps had been completed in 14 different countries and more were in progress. These are termed private because they were negotiated by and used funds raised by private international conservation organizations (COs). Three COs have been

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1 A second manifestation is the emergence of contracts for the collection, identification, and commercial application of biological substances found in the tropics. See Eiser (1989–90) and Joyce (1991).
2 Public Law 101–240 of 1989 (U.S. Congress, December 19, 1989) directs the Secretary of Treasury to promote and assist in debt-for-nature exchanges involving multilateral lending agencies and directs the administrator of the U.S. Agency for International Development to offer financial assistance to conservation groups seeking to carry out such swaps. In addition, the Enterprise for the Americas Initiative, described later, has canceled $875 million in debt to the U.S. through nine swaps.
4 The countries involved are Madagascar, Zambia, Bolivia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, the Philippines, Poland, Nigeria, Brazil, and Panama.
most active: Conservation International, The Nature Conservancy (TNC), and the World Wildlife Fund (WWF). Measured either by the face value of debt retired or by the cost of funds to the COs, Costa Rica, Ecuador, the Philippines, and Madagascar are the countries most heavily involved. The face value of debt retired in private swaps is $95.1 million. This debt was acquired by international COs at a cost of $24.6 million, so the average purchase price was 26 percent of face value. In exchange for canceling its debt the debtor government typically agrees to endow a conservation trust fund. The formation of these funds and their use in securing the environmental objectives of the international COs is explained later. The face value of funds pledged to conservation trusts in the swaps examined is $78.7 million.5

Several additional debt-for-nature swaps have been negotiated by developed country governments rather than international COs. The first two such “public” swaps used debt donated by Sweden and the Netherlands. Nine have proceeded under the U.S. Enterprise for the Americas Initiative (EAI), a program that allows debt owed to the U.S. by Latin American and Caribbean countries to be swapped for economic and environmental concessions. These 11 public swaps reduced debt by $904.5 million and generated conservation funds of $181 million (U.S. Department of Treasury, January 15, 1993).6

In 1992 the Government of Poland reached an agreement with the Paris Club, a group of 17 developed creditor nations, allowing the latter’s members to swap Polish debt for environmental concessions by Poland in amounts up to $3 billion. The amount swapped to date, $460 million, represents the largest debt-for-nature swap undertaken in a single country. When public and private transactions are combined, debt-for-nature swaps have involved 19 debtor countries and $1,460 million in debt.7

The availability of a secondary market for “nonperforming debt” and discounted prices as low as five cents on the dollar are cited as ingredients for interest in these swaps. The secondary market arose from the debt crisis that became evident in 1982 when Mexico suspended debt service payments. Several developing countries followed, rescheduling payment as global recession and high interest rates made debt obligations increasingly burdensome. The total external debt outstanding to developing countries stood at $1.34 trillion as of 1990 (World Resources Institute 1986, 18; Anonymous 1991, 2).8

A typical private swap includes three or more parties, an international CO that donates the funds and often initiates the process, a conservation organization in the host country with whom the international CO has established a working relationship, and one or more government agencies from the host country (von Moltke and DeLong 1990). Representation by the host government may include the central bank, with responsibility to convert external debt to domestic currency obligations, and an agency with general oversight responsibilities. The process begins when the debtor country’s central bank agrees in principle to convert a portion of its external debt. It may also specify an upper limit to conversions, an applicable exchange rate, and a conversion rate. The interested CO then negotiates specifics with

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5 The figure for conservation funds generated equals the face value of local currency bonds issued by host countries. Host countries usually have issued local currency bonds to finance the conservation obligations created by debt-for-nature swaps. The $78.7 million figure does not include interest, nor is it adjusted for the probability of default.

6 The debt involved in EAI swaps is P.L.480 “Food for Peace” debt, which offers low interest loans to developing countries to purchase U.S. agricultural products, and U.S. Agency for International Development debt. EAI allows debtor countries to pay interest from part of this debt into a fund designated for conservation. Latin American and Caribbean countries now owe the U.S. $1.7 billion under P.L.480, and the probability of repayment appears very low. This may account for the fact that the conservation fund yield on debt canceled under the EAI program has been low in comparison to the yield on private swaps.

7 Public swaps have involved Costa Rica, Ecuador, Bolivia, Jamaica, Chile, Colombia, Uruguay, El Salvador, Argentina, and Poland.

8 Brock (1984, 1043) cites the 1979 oil shock which induced oil-importing countries to increase borrowing, and growth in the real exchange value of the dollar which increased the burden of dollar-denominated debt, as factors contributing to the debt crisis.
the debtor government, the host country CO, and other relevant parties. The debt instrument is acquired only after an agreement is reached. A debt-for-nature swap often results in the host country placing domestic currency bonds in an environmental trust fund. In such cases the host country's overall nominal debt obligation may not change. Because of currency exchange restrictions, however, the conversion of external debt to an obligation payable in domestic currency often is advantageous for the country.

While the debt relief provided by debt-for-nature swaps to date is tiny relative to what is owed, the resulting conservation funds can be large relative to what the country would otherwise spend. WWF's first swap in Ecuador reduced an $8.3 billion foreign debt by only $1 million, but the resulting conservation fund yielded revenue equal to twice the existing government budget for parks and reserves (Patterson 1990, 6). In Costa Rica, interest from debt-for-nature swaps is several times that country's national park budget (Reilly 1990, 136).

III. THE STRUCTURE OF DEBT-FOR-NATURE CONTRACTS

The explanations most commonly used by economists to explain contract provisions are based either on transaction costs or risk aversion. Transaction cost explanations emphasize that the value of any transaction is lowered by the monitoring, enforcement, and dispute resolution costs that accompany it, and that parties to an exchange can gain mutually by adopting a contract structure that mitigates these costs (Leffler and Rucker 1991). This implies the principle that contract structure will be chosen to maximize the value of the transaction, net of transaction cost. The sharecropping analysis of Braverman and Stiglitz (1982) exemplifies this approach. The risk preference approach is built around the observation that the outcome of a transaction often is uncertain, and that the choice of contract structure induces a specific distribution of returns to the parties. This suggests the principle that contracts will tend to be structured in ways that minimize the overall cost of risk bearing, for example, by allocating risks to parties who can bear it most efficiently. Leland's (1978) analysis of oil and gas leasing contracts exemplifies this approach. These two views clearly are not mutually exclusive, and a given contract could be a product of both forces. Our interpretation of contract structure stress transaction cost arguments because we believe this paradigm has more explanatory power in the present context. We do, however, examine the ability of the risk preference approach to explain differences in the structure of private versus public swaps.

The transaction cost approach points out that no contract specifies the responsibilities of the parties in exhaustive detail because at the margin the cost of doing so would outweigh the benefit (Barzel 1989, 64). A costly dispute can result as if an untreated contingency arises. Dispute resolution costs can be mitigated by choosing a structure that lowers the stake each party has in the disagreement and constrains their latitude for attempting to gain an advantageous settlement. Clauses that govern arbitration, choice of law and forum, and waiver of sovereign immunity all have this effect. Limiting a contract's duration and relying on reputation and repeat dealings also lowers each party's incentive to gain advantage, but at the cost of more frequent contract negotiation. Absent perfect monitoring, each party has an incentive to cheat on the contract's terms. Such behavior is sometimes difficult to detect while it is happening but becomes evident after the fact. If so, such opportunism can be forestalled by shortening a contract's duration and making it renewable, that is, using the mutual benefits of future exchanges as a performance bond.

Monitoring costs depend on the particular quantities and attributes of the contract specified. When outputs are difficult to observe precisely, a contract may focus instead on specifying inputs used and their methods of application. If inputs can be observed cheaply, this will reduce effort spent on monitoring, but at the cost of allowing the parties to act opportunistically in choosing the attributes of the final output. A similar strategy for mitigating transaction costs is to exploit patterns of complementarity and substitution. If party A wishes to limit B's use of a good that is very costly to monitor, A may find it best to subsidize B's use of a substitute. A related possibility arises when an asset provides services that simultaneity benefit two parties. For example, if protection of A's forest benefits party B and B prefers a degree of protection beyond what A provides independently, then B can gain by subsidizing part of A's protection expense.

Each of these transaction cost considerations arises in what follows. Private debt-for-nature contracts are examined first and then their structure is compared to public, government-to-government, swap contracts. The unpublished sources examined for each swap are listed in the Appendix to avoid cluttering the text with numerous citations. Since the format of private swap agreements has become somewhat standardized, a single representative agreement, between WWF and Costa Rica, is described in detail.

A Private Debt-for-Nature Contract

On March 20, 1990, the WWF, the Costa Rican Ministerio de Recursos Naturales, Energia Y Minitas (the Ministry), and the Fundacion de Parques Nacionales (the Foundation) agreed to the terms of a debt-for-nature swap in Costa Rica. The Ministry is a government resource management agency and the Foundation is a private Costa Rican conservation organization. The Central Bank of Costa Rica had agreed separately to exchange up to $10.8 million in Costa Rican external debt for domestic currency bonds issued specifically to fund conservation activities.

The six-page contract opens with preliminary statements referring to the country's unique natural resources, the Central Bank's intent to fund conservation projects, the conservation objectives of the parties, and a separate trust agreement that establishes a conservation fund and names a private bank as trustee. Next, the contract charges WWF to acquire Costa Rican debt instruments up to a specified limit and directs the Bank to exchange them for Costa Rican government bonds to be held in the conservation fund. The prescribed uses of funds are then delineated in broad terms: "administration, protection, and management of protected areas and their buffer zones," with more specific examples such as boundary demarcation, elaboration of management plans, training programs, development of infrastructure and activities related to environmental education. With these goals established the contract authorizes WWF and the Foundation to select, administer, and monitor specific projects. Conservation proposals are to be submitted by the Foundation and approval of funding requires WWF consent. The Foundation also is responsible for preparing budgets and reporting on activities completed. Con-

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9 Acquisition is sometimes complicated by debt rescheduling covenants that prevent one bank from selling a particular country's debt without the permission of the country's other creditors.

10 Allen and Loeen (1992) motivate their empirical analysis of contract choice for U.S. midwestern farms in much the same way as the normative content, however, because a given transaction may affect excluded parties (de Meza and Gould 1992).

11 Braverman and Stiglitz (1982) apply this general principle to the theory of sharecropping. The advantages of this strategy are greater if the substitute is easily monitored and the degree of substitution between the goods is high.

12 Such subsidies introduce new enforcement issues, however. If B offers, lump sum augmentation, A's provision might be reduced once B's contribution is secured. Alternatively, if B pays a share of A's cost and relies on the negotiation, A's demand curve for augmentation, B must monitor A's costs to ensure they are not inflated.

13 All contracts negotiated by WWF have the same structure; Barbara Hอกkinson (unpublished).

14 The target area is the Regional Conservation Unit of Tabalante, a mountainous area covering 12 percent of the country. The trust account is held by the private Banco Cooperativo Costarricense, R.L.

15 The face value of debt swapped by WWF was $55,488. Two other transactions, the Swedish International Development Authority and The Nature Conservancy, completed separate agreements amounting to $4.5 million and $9.25 million, respectively. The face value of the Costa Rican bonds obtained equalled 100 percent of the face value of the external debt exchanged, using the government's official exchange rate. The bonds pay interest at a fixed annual rate of 8 percent and mature in 20 years.
servation activities are to be directed toward a specific region of the country and one representative of the donor organization, WWF, is to be appointed to the government’s national parks coordinating commission for that region. The contract exists in both Spanish and English versions; the former is controlling in Costa Rican courts and the latter is controlling elsewhere. The contract ends with assurances that projects approved will be compatible with host government policies. Contracts negotiated by TNC follow a similar format.16

Subsidizing Enforcement of Another Party’s Ownership Claim

The general statements of allowed actions in debt-for-nature contracts indicate that these swaps often aim to enhance the delineation and enforcement of existing nominal property rights that are held by the host government. Developing countries often designate large tracts of land as government reserves but do not provide monitoring and enforcement—creating so-called paper parks.17 The prescribed uses of conservation funds in WWF and TNC contracts frequently include marking boundaries and establishing buffer zones for these parks, clearly enforcement actions (WWF, March 20, 1990; TNC, March 22, 1989). Formulating a management plan, another frequently prescribed action, also is a delineation of rights since it designates which uses are allowed.

Corroboration for this general point is found in the specific projects funded by debt-for-nature swaps. A WWF-Philippines swap explicitly directs expenditures to “help government crack down on illegal trading and exploitation of wildlife” on government land (WWF, June 1988). A WWF-Madagascar swap proposes to train, equip, and support over 400 park rangers and promotes actions intended to reduce illegal logging and poaching on government land (Sadler 1990, 333–34). WWF agreements with other countries aim to curtail poaching and spontaneous colonization (Hamlin 1989, 1078). The importance of enforcement is underscored in a WWF (March 5, 1990) compliance review of a 1988 swap in Costa Rica, which generally found the swap to be achieving its goals but noted that personnel often were distracted from assigned duties by the task of repelling invasions by gold miners into the protected area.

Similar features are prominent in a swap between TNC and the Dominican Republic (Marti, February 1990). One proposed conservation project cites indiscriminate hunting and fishing and continuous cutting of the dry forest in a national park, and calls for additional park guard and reinforced surveillance. A second project proposed increased resources for surveillance for reforestation and conservation projects.

International COs began defining and enforcing rights held by others long before the first debt-for-nature swap. In Costa Rica, WWF regards acquisition of legal title to additional land as a low priority and in the past has focused more on protecting government reserves from illegal users (WWF, “A Quarter Century in Costa Rica”). WWF has helped the park service evict and resettle illegal miners outside Corcovado National Park and followed with assistance in management planning and protection.18 What

16 A debt-for-nature agreement with Fundacion Natura in Ecuador (The Nature Conservancy, March 22, 1989) is typical of contract negotiated by TNC. It differs significantly from the WWF agreement in one respect, however; it allows Fundacion Natura, the Ecuadoran CO, to acquire and manage small nature reserves. See Hamlin (1989, 1065–70) for a clear description of swaps in Bolivia, Ecuador, Costa Rica, and the Philippines.

17 While parks and nature reserves make up 11 percent of Costa Rica’s land area, they are extensively used by miners, poachers, loggers, and farmers (World Wildlife Fund, “A Quarter Century in Costa Rica”). In Colombia more than 55 percent of lands designated as national parks are held by private owners, 20 percent are controlled by unmarked squatters who inhabited them before the parks were established, and another 30 percent is disputed by more recent settlers. Drug smuggling, guerrilla warfare, paramilitary operations, and conflicts among native groups and farmers all hamper government control (Anonymous 1992, 52–53.)

18 WWF has helped private individuals establish ownership to farmland in a region of Costa Rica where farmers typically do not legally own the land they farm. Costa Rican law normally requires them to cut the timber or otherwise clear the land to gain title, and WWF has supported an effort to drop this requirement.
makes such enforcement actions remarkable is that the parties undertaking them do not hold title to the assets protected. As a conservation strategy this approach allows the COs to gain partial control over how the land is used, but without acquiring title and confronting difficult sovereignty issues.

This aspect of debt-for-nature contracts suggests that swaps will be more frequent in countries where the paper parks phenomenon is common. This hypothesis is examined empirically in the following section.

*Delineating Inputs Rather Than Outputs*

One might expect a debt-for-nature contract to specify the degree of environmental protection to be attained because the swap’s donors are primarily concerned with preserving a specific environment. Basing a contract on delineation of outputs would be problematic, however, because environmental quality has many dimensions and is difficult to observe. Defining preservation during contract negotiation would be complicated, monitoring outcomes and judging compliance would be difficult, and disputes consequently would be likely. The CI-Bolivia swap, described later, illustrates these problems. Most debt-for-nature agreements focus on inputs instead, delineating activities to be undertaken and inputs to be supplied. The typical swap endows a fund and prescribes the kinds of conservation expenditure the fund can make. Specific project proposals are then described in terms of the amounts and uses of inputs to be supplied, for example, park guards hired, boundaries marked, and facilities constructed. Specifying a contract in terms of inputs rather than outputs is also costly since the input provider may shirk in providing the quantity and quality of inputs the purchaser desires. In debt-for-nature swaps, however, the advantages of this approach evidently outweigh these costs.

*Sovereignty, Foreign Ownership, and Contract Structure*

Debt-for-nature swaps seldom transfer ownership of land or resources. In those rare cases where land is purchased, the international CO that arranges funding avoids direct ownership by itself or other foreign agencies. The TNC swap in Ecuador in March 1989 resulted in the purchase of some land for the Maquipucuna Reserve, but title was received by the host country CO, the Fundacion Maquipucuna of Ecuador (TNC, February 6, 1990). A public swap between Costa Rica and the Netherlands resulted in land purchases to extend a national park, but title was retained by the Costa Rican government even though the Netherlands provided the funds. As argued later in discussing the CI-Bolivia swap, negative popular reaction to foreign ownership of a national park or reserve would make it politically costly for a government to enforce a foreigner’s legal claim. Since any such claims would be insecure, there is little incentive for the parties to incorporate them.

Questions of sovereignty and foreign ownership also impinge on the conservation fund and contractual obligations a debt-for-nature swap creates. Once the debt has been cancelled the CO must be concerned that the host government might seize the conservation fund, fail to service the bonds the fund holds, or renge on actions promised in the agreement. While a CO facing such a problem might bring suit to enforce the agreement, international law lacks concrete sanctions. International courts will rule to uphold clear contractual obligations, but they have no enforcement

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19 Popular opinion in debtor nations sometimes regards the debts accruing by past political regimes as illegitimate and some have objected to debt-for-nature swaps because they lend an air of legitimacy to the actions of former leaders (Anonymous 1991, 7). One Ecuadorian official remarked: “It is absurd to pay the debt . . . [In a few years there will not even be any point in negotiating on the debt and swaps will become meaningless” (quoted by Greener 1991, 168). The expected cost of repudiation presumably is reflected in the terms of the swap, e.g., the discount from the debt’s face value, the interest rate specified for the conservation trust fund, and so forth. The possibility of repudiation also increases the variance of returns. A risk averse CO can mitigate this variance by diversifying, making several small swaps in different countries. A “pay as you go” approach, wherein portions of the debt are canceled as conservation projects are completed, might also reduce the CO’s variance. This strategy is discussed shortly.
powers and the conservation groups who are likely litigants lack standing. Alternatively, a dissatisfied CO might consider bringing suit against a developing country swap partner in U.S. court. However, the U.S. Foreign Sovereign Immunity Act renders foreign states immune to such actions except where there is a direct effect in the U.S., and according to Sher (1993, 196–97) this exception would not apply to actions that only involve the foreign state's own resources.

Lacking credible third party enforcement, those negotiating debt-for-nature contracts have avoided provisions that might plausibly require a sovereign state to act against the self-interest of its leaders. In practice, this means that private swap contracts seldom include the host country's government as an active party. TNC's swap agreement in Ecuador is a contract between two conservation groups, TNC and Fundacion Natura. It refers to a prior policy by Ecuador's Monetary Board approving swaps of external debt for domestic currency bonds, but does not involve any government agency as a party with responsibilities. While WWF's debt-for-nature contracts include host government agencies as parties, they do not assign them responsibilities to carry out. Their agreements with Costa Rica name the Ministry of Natural Resources, Energy, and Mines as a party, but define no specific activities for it to undertake. Approval of specific projects only requires agreement between WWF and the Costa Rican CO. The contract requires, however, that selected projects be compatible with the Ministry's objectives—allowing the agency to veto specific projects without nullifying the entire agreement.

Overall, the contract structure that has evolved only requires that the host government not disrupt the swap's projects, and the likelihood of disruption is minimized by avoiding projects contrary to the government's self-interest. Though minimized, such conflicts might still occur. One factor that renders them more likely is changeability in the objectives of the host government or in the identity of its leaders. This suggests that swaps will be less likely in countries that are unstable politically or are ruled by individuals and cliques who could be deposed, and will be more likely in countries ruled by impersonal laws and constitutions. This possibility is examined empirically in the next section.

The Absence of Enforcement Mechanisms in Private Debt-for-Nature Swaps

In anticipation of disputes, contracts often include clauses that narrow the scope for costly opportunism in the settlement process. Such clauses may specify arbitration procedure, default remedy, waiver of sovereign immunity, and choice of forum. Despite the clear possibility of disputes in debt-for-nature swaps, none of the private contracts examined includes such conditions and none even mentions default or the chance that the agreement might fail. While Sher (1993) and others see this as a glaring omission, it can be explained by the kinds of disputes that are possible and the cost effectiveness of the enforcement options available.

To oversimplify slightly, a debt-for-nature transaction includes three parties: the international CO that raised money to buy the debt, the debtor government that promises to service the bonds that endow the conservation fund, and the local CO charged with using the fund for conservation projects. The international CO must relinquish the host country's debt in return for the government's promise to make payments into the fund. If the host government seizes the fund

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20 Only states can bring an action before the International Court of Justice. One might expect the U.S. to intervene on behalf of a U.S.-based CO seeking redress, but this possibility was ruled out when the U.S. surrendered its capacity to bring actions before this tribunal. This resulted from a dispute in the court's handling of a case brought by Nicaragua against the U.S., see Hrynuk (1990, 161).

21 It guarantees, however, that projects selected will be compatible with Ecuadorian government policies.

or fails to make interest payments, the international CO’s reputation with donors could be damaged. There are three ways the CO might deal with this possibility. The first is to take legal recourse, and if the international CO intends this then default remedies and sovereignty waivers should be included in the contract. The international group would have to rely on the debtor government and its courts to enforce these provisions, however, and there is little incentive for them to do so. One alternative strategy is to document any default that occurs and to “complain publicly and attract attention” (Gibson and Curtis 1990, 342).

To a degree, international CO’s specialize in such actions and their effectiveness is self-evident. Negative publicity, particularly if it influences the policies of lending or aid-granting agencies, is an inexpensive way to impose costs on any government that reneges and to advertise the costs of reneging to governments involved in other swaps. Another alternative is to adopt a “pay as you go” mechanism in the swap, canceling portions of the debt as conservation projects are completed. The debt cancellation mechanism in the Poland–Paris Club swap, a public swap discussed near the end of this section, effectively takes this approach.23

The international CO’s other risk is that the local CO might fail to perform, possibly by mismanaging funds or undertaking inappropriate projects. Bringing suit in the debtor country is again unattractive because the political cost of enforcing a claim would be high to the debtor government. The resources involved would be regarded as the patrimony of the debtor nation and the foreign plaintiff would have to argue that they are being mismanaged by the local conservation group. The international CO’s alternative is to avoid further swaps with the mis-performing local group, and to encourage other international COs to follow suit. Avoiding future swaps in a single country is, arguably, a low cost option for the international group. The developing world abounds with threatened environmental resources, so there are numerous substitute uses for donors’ funds. For the local CO that loses the reputation needed for future business, however, such a loss could be devastating. Again, a court remedy is the less effective alternative so contractual dispute resolution terms are not useful.

The host country faces risks as well, but they are not of the sort that could be mitigated by contract enforcement clauses. Its risks arise from the chance that the international or domestic CO will take an action that damages the government’s political relationship with constituents. Typical debt-for-nature contracts require the projects approved to be consistent with government policies, however, thus allowing the host government to suspend activities of the fund if they are unacceptable. This escape clause obviates the inclusion of common contract enforcement terms, given that the party at risk in this case is a sovereign and has a sovereign’s enforcement powers.24

An apparent exception to this rule is TNC’s swap with Panama in 1992, which includes enforcement terms. If Panama fails to service the conservation bonds as agreed, remaining interest and principal payments become payable immediately. Also, a specific forum is named for litigation in case of a dispute. Significantly, however, this swap was primarily funded by the U.S. Agency for International Development (AID) and was preceded by a debt relief agreement between AID and Panama. As a consequence, the U.S. government is “virtually a party” to this swap, and the substantial enforcement options available to it make strict enforcement more attractive than reliance on reputation alone.

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23 We are indebted to a referee for this observation. To our knowledge the pay-as-you-go option has not been incorporated in private swaps, possibly because they often involve only a single debt instrument.

24 Risks to the host country CO appear minimal, and are not of the variety that could be mitigated by explicit enforcement mechanisms. One might fear that a debt-for-nature contract would require the host country group to carry out projects it opposes. This is not the case, however, as typical agreements require host CO approval for all fund expenditures. Indeed, the contract typically grants the host conservation group operational control of the fund created while the international CO’s role is primarily one of oversight.
Finally, the omission of enforcement mechanisms in private debt-for-nature swaps is not simply an oversight by the international COs, since they include such clauses in other contracts they negotiate. While WWF’s debt-for-nature contract with the Philippines excludes dispute resolution clauses, WWF’s contract with a Hong Kong bank that executed the purchase component of the same swap explicitly requires the use of New York laws and courts for handling disputes. The telling difference is that in the latter case the CO’s counterpart was a bank, whereas in the former case it is a sovereign nation.

Comparing Recent Practice to the CI-Bolivia Swap

While the contract structure described to this point is now common, the first debt-for-nature swap, between Conservation International (CI) and Bolivia, took a different approach. Numerous authors have commented on the problems it encountered (Gibson and Curtis 1990; Hamlin 1989; Hryniuk 1990) and it is instructive to compare the nature of these problems to the way the transaction was structured. First, the CO-Bolivia deal sought a redefinition of the legal status of land in the swap’s target area, the Beni Biosphere Reserve, and thus stressed assigning nominal title over augmenting enforcement. The Government of Bolivia agreed to grant the reserve the highest degree of legal protection and to designate three adjacent areas as buffer zones. Legislation to enact these redefinitions was delayed, however. Just before the swap was completed the Bolivian government granted logging concessions in the buffer zone. Timber was harvested without the required reforestation and the resulting logging roads invited free access colonization. Apparently, the Bolivian government lacked the incentive to aggressively enforce nominal property rights to the reserve before the swap, and the swap did nothing to change this. Before and after the swap, control of the buffer zones was contested by timber companies, indigenous Indians, and coca growers. As explained earlier, debt-for-nature swaps that followed stressed augmenting enforcement over establishing nominal title.

Second, the CI-Bolivia deal leaned toward delineating outputs rather than inputs. Hamlin (1989, 1076–77) points out that the CI-Bolivia contract intended to achieve a “sustainable development” outcome in the Beni Reserve region. The agreement’s first clause states that CI will, among other aims, promote sustained use of resources and the third requires the government to “develop activities favoring conservation and sustained use of natural renewable resources.” The parties evidently disagreed over whether the logging concessions and failure to reforest violated the meaning of “sustained use.” The new common practice of specifying inputs rather than outputs in debt-for-nature contracts may well have avoided this disagreement.

Issues of foreign ownership and sovereignty also were prominent in the CI-Bolivia swap. When the deal was signed the Bolivian press reported, incorrectly, that CI had been granted ownership of part of Bolivia’s forests. A Bolivian government official added fuel by joking that anyone who forgave Bolivia’s $4 billion debt could have half of the country, and this made the news as well (Page 1990, 277). The ensuing public outcry and political crisis illustrated the importance of avoiding any appearance of foreign ownership in debt-for-nature swaps. Further, the Bolivian government was an active party with key responsibilities since the contract stipulated that it would enact land use legislation and set up a fund to finance expenses associated with managing the area. The required legislation was delayed and the government’s contribution to the fund was 21 months late, causing a substantial loss in interest income (Gibson and Curtis 1990, 355–58; Green 1991,

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25 CI’s view of sustainable development in this case is the preservation of a core area for scientific observation, surrounded by buffer zones used for sustainable agriculture and logging and as homelands for the nomadic Chamane Indians; see Hamlin (1989, 1076–77) and Gibson and Curtis (1990, 353–56). The following descriptions and quotes from the CI-Bolivia contract are taken from Hamlin (1989, 1076).
164–67). CI had little recourse because its counter-party was a sovereign state. Subsequent swaps have minimized the contractual obligations of host governments.

Transaction Costs and the Structure of Public vs. Private Swap Contracts

One of the central claims is that the enforcement terms specified in debt-for-nature contracts reflect the enforcement options available to the participants. This point is illustrated by a comparison of public and private debt-for-nature contracts. The private swap contracts discussed to this point rely on reputation and repeat dealings rather than strict contract terms for enforcement, and we argue that this is due to the weak enforcement options available to COs. In public swaps the parties giving up debt are developed country governments and their potential enforcement options are much broader—withstanding future aid, influencing the lending and aid-granting policies of other nations and organizations, imposing trade sanctions, and seizing debtor nation assets. Since more effective and less costly enforcement mechanisms are available to those participating in public swaps, the net benefit of including explicit dispute remedies in contracts is commensurately greater. Public swaps are therefore expected to rely more heavily on contractual enforcement terms and less on the force of reputation.

The first government-to-government swap between Costa Rica and the Netherlands illustrates this point. It went beyond the private swap paradigm in its inclusion of enforcement and compliance provisions (Sher 1993, 170). The Netherlands retained effective control over how funds are spent and could force suspension of any project if it found contrary to the swap's agreed specifications. This control resides in a clause that both parties must agree on all spending decisions and either may stop funding for any ongoing project if it finds objectionable. Further, the Netherlands had earlier funded conservation projects in Costa Rica that were in progress when the debt-for-nature swap became effective. These ongoing projects gave the Netherlands a lever—project suspension—to apply if a dispute arose.

Contracts for the nine Enterprise for the Americas Initiative (EAI) swaps also illustrate this point since they include safeguards and default provisions to protect the party releasing the debt, the U.S. government. The swap's environmental fund is required to be free from taxation or other charges by the host government. Interest payments are due as soon as the document is signed and are deposited in escrow until the conservation fund is created. Failure to establish the fund within 12 months causes the escrow fund to be immediately payable to the U.S., in dollars. If the agreement is terminated for any reason by either party, remaining interest obligations on the debt become payable to the U.S., in dollars. If a dispute arises either party may request consultation. If either party finds the outcome of consultation unsatisfactory, the fund is frozen and all remaining obligations become payable to the U.S., in dollars. Either party may terminate the agreement on six months notice, but if this occurs the same dispute remedy is applied.

The Poland–Paris Club deal, another government-to-government swap, also leans in the direction of explicit enforcement terms (Sher 1993, 185).26 The fund's voting rules and the makeup of its governing board imply that creditor governments can collectively block any expenditure proposal. In addition, each creditor nation can choose the monitoring actions to be taken in evaluating projects funded by debt it donates. While the Poland–Paris Club swap does not contain explicit dispute remedies, a clever debt transfer mechanism eliminates problems of fund seizure or nonpayment. In effect, the Polish swap does not result in debt cancellation at all. Rather, a participating creditor country simply elects to have interest payments made to an escrow account at the Bank of International Settlements in Switzerland, and it is this bank account that the swap's governing board

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26 The following descriptions are from publications of the Polish EcoFund, listed in the Appendix.
controls. If Poland violated the contract, its loan payment obligation to creditors would not disappear, but creditors would have the right to veto use of the fund to support projects in Poland. Likewise, there is no threat of fund seizure since the fund is in a third country.

Compared to private contracts the enforcement terms in these public swaps are highly explicit. Furthermore, they tend to avoid canceling the host's debt obligation until conservation measures are completed.

Risk Preference and the Structure of Public vs. Private Swap Contracts

The risk preference approach to contract structure predicts that contracts evolve to minimize the aggregate cost of risk bearing and to allocate risk toward those parties who can bear it with least cost. The information available allows only a rough assessment of how well the risk preference argument fits the actual pattern of contract adoption. We have stylized information on the form of the private versus public swap contracts, and this permits us to assess the variance in returns to the parties under the two contract structures. Also, it seems plausible to us that COs are more risk averse than developed country governments in the sense of assigning a higher risk cost to any given gamble. Assuming this to be true, considerations of risk would tend to make COs more likely, and developed country governments less likely, to adopt the contract structure with the lower payoff variance. We examine this hypothesis in what follows.

The differences in contract terms for private and public swaps that are salient for assessing risk are as follows. With the private contract form, denoted with the subscript 0, the host country obtains cancellation from the environmental protection purchaser before any environmental funds are spent. Once the debt is canceled the purchaser has no recourse if the exchange fails. Under the public contract form denoted 1, the purchaser does not relinquish the debt until environmental funds are spent. Let \( \pi \) be the probability of an exogenous event that causes the exchange to fail, and assume this probability is independent of the form of the contract. Let \( E \) denote the level of environmental expenditure promised by the host under either contract. Let \( D_0 \) and \( D_1 \) represent the amounts of debt canceled under the alternative contracts. The purchaser's payoff from a swap of type 0 is \( E - D_0 \) with probability \( 1 - \pi \) and \(-D_0 \) with probability \( \pi \). With a type 1 swap it receives \( E - D_1 \) with probability \( 1 - \pi \) and zero with probability \( \pi \). The variances of the purchaser's returns with type 0 and 1 contracts are, respectively, \( \pi(1 - \pi)E^2 \) and \( \pi(1 - \pi)(D_1 - E)^2 \). The variance with the type 0 contract is lower than with the type 1 contract if \( E/D_1 < 1/2 \), and higher if \( E/D_1 > 1/2 \).

It is difficult to judge the direction of the inequality in actual swaps to date. The relevant value of \( D_1 \) is the dollar cost to the host of having the debt outstanding. For debt traded on secondary markets the relevant figure is probably close to its secondary market value, since that is the market's assessment of the host's expected future payments. All of the swaps using contract form 1 have involved debt owed to developed country governments, however, and this debt is not traded, so market values are not observed directly. Suppose, however, that the ratio of market value to face value for this debt is the same as for debt owed to private institutions.

\[ ^{27} \text{We are indebted to a referee for suggesting the following development.} \]
\[ ^{28} \text{This would be true if both share a utility function that exhibits decreasing absolute risk aversion, since a given swap represents a far greater share of wealth for the CO than for a developed country government.} \]

The contract with the lower variance in returns need not be adopted in all cases. Some factor other than risk may favor one contract over another. Differences in risk bearing costs may be sufficient to offset this factor for a swap involving a very risk averse party, but not for one involving a less risk averse party. Also, we ignore the cost of risk bearing to the host country. Since host countries are observed to carry out exchanges with both COs and developed governments, we assume they are indifferent at the margin to swapping with either type of party. That is, their expected utility is the same for swaps with either COs or developed governments.
banks, or about 0.26. Then the market value of debt retired in the 11 public swaps described in Section II would be $234 million. The value of conservation fund generated is $181 million, implying $E/D_1 = .77$. The variance in returns thus appears lower under contract type 1.\textsuperscript{30}

On the basis of this admittedly imprecise information, it appears that contract type 1, the pay-as-you-go contract, involves a lower variance in returns than contract type 0. In other words, the contract form used by COs appears to have a higher variance in returns than the contract form used by developed country governments. Assuming, as we believe is appropriate, that COs are more risk averse than developed governments, this pattern runs counter to what one would expect from simple risk preference considerations. Overall, the available evidence indicates that transaction cost considerations provide a stronger rationale for the match between contract form and swap participants actually observed.

Other Considerations

The question of “additionality,” whether the funds a swap provides will augment or replace existing conservation expenditures, has concerned several observers. Additionality is not addressed in private swap contracts, possibly because host government expenditures on such conservation activities generally are very small \textit{ex ante}, so no significant replacement is possible.\textsuperscript{31} In contrast, the additionality principle is a central feature of the Polish swap (Zylicz 1992, 14), perhaps because Poland’s own outlay for environmental protection is substantial. Since additionality is difficult to determine on a project-by-project basis, it is judged to be satisfied in a given year if Poland’s own-source environmental expenditure exceeds its 1991 outlay.

One common feature of private and public swap contracts has not been discussed, the stress placed on environmental education and other programs to promote positive public opinion toward conservation. WWF contracts support training cadres of conservation professionals, university training programs, and other community environmental education efforts. Some TNC and CI agreements support similar actions and EAI contracts list “training programs to strengthen conservation institutions” and efforts to “enhance public commitment to conservation” as major goals. This can be seen as a low profile way for donors to influence long-run behavior in the host country, by enhancing the economic and political clout of local conservation groups that share the donor’s conservation philosophy.

IV. WHAT DETERMINES THE OCCURRENCE OF DEBT-FOR-NATURE SWAPS?

Debt-for-nature swaps have been concentrated in a fairly small number of developing countries. It is of interest to determine if there are attributes of countries that predispose them to become involved in environmental protection agreements with the developed world. Some potential factors are obvious, for example, intuition suggests that swaps should be most likely in countries where threats to species and other environmental resources are most acute and in countries with heavy debt burdens. The discussion of debt-for-nature contracts suggests additional possibilities—swaps may be more prevalent in countries where paper parks are common and in countries where a stable rule of law is well established. This reasoning is developed in more detail in

\textsuperscript{30} Both dollar figures are simple, undiscounted, sums of payments. The information needed to compute present values is unavailable. The 11 public swaps that retired debt owed to the U.S., Sweden, and the Netherlands involved debt with a face value of $904.8 million and generated conservation expenditures of $181 million. The Poland–Paris Club swap involved debt of $460 million face value, traded for environmental spending of the same amount. Taking the face value as the debt’s market value in this case raises the ratio to $614/694 = 0.92$.

\textsuperscript{31} As noted earlier, swap funding for protection of Costa Rican and Ecuadorian national parks is large relative to host government expenditures. The Costa Rica–Netherlands contract states that funds will complement, not replace. Costa Rica’s expenditure on forestry, but contains no criteria for compliance.
this section and is tested with appropriate data.

Our empirical analysis focuses on the probability that a swap occurs in a given country. By hypothesis, this probability depends positively on the potential aggregate gain to all participants, net of transaction costs. First, consider the CO's motives. The benefit a CO anticipates from gaining partial control of a parcel of undeveloped land in country \( i \) depends on how well the conservation opportunities in country \( i \) match the CO's conservation preferences. While individual swaps involve specific land parcels with specific attributes, the probability that a CO will find at least one suitable target site somewhere in the country \( i \) is related to the menu of conservation choices the country offers, and this depends on its countrywide environmental attributes. The following general environmental measures are potentially relevant: the percent of the country's land classified as "tropical," numbers of threatened bird species and plant taxa per hectare, and the recent rate of deforestation. We use the first of these directly and combine the other three into an index of the threat to species, calculated as the number of threatened plant taxa and bird species per hectare multiplied by the share of land deforested during 1981–85. The deforestation rate is the countrywide average probability that an acre of forest land will be converted to agriculture or wasteland in a given period. Multiplying this rate by the density of threatened species gives a measure that is increasing both in the rate of habitat loss and in the density of threatened species. The fact that debt-for-nature swaps often subsidize enforcement in paper parks suggests that the percent of a country's land area that is nominally in protected status may also affect the occurrence of swaps, so we test for the significance of this effect as well.

The country hosting a debt-for-nature swap stands to gain debt relief, at the cost of ceding control to a portion of its land area. If the host country's outstanding debt is large relative to its ability to repay, it may be denied access to credit markets. Because debt reduction can remove this constraint, a heavily indebted country may assign a shadow value to debt reduction that exceeds the debt's market value. This indicates that debt-for-nature swaps may be more likely in countries with heavy debt burdens relative to repayment capacity. We examine two debt burden measures that have been used in the empirical literature on sovereign debt. The first, the ratio of annual debt service obligations to exports, measures the country's solvency. Regarding the cost to the host of ceding control of land areas, we postulate that the foregone alternative use for land protected by debt-for-nature swaps usually will be agriculture. This suggests that the cost of setting aside land will be relatively high, and swaps therefore relatively infrequent, when the demand for agricultural land is intense. This possibility is examined by testing whether the occurrence of swaps is related to the share of the work force in agriculture.

If transactions were costless and free from default an exchange would occur whenever the sum of the net gains to the two parties is positive. The cost of negotiating and monitoring the exchange subtracts from the potential net gain. Also, the contract might fail if an unforeseen circumstance arises or if either party takes an action that violates its terms. For example, the host government might decide to stop payment into the fund

\[ ^{32} \text{That is, we treat buyers of environmental protection in developing countries as indistinguishable and model the probability of a swap in a given country as a function of country characteristics. Detailed definitions of variables and data sources are presented in the Appendix.} \]

\[ ^{33} \text{Habitat loss resulting from deforestation is considered an important source of species loss.} \]

\[ ^{34} \text{A high proportion of nominally protected land might indicate strong prospects for subsidizing enforcement. Alternatively, it might indicate little need for further protection if the host country's protection of such areas is effective. Hence, the sign on this variable in the probability of a swap could be either positive or negative. The institutional literature strongly suggests that it is positive, however.} \]

\[ ^{35} \text{See Murphy (1994). Direct repurchase of one's own debt at a discount typically is prohibited by loan contracts and debt rescheduling agreements.} \]
or the CO might initiate a project contrary to the host country’s national policies. In this case the cost of negotiating the contract is lost.\textsuperscript{36} Contracts are postulated to be least secure when contract enforcement and the judicial process in the host country are controlled by individuals or cliques rather than laws, constitutions, and anonymous legal institutions, and when the host government is vulnerable to overthrow.\textsuperscript{37} To test for the rule of law we construct a categorical variable that equals one when a country is ruled by an unelected executive, such as a military dictator or monarch, or when it has an elected executive but lacks an effective legislature.\textsuperscript{38} Swaps are expected to be less common in such regimes. To test for the effect of political instability on swaps four indicators of instability are examined: frequencies of political assassinations, riots, political purges, and instances of guerrilla warfare.

To summarize, the net gain from a debt-for-nature swap in country $i$ is modeled as

$$G_i = G(E_i, D_i, A_i, P_i; \beta) + \epsilon_i$$  \hspace{1cm} [1]

where $E_i$ is a vector of environmental variables, $D_i$ is a vector of debt burden indicators, $A_i$ is the share of the work force in agriculture, $P_i$ is a set of political characteristics, $\beta$ is a parameter vector, and $\epsilon_i$ is a random disturbance that captures omitted factors. Although $G_i$ is unobserved, it is known whether or not a transaction occurs. A dummy variable $S_i$ indicating the occurrence of a swap is defined as:

$$S_i = 1 \text{ if } G(E_i, D_i, A_i, P_i; \beta) > 0,$$
$$S_i = 0 \text{ otherwise.}$$  \hspace{1cm} [2]

Assuming $\epsilon_i$ to be normally distributed, $\beta$ can be estimated up to a constant of proportionality by probit methods. For countries that have participated in swaps, we also observe the number of swaps completed. Postulating that the number of swaps completed in a country, $N_i$, is positively related to the gain, $G_i$, suggest the specification:

$$N_i = N(G(E_i, D_i, A_i, P_i; \beta)) \text{ if } G(\cdot) > 0,$$
$$N_i = 0 \text{ otherwise,}$$  \hspace{1cm} [3]

which can be estimated by tobit methods.\textsuperscript{39} The models in equations [2] and [3] are both estimated in what follows.

Empirical analysis is based on data for over 100 countries. Countries classified by the World Bank as “high income” are excluded. Lack of data on environmental attributes and debt burdens reduces the sample further to 75 countries. This sample includes all but one (Poland) of the countries that had completed debt-for-nature swaps through 1992 and includes most nations normally described as “developing.” In empirical analysis we first include only private swaps in $S$ and $N$. We then reestimate probit and tobit models after redefining the dependent variables to include both private and public swaps, and test whether including public swaps causes significant changes in the coefficients.

\textsuperscript{36} The payment stipulated in the swap presumably is shared by the parties in some fashion in such cases. It is possible, however, that either or both parties lose something that is not gained by the other when such an agreement fails, e.g., a loss in reputational capital.

\textsuperscript{37} Countries that lack stable political institutions find it difficult to make credible long-term commitments because honoring a contract’s provisions may not be in the self-interest of the regime in power at a future date. Similarly, if regimes change frequently then no single regime will find it worthwhile to build up reputational capital to act as an implicit bond, forfeited if its promises are not kept. Aldous (1992, 290) and Roberts (1991, 1143) argue that Costa Rica’s stable democratic government has been an important ingredient in the biodiversity contracts it has negotiated with pharmaceutical firms. Similarly, TNC’s Randall Curtis (personal communication, April 1992) notes that their consideration of a swap involving Peru was tabled after the Fujimori government suspended Peru’s constitution and legislature.

\textsuperscript{38} The categorical variable for political regime also equals one in situations of anarchy—when no effective government control can be identified.

\textsuperscript{39} Tobit estimation is employed because of the censored sample; that is, the frequency of swaps is observed only if a swap occurs. As a result, the conditional expectation of the error term is non-zero and least squares estimates are biased and inconsistent.
<table>
<thead>
<tr>
<th>Variable</th>
<th>All Countries</th>
<th>Private Swaps Only</th>
<th>Private &amp; Public Swaps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Swap Completed</td>
<td>No Swaps</td>
<td>Pr &gt;</td>
</tr>
<tr>
<td>Number of countries</td>
<td>75</td>
<td>11</td>
<td>64</td>
</tr>
<tr>
<td>Environmental attributes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical land (share)</td>
<td>.79</td>
<td>.94</td>
<td>.77</td>
</tr>
<tr>
<td>Threatened species index</td>
<td>.80</td>
<td>2.98</td>
<td>0.42</td>
</tr>
<tr>
<td>Land area protected (%)</td>
<td>4.82</td>
<td>7.06</td>
<td>4.43</td>
</tr>
<tr>
<td>Debt burden</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt service/exports</td>
<td>.18</td>
<td>0.24</td>
<td>0.16</td>
</tr>
<tr>
<td>Debt/GDP</td>
<td>.82</td>
<td>1.01</td>
<td>0.78</td>
</tr>
<tr>
<td>Land use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor force in agric. (%)</td>
<td>60.1</td>
<td>49.5</td>
<td>61.9</td>
</tr>
<tr>
<td>Political indicators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondemocratic regime</td>
<td>.67</td>
<td>0.27</td>
<td>0.73</td>
</tr>
<tr>
<td>Guerrilla warfare</td>
<td>.23</td>
<td>0.20</td>
<td>0.23</td>
</tr>
<tr>
<td>Political ass'ns.</td>
<td>47.37</td>
<td>97.47</td>
<td>38.62</td>
</tr>
<tr>
<td>Riots</td>
<td>.57</td>
<td>0.54</td>
<td>0.57</td>
</tr>
<tr>
<td>Political purges</td>
<td>.06</td>
<td>0.03</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Notes: Sources are listed in the Appendix. Detailed definitions of the threatened species index, nondemocratic regime indicator variable, and political instability measures are provided in the Appendix. Probability levels are for two-tailed tests of the null hypothesis that mean attributes for swapping and non-swapping countries are equal. Each test is based on data for 75 countries.

*Indicates less than .005.

Table 1 provides summary statistics. It also compares mean attributes for swapping versus non-swapping countries and gives test results for the null hypothesis that the means are equal in the two groups. Results labeled “private swaps only” count as swapping countries only those that had completed swaps with private COs. The next set of three columns give means and test results when countries completing public swaps are included. The differences in mean environmental, debt burden, and land use attributes are in the expected direction in all 12 comparisons. Five of these differences are significant at 5 percent and two more are significant at 10 percent. The nondemocratic political regime indicator is significantly different in swapping and non-swapping countries for both sets of comparisons, and the difference is in the expected direction. Differences in means for the four indicators of political instability are insignificant in all eight comparisons.

Table 2 reports results from estimating the probit and tobit models. In estimating these models we started with a specification that included, as explanatory variables, percent tropical land and the threatened species index as environmental indicators, the two debt burden measures, the percent labor force in agriculture, and the nondemocratic regime indicator. The percent labor force in agriculture was found to be insignificant (at 10 percent) in all four equations and was dropped from all specifications. Next, tests were conducted on the hypotheses that percent land area protected could be added to the basic specification. The null hypothesis that its coefficient is zero could not be rejected (at 10 percent) in any of the four models, so it was not added to the specification. Finally, the hypothesis that the set of political violence measures could be added as a group to the basic specification was examined. In both probit and tobit models the hypothesis that the coefficient vector for these variables is zero could not be rejected at 10 percent, so they were not added.

The signs of all coefficients are consistent with expectations and each variable is significant in at least two of the models estimated. For the probit estimates we re-
TABLE 2
PROBIT AND TOBIT ESTIMATE OF OCCURRENCE OF SWAPS

<table>
<thead>
<tr>
<th>Variable (expected sign)</th>
<th>Probit Estimates</th>
<th>Tobit Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Private Swaps Only (Coefficient)</td>
<td>Private &amp; Public Swaps (Coefficient)</td>
</tr>
<tr>
<td></td>
<td>(Marginal Effect)</td>
<td>(Marginal Effect)</td>
</tr>
<tr>
<td>Tropical land share (+)</td>
<td>2.7895* (1.56)</td>
<td>.9272 (.1916)</td>
</tr>
<tr>
<td></td>
<td>.6406 (.3604)</td>
<td>.2497 (.6538)</td>
</tr>
<tr>
<td>Threatened species index (+)</td>
<td>.2291 (.0378)</td>
<td>.1784 (.0472)</td>
</tr>
<tr>
<td></td>
<td>.0526 (.0378)</td>
<td>.0518 (.0472)</td>
</tr>
<tr>
<td>Debt service/exports (+)</td>
<td>9.0158** (3.48)</td>
<td>2.0707 (2.89)</td>
</tr>
<tr>
<td></td>
<td>.7987 (.7897)</td>
<td>.8346 (.8398)</td>
</tr>
<tr>
<td>Debt/GDP (+)</td>
<td>.6100* (0.37)</td>
<td>.5724* (0.34)</td>
</tr>
<tr>
<td></td>
<td>.1404 (.0839)</td>
<td>.1665 (.0997)</td>
</tr>
<tr>
<td>Nondemocratic regime (-)</td>
<td>- .9281* (0.53)</td>
<td>-1.2461* (0.46)</td>
</tr>
<tr>
<td></td>
<td>- .2460 (.1396)</td>
<td>- .4012 (.1479)</td>
</tr>
<tr>
<td>Constant</td>
<td>- .5615 (2.01)</td>
<td>-3.1064 (1.06)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chi square (S)</td>
<td>27.08</td>
<td>30.51</td>
</tr>
<tr>
<td>Pr &gt; Chi Square</td>
<td>0.0001</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Note: Each equation has 75 observations. Numbers in parentheses are standard errors. * denotes significant at 10 percent and ** denotes significant at 5 percent. Marginal effects are evaluated at sample probability of a swap.

...port both probit coefficients and the marginal effects on the probabilities of a swap, evaluated at the sample swap probability. The results obtained for private swaps and for all swaps are very similar. The only difference is in the effect of tropical land on swaps. Evidently, developed country governments undertaking public swaps do not emphasize conservation in tropical climates to the degree that COs do. This holds for both the probability and the frequency of swaps.

The non-nested structure of the models makes conventional hypothesis tests for differences in estimated coefficients between the "private swaps" estimates and "all swaps" estimates difficult to perform. 40 However, we performed a crude test for equality of the probit coefficients across models by first testing whether the individual coefficients for private swaps are significantly different from the point estimates for all swaps, and then performing the test in reverse. This revealed that the "tropical land" coefficient from the total swap probit equation differs significantly from its counterpart in the equation for private swaps. The tobit models yielded similar results—coefficients for the tropical land variable differ significantly but none of the other coefficients do.

Because coefficients from probit regressions are not readily interpretable, it is instructive to consider the marginal effects from the probit regressions as well. The marginal effects presented in Table 2 indicate the change in the probability of a swap, given a marginal change in an independent variable, evaluated at the sample swap probability. Thus, in the case of private swaps a 1 percent increase in tropical land area increases the probability of a swap by .6406 percent. To gauge the sensitivity of predicted swap probabilities to these determinants, it is more revealing to look at the effect of changing each determinant by one standard deviation. 41 Using this measure,

40 To test the hypothesis that the two models have the same coefficient vector would require an estimate of the covariance matrix across the two equations, a task that is beyond the scope of the paper.
41 Each marginal effect actually gives the change in the probability of a swap from an infinitesimal change in the independent variable. The reported changes in probabilities from one standard deviation changes are therefore approximations.
the effect on the probability of a private swap of a one standard deviation increase in percent tropical land is to increase it by 22 percent. Regarding the other determinants, the effect on the probability of a private swap from a one standard deviation increase, with the standard deviation in parentheses, is: 12 percent for the threatened species index (2.28), 14 percent for debt service/exports (.07), and 8 percent for debt/GDP (.59). The marginal effect of a nondemocratic regime is to reduce the probability of a private swap by 25 percent. The marginal effects of these determinants on probabilities of private plus public swaps are generally similar. There are two exceptions, however. When public and private swaps are considered jointly, the effect of a one standard deviation increase in tropical land on swap probability becomes less important, falling to 8 percent; the effect of nondemocratic regime becomes more important, reducing swap probability by 40 percent.

To interpret the effect of these determinants on the number of swaps it is useful again to consider the effect of a one standard deviation increase in individual determinants on the expected number of swaps completed in a country. Based on the tobit estimates for private swaps, these marginal effects are: 1.86 for tropical land, .58 for threatened species, 1.08 for debt service/exports, and 0.52 for debt/GDP. The effect of a nondemocratic regime is to reduce the number of swaps undertaken, on average, by 1.45. Tobit effects for all swaps are again similar, except that the effect of tropical land is reduced by about two-thirds and the effect of a nondemocratic regime becomes more important.

Overall, these results indicate that the factors considered are not just significant statistically, but also are important quantitatively.

V. CONCLUSIONS

Aside from explaining what debt-for-nature swaps are, our aims here were twofold: to learn what debt-for-nature swaps can teach about structuring transactions in environmental services and to understand what makes some developing countries more likely to participate in such environmental agreements than others. Regarding the first, the common structure of debt-for-nature contracts appears a rational vehicle for mitigating the transaction costs inherent in such exchanges. For the most part, debt-for-nature contracts rely on delineation of inputs rather than outputs, reflecting the high costs of unambiguously measuring outputs of environmental services. Existing swaps also indicate that the constraining factor in completing ownership rights to environmental resources in developing countries is not the legal assignment of title, but rather the degree of enforcement practiced on existing nominal claims. As evidence, the specific actions mandated in swaps often amount to augmentation of enforcement for claims that already exist on paper.

The international scope of debt-for-nature swaps is a complicating factor. Third party enforcement of an agreement is hampered if one of the parties to a contract is a sovereign state. In response, debt-for-nature swaps typically do not include host government agencies as parties with substantive responsibilities, and they limit prescribed actions to those that are consistent with the interests of host nations. When the group donating debt is an international CO, available enforcement measures are largely limited to applying political pressure and to withholding future contributions. Accordingly, remedies for default are not included in such contracts. In public swaps, on the other hand, the donor is a developed country government and the associated contracts reflect a government's broader enforcement options.

Some have argued that rewarding a host country for protecting its environmental resources can have a perverse effect, in that

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42 The distribution of tropical land share in the sample of countries is highly skewed toward 1.0, so the hypothesized one standard deviation increase is not terribly relevant in this case.

43 Again, the skewed distribution of tropical land shares diminishes the relevance of a one standard deviation increase.
the host country might threaten to degrade its resources in order to receive a reward for protecting them. Our interpretation of the experience to date with debt-for-nature swaps does not indicate that this is a problem. The recent rapid loss of species and natural habitat is a widespread phenomenon, so there are numerous countries in which an interested donor can pursue environmental preservation. An individual host country is more in the position of a price taker than a monopolist in the market for habitat and species protection. This interpretation is reinforced by the fact that NGOs and developed country governments have entered into swaps with 19 different host countries to date, including nations as diverse as Costa Rica, the Philippines, Nigeria, and Poland. In addition, the voluminous institutional literature that now exists on debt-for-nature swaps does not report any instances of host countries threatening destruction of resources to obtain favorable swap terms.

Only limited data are available to assess what factors determine participation in debt-for-nature swaps, but the results obtained reveal interesting patterns. As expected, tropical countries with large numbers of endangered species are likely candidates. Also, countries that face high debt service burdens are significantly more prone to swap debts for nature than otherwise similar nations, possibly indicating the effect of credit constraints. Finally, debt-for-nature swaps also are more common when the host government is democratic than otherwise, which lends empirical support to a factor that those directly involved in swaps have noted in anecdotes.

While the number of swaps completed is growing, the sums involved are so small that it is unrealistic to expect debt-for-nature exchanges to significantly affect the amounts developing nations owe. The funds generated often represent substantial augmentations to environmental protection in the nations involved, however. Beyond any practical environmental effect they have, debt-for-nature swaps are valuable on methodological grounds. They aid our understanding of the transaction costs involved in international environmental agreements and provide insight on the degree to which these costs can be mitigated by structuring contracts appropriately.

APPENDIX

I. SOURCES OF INFORMATION ON CONTRACT STRUCTURE

The information sources used in studying the structure of debt-for-nature transactions are too numerous and varied to cite compactly in the text. These sources are listed in what follows, by swap, for each transaction studied. Private swaps are listed first, then public swaps. The list gives the host country and principal donor involved, the date, the amount of debt cancelled, and the information sources examined. This listing excludes citations to more general works, for example, academic journal articles, referenced in the text. All of the items noted below are available from the authors on request.

Bolivia–CI Swap: July 1987, $650 million debt swapped.


Costa Rica–WWF Swap: March 1988, $5.4 million debt swapped.


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44 A quick review of statistics on biodiversity shows that there are threatened mammals, birds, and higher plants in virtually all countries. See World Resources Institute (1994, Table 20.4).
Philippines–WWF Swap: June 1988, $39 million debt swapped.


Ecuador–TNC Swap: March 1989, $9 million debt swapped. This swap also involved WWF and the Missouri Botanical Garden.


Zambia–WWF Swap: August 1989, $2.3 million debt swapped.


Poland–WWF Swap: January 1990, $50,000 debt swapped.


Costa Rica–WWF Swap: March 1990, $10.8 million debt swapped. This swap also involved funds donated by TNC and the Swedish International Development Agency.


Dominican Republic–TNC Swap: March 1990, $582,000 debt swapped.


Letters dated January 2, 1990, and January 22, 1990, from Domingo Marte to Randy Curtis, The Nature Conservancy. (Description of alternative structures for proposed swap agreement.)


Madagascar–CI Swap: May 1990, $1.18 million debt swapped to date.


Madagascar–WWF Swap: August 1990, $9 million debt swapped.


Mexico–CI Swap: February 1991, $1.3 million debt swapped.


for the Jamaica National Park Trust Fund." Arlington, VA. (Funding proposal.)

Panama–TNC Swap: January 1992, $30 million debt swapped.


Guatemala–CI Swap: May 1992, $5 million debt swapped.


Brazil–TNC Swap: May 1992, $2.2 million debt swapped to date.


Costa Rica–Netherlands Swap: July 1988, $33 million debt swapped.


Chile–U.S. Swap (EAI): February 1992, $15.9 million debt swapped.


Poland–Paris Club Swap: April 1992, debt swap limit approximately $3 billion.


General Information Sources: Unpublished sources that provided information on more than one swap.


II. DATA SOURCES AND DEFINITIONS

Political variables were taken from:


Information on debt was obtained from:


Information on environmental and climate indicators was obtained from:


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**APPENDIX TABLE 1**

**DEFINITIONS OF VARIABLES**

- Tropical land share: Share of land where mean monthly temperature exceeds 18° C, corrected for altitude.
- Threatened bird species and plant taxa: Defined by World Conservation Union to include species whose extinction is either imminent or foreseeable unless causal factors change. See World Resources Institute (1993, 330) for further detail.
- Land area protected: Percent of land "totally protected" or "partially protected" as defined by the World Conservation Union. See World Resources Institute (1993, 310).
- Guerrilla warfare: The presence of any armed activity, sabotage, or bombings carried on by independent bands of citizens or irregular forces and aimed at the overthrow of the present regime; coded as 1 if an event is recorded in a given country and year.
- Political assassination: Any politically motivated murder or attempted murder of a high government official or politician.
- Riot: Any violent demonstration of more than 100 citizens involving the use of physical force.
- Nondemocratic regime: Executive is nonelected, or the legislature is "ineffective" as a force in influencing the country's national parties. Includes monarchies with ineffective legislature, military dictatorships, "strong" executives with rubber stamp legislatures, and situations of anarchy.
- Debt measures: All debt measures refer to externally held debt of the country's central government. Other variables are self-explanatory.

Appendix Table 1 provides definitions of variables used in empirical analysis.

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**References**


