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## International environmental negotiations and non-exclusive domestic property rights

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# Kieler Arbeitspapiere Kiel Working Papers

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INTERNATIONAL ENVIRONMENTAL  
NEGOTIATIONS AND NON-EXCLUSIVE  
DOMESTIC PROPERTY RIGHTS

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## 1. Introduction

A folk theorem in environmental economics suggests that in the presence of transboundary environmental spillovers international negotiations may improve on environmental quality. More so, if side-payments according to the "victim-pays principle" are undertaken, environmental safeguards agreed upon by the parties to an international agreement can be optimal from the point of view of a global social planner.

Implicitly, this folk theorem makes an important assumption: All requirements emanating from the stipulations of an international environmental agreement are smoothly and completely executed within the home countries of the parties to the contract, or so the story goes.

However, this presumption is not necessarily fulfilled. In particular, the execution of what the agreement requires from the parties involved may be severely thwarted by either of three reasons.

First, international environmental agreements are not strictly enforceable in the legal sense. Country sovereignty may entice a country to breach in the interest of its constituency an agreement it is already a party to (Mohr [1990a]). Second, even if international agreements are binding or supported by the domestic constituency, costs of monitoring the long way up from government legislation down to agency performance may lead to substantial implementation gaps (Pethig [1990]). Third, even if a government is eager to abide by an agreement, it may not be able to because it does not possess exclusive property rights over the environment on the home turf. It is this third obstacle to the rosy prospects of the folk theorem which will be addressed in this paper.

Empirically, this obstacle is, perhaps, of substantial relevance. At home the arm of the government may simply be too short to enforce the agreement domestically. A point in this case may be the demise of the tropical rainforests.<sup>1</sup> Preventing private wildcatting and unauthorised

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<sup>1</sup> For an analysis of economic problems associated with deforestation in the tropic see e.g. Amelung [1990] and Rauscher [1990].

development, even if intended, may indeed be a problem for the governments of countries hosting the rainforests.

However, this paper analyses the implications of a different source of non-exclusive domestic property rights. The legal system in constitutional democracies may in itself give rise to a non-exclusivity of domestic property rights over the environment.

Existing emission sources are to some degree protected from a tightening of standards by project permits given in the past. Even if these permits have been conditioned on future environmental policy, even if they are subject to periodic revisions by a bureaucracy or if they are granted only for a fixed period of time, project operators almost always have the right to fight a tightening of required environmental safeguards in the courts. Hence if courts are independent and if the probability of winning a court litigation is positive for the project operator the domestic government and its agencies do not possess exclusive property rights over the environment. It is this implication of the trichotomy of powers which will be introduced into the analysis of international environmental negotiations.

Interesting questions arise if governments with non-exclusive domestic titles to the environment are involved in international environmental negotiations. Can an agreement be found at all if the fur under negotiation is not the sole property of those trying to divide it? If yes, what are its properties compared to the case of complete domestic control? Will the folk theorem persist or perish?

With uncertain court litigation pending at home the environmental implications of an international agreement are ultimately determined at home. The environmental effects of international agreements therefore depend on how the "commons" is divided by those which share a title to it. In this paper the view is entertained that uncertain court litigation gives an incentive for both project operators and an environmental bureaucracy to settle the conflict out of court (Mohr [1990b]). This may be achieved by reaching an agreement on (additional) safeguards to be applied by the operators. In what follows it is therefore presumed that the ultimate environmental allocation is determined in a domestic bargaining game.

Questions raised above are addressed by applying the strategic bargaining approach to negotiations (Rubinstein [1982]). Analysing

international negotiations in the face of non-exclusive property rights requires, however, considerations which go beyond those dictated by bargaining theory alone. If the implications of a negotiated agreement are ultimately determined outside but under influence of a party inside the bargaining room, the other parties to an agreement face an agency problem too. They have to try to push for an agreement which creates an incentive for that party to act outside the bargaining room in the interest of the other signatories of the agreement.

For illustration, in the precise context of our problem foreign governments face the task of designing an international agreement which has the property that the home government, possessing non-exclusive property rights in the domestic game, acts during negotiations with project operators in the interest of foreign countries. Given non-exclusive domestic property rights international environmental agreements should therefore be incentive compatible. It is therefore necessary to analyse international environmental agreements under considerations of both bargaining as well as principal-agency theoretic considerations.

The paper is organised as follows. In Section 2 the environmental problem is defined. In section 3 a simple strategic bargaining model is developed. As a frame of reference international negotiations in the presence of exclusive property rights are discussed in Section 4. Sections 5, 6 and 7 then address the consequences of non-exclusivity of environmental property rights. Section 8 concludes the paper.

## 2. A Simple Upstream - Downstream Model of Transfrontier Pollution

Consider a two country model where in the home country a project is undertaken with gross value per period  $W$ . The project causes environmental costs (in money terms) at home,  $D(S)$ , and in a downstream country,  $D^*(S)$ , where  $S$  are the safeguards (in money terms) applied by the project operator. Suppose  $D'(S) < 0$ ,  $D''(S) > 0$ ,  $D'^*(S) < 0$ ,  $D''^*(S) > 0$ .

A domestic bureaucracy maximising the domestic net project value per period,  $W - D(S) - S$ , would grant permission to undertake the project subject to the application of optimal safeguards  $\tilde{S}$ , where  $-D'(\tilde{S}) = 1$ , if  $W - D(\tilde{S}) - \tilde{S} > 0$ . Suppose this is the case.

Further suppose that optimal safeguards  $\tilde{S}$  have to be paid for by the project operator himself so that his private net project value is given by  $\Pi(\tilde{S}) \equiv W - \tilde{S}$ . An interpretation of this is that domestic environmental policy is undertaken by command and control instruments. As a starting point from which we embark to analyse international environmental negotiations we take it that the project operator has been allowed to undertake the project subject to safeguards  $\tilde{S}$ . This project permit received gives the operator a title to the environment which he can defend in court.

As the project causes environmental costs,  $D^*(\tilde{S})$ , abroad,  $\tilde{S}$  is not necessarily optimal from the point of view of the downstream country. To be precise, if the foreign country could select the level of safeguards to be applied in the home country if it paid for it, it would set  $S = \tilde{S}^*$ , where  $-D^*(\tilde{S}^*) = 1$ . Obviously  $\tilde{S}^*$  may be larger, equal or smaller than  $\tilde{S}$ .

The foreign country would never be enticed to engage in international negotiations pertaining to a modification of safeguards applied in the domestic country unless  $\tilde{S}^* > \tilde{S}$ . Let this be the case.

Note that a global social planner would require safeguards  $S^G$ , where

$$(1) \quad -D'(S^G) - D^{*'}(S^G) = 1.$$

Apparently

$$(2) \quad S^G > \tilde{S}^* > \tilde{S}.$$

Given  $\tilde{S}^* > \tilde{S}$  the foreign country is inclined to make some payments to the home country in order that tighter safeguards be undertaken. And obtaining sufficient payments from abroad the domestic government may be willing to instruct its bureaucracy to bargain for tighter safeguards in the domestic game.

### 3. The Bargaining Model

Both international and domestic negotiations will be analysed in variations of the two party bargaining game depicted in Diagram 1.<sup>2</sup>

At time  $t=0$  party  $i$  makes a proposal to party  $j$  concerning the division of a cake of any size. If  $j$  rejects  $i$ 's offer it can terminate negotiations and take an outside option which gives  $i$  a share  $e_i$  and  $j$  a share  $e_j$  of the cake under negotiation. Rejecting  $i$ 's offer,  $j$  may, however, continue bargaining by making a counter-offer in period  $t=1$ . Party  $i$  then can accept  $j$ 's offer, or terminate negotiations by taking the outside option  $e_i$  (implying  $e_j$  for  $j$ ) or it can continue bargaining in the

Put Diagram 1 about here

following period. The bargaining game continues until one country accepts a proposal made or until a country takes its outside option. The game is stationary.

Time costs of bargaining may occur because counter-offers can be made only after one period has elapsed. Let this be represented by a discount factor  $h_i$  and  $h_j$ ,  $0 \leq h_i, h_j \leq 1$ , for parties  $i$  and  $j$  respectively.

Following the strategic approach to bargaining, a negotiated division of the cake at stake must be an equilibrium point of the game in extensive form, defined by the rules depicted in Diagram 1. Let  $m_i$  be the equilibrium share of the cake party  $i$  receives. It is shown in the Appendix that  $m_i$  is given by

$$(3) \quad m_i = (1-h_j)/(1-h_i \cdot h_j) \quad \text{if} \quad \begin{cases} e_i \leq h_i \cdot (1-h_j)/(1-h_i \cdot h_j) \\ e_j \leq h_j \cdot (1-h_i)/(1-h_i \cdot h_j), \end{cases}$$

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<sup>2</sup> It is a modified version of the bargaining model in Sutton [1986].



$$(4) \quad m_i = 1 - h_j \cdot (1 - e_i) \quad \text{if} \quad \begin{cases} e_i > h_i \cdot (1 - h_j) / (1 - h_i \cdot h_j) \\ e_j \leq h_j \cdot (1 - e_i), \end{cases}$$

$$(5) \quad m_i = 1 - e_j \quad \text{otherwise.}$$

The division of the cake,  $m$ , being a perfect equilibrium ensures that a party's threat to leave the bargaining table and take the outside option does only influence the outcome of negotiations if such a threat is not incredible.<sup>3</sup> The outcome hence differs as to which party's outside option poses a credible threat. This is represented by equations (3)-(5). Equation (3) gives the equilibrium division of the cake if neither party possesses a credible outside option. If only  $i$  has a credible outside option available, then the equilibrium partition is given by equation (4). And equation (5) represents the case where (only or in addition to party  $i$ ) party  $j$  possesses a credible outside option.

In the following sections this bargaining game will be applied to international and domestic negotiations. As a starting point from which to embark onto the analysis of consequences of non-exclusive domestic property rights international negotiations in the presence of exclusive titles to the environment are analysed first.

#### 4. International Negotiations and Exclusive Domestic Property Rights

Let  $i$  be the upstream (home) country and let  $j$  be the downstream (foreign) country. If the countries agree on safeguards  $S > \tilde{S}$  to be undertaken in the upstream country the environmental gains obtained are given by  $D^*(\tilde{S}) - D^*(S)$  abroad and  $D(\tilde{S}) - D(S)$  at home. Tighter safeguards, however, cause additional costs,  $S - \tilde{S}$ . Hence the size of the

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<sup>3</sup> A necessary condition of credibility of the threat of taking an outside option is that taking it gives the party a payoff which is at least as high as the payoff it receives if it would not take this option.

cake,  $C(S)$ , which can be divided in negotiations in which safeguards  $S$  are agreed upon is given by

$$(6) \quad C(S) = D^*(\bar{S}) - D^*(S) + D(\bar{S}) - D(S) - (S - \bar{S}).$$

If side-payments according to the "victim-pays" principle are permitted countries agree to maximise the cake under negotiations (e.g. Kuhl [1987]). Taking the derivative of equation (6) with respect to  $S$  it follows that the countries agree to apply the globally optimal safeguards  $S^G$ . Hence as the folk theorem suggests, negotiations lead to a globally optimal allocation of the environment if international side-payments are allowed.

Allowing for side-payments, bargaining over safeguards applied are separated from bargaining over the distribution of benefits  $C(S^G)$ . To determine the outcome of the latter, note that for as long as negotiations continue  $S = \bar{S}$  so that both countries remain deprived of any benefits accruing from an agreement. Hence time costs of bargaining are positive for both. Let this be represented by

$$(7) \quad \begin{aligned} h_i &\equiv h < 1 \\ h_j &\equiv h^* < 1. \end{aligned}$$

Furthermore, it is straightforward that walking away from the bargaining table without having reached an agreement would preserve the status quo  $\bar{S}$ . Hence the outside options are given by

$$(8) \quad \begin{aligned} e_i &\equiv e = 0 \\ e_j &\equiv e^* = 0. \end{aligned}$$

Terminating negotiations without an agreement is good for nothing.

Hence from (3)-(5), (7) and (8) the equilibrium partition  $m_1 \equiv m$  is given by

$$(9) \quad m = \frac{1-h^*}{1-h \cdot h^*},$$

where  $m$  is the share the upstream country receives from the cake of size  $C(S^G)$ .

Note that the total benefit  $M$ ,  $M = m \cdot C(S^G)$ , the upstream country receives may be smaller, equal or larger than the domestic environmental gain  $D(\tilde{S}) - D(S^G)$ . This is because the upstream country's domestic environmental gains are counted into the size of the cake under negotiations and because safeguards  $S^G - \tilde{S}$  are paid out of gross benefits  $D^*(\tilde{S}) - D^*(S^G) + D(\tilde{S}) - D(S^G)$  (see equation (6)).

## 5. The Problem With Non-Exclusive Property Rights

Given the project operator's right to apply in court the magnitude of safeguards applied is in effect determined within the home country. As a consequence the parties to an international agreement are restricted with respect to the design of the contract. In particular, they are not free anymore in setting safeguards.

This need not imply that the actual level of safeguards applied is independent of the agreement reached in the international game. The agreement could stipulate actions to be taken by the domestic government which affect environmental quality indirectly by impinging on the process in which the environment is allocated between the domestic parties claiming titles to it. If the environment is in effect allocated as a result of domestic negotiations an international agreement could therefore stipulate the position or behaviour of the domestic government or their agencies in the domestic game.

Here, however, arises a difficulty if the foreign government cannot sufficiently monitor the activities of the domestic government. In this case, the domestic government could silently but effectively peter out of the duties imposed by the agreement without at the same time sacrificing all of the benefits.

Insufficient monitoring must be expected to pose a problem when domestic property rights are not exclusively held by the parties to

international environmental agreements because a country's performance cannot simply be judged by environmental quality alone. In general, if property rights are non-exclusive, a party's domestic claiming effort would have to be monitored directly in order to evaluate its performance. With respect to the particular problem we analyse, monitoring the domestic bargaining process and the role of domestic government agencies therein appears to be impossible.

There exists, however, an alternative. Countries could negotiate an agreement which is incentive compatible. With an incentive compatible contract the domestic government's self-interest ensures that it behaves in accordance with the agreement.

In our model an incentive compatible international environmental agreement is particularly simple. To see this, note that despite non-exclusive property rights the two governments can agree on the division of the benefits accruing from the application of safeguards  $S, S > \bar{S}$ , whatever the size of  $S$ . Suppose therefore the two countries would agree on a share  $m = m^i$ , the domestic country receives of a cake of size  $C(S)$ , whatever the size of the cake may be. Suppose, that after an agreement on  $m^i$  is reached, the domestic government would be free to set safeguards applied domestically.<sup>4</sup> It then would maximise the domestic benefit  $M(S) \equiv m^i \cdot C(S)$  by setting  $S \geq \bar{S}$ . Inserting equation (6) into the definition of  $M(S)$  and taking the derivative with respect to  $S$  we obtain the first order optimality condition  $-D'(S) - D^*(S) = 1$  which is the same as condition (1) which holds for a global social planner. Given an agreement on a share  $m^i$  the domestic government would therefore apply the globally optimal safeguards  $S^G$  in order to maximise the domestic benefit from the agreement. Hence an international agreement in which only a share  $m^i$  is fixed would be an incentive compatible contract if the domestic government were free to set the environmental diligence applied.

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<sup>4</sup> It is therefore presumed that the domestic government possesses exclusive property rights. However, contrary to the analysis of Section 4, the magnitude of environmental diligence,  $S$ , applied is not under negotiation.

If property rights are non-exclusive and if safeguards are negotiated in a domestic bargaining game, an international agreement on the share  $m^i$  which the domestic country receives if it negotiates safeguards  $S$ ,  $S > \tilde{S}$ , with domestic project operators gives therefore the home country an incentive to press for  $S = S^G$  in the domestic game. In this sense an international contract on  $m^i$  alone is incentive compatible. When analysing the domestic bargaining game, we will therefore presume that in the international game an incentive compatible agreement has been reached.

Before turning to the domestic game a remark is in order. The inability of governments to negotiate environmental safeguards in the face of transboundary pollution is not necessarily a source of suboptimal environmental policy. Optimal environmental safeguards may emanate from international negotiations which merely set the "right" incentives for the party which controls the environment. A suboptimal allocation of the environment requires at least an additional restriction on the actions which can be taken by parties to international negotiations such as those which may emanate from the non-exclusivity of property rights.

## 6. The Domestic Bargaining Game

Suppose in the international game an agreement is reached by which the domestic country receives a share  $m^i$  of whatever the global benefit  $C(S)$  may be from safeguards  $S$ ,  $S \geq \tilde{S}$ , determined in the domestic game. It is known from Section 5 that for this agreement the domestic government's most preferred safeguards are  $S = S^G$ .

In defining the domestic bargaining game, suppose that a domestic private party having obtained a project permit conditional on the application of safeguards  $\tilde{S}$  can appeal in the courts against governmental command and control measures requiring safeguards in excess of  $\tilde{S}$ . Suppose the probability that a project operator wins the court litigation is given by the parameter  $k$ ,  $0 \leq k \leq 1$ . If the government or an environmental bureaucracy in its stead wins in court then safeguards have to be

applied as required by the government. If the project operator wins in court then the project may be continued with safeguards  $\tilde{S}$ .<sup>5</sup>

If  $k=0$  property rights over the environment are held exclusively by the domestic government and if  $k=1$  they are held only by the project operator. If  $0 < k < 1$  both the government and the project operator possess competing claims over the environment. The parameter  $k$  may be interpreted as an indicator of the ex ante distribution of property rights.

Given the international agreement  $m^i$  the domestic government wants that safeguards  $S^G > \tilde{S}$  be implemented. Suppose that it therefore advises its environmental bureaucracy to pledge in a court litigation for safeguards  $S^G$ .<sup>6</sup>

If the environmental bureaucracy wins in court then the private project value is given by  $W - S^G = \Pi(\tilde{S}) - \Delta S^G$ , where  $\Delta S^G \equiv S^G - \tilde{S}$  and where  $\Pi(\tilde{S}) \equiv W - \tilde{S}$ . Solvency of the project operator in case of a lost court battle requires  $\Pi(\tilde{S}) - \Delta S^G \geq 0$ . Suppose this is the case.

If  $0 < k < 1$  both the project operator and the environmental bureaucracy representing the domestic government may lose in court. Both therefore have an incentive to avoid court litigation and to negotiate an agreement on additional safeguards  $\Delta S$  out of court.

In this domestic bargaining situation the cake under negotiation is given by the project operator's private project value  $\Pi(\tilde{S})$  as additional safeguards  $\Delta S$  reduce the project value below  $\Pi(\tilde{S})$ .

It will be assumed that the rules governing the domestic game are those depicted in Diagram 1. In particular, suppose the environmental bureaucracy, party B in the domestic game, is represented by party  $j$  in Diagram 1 and a project operator, party A in the

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<sup>5</sup> For simplicity, we neglect the possibility that the courts may decide to implement safeguards which differ from either the safeguards pleaded for by the project operator or those pleaded for by the government or its agent.

<sup>6</sup> Implicitly, it is assumed that government agencies are required to represent the national public interest in court battles with private domestic parties.

domestic game, is represented by party  $i$  in Diagram 1. Suppose both project operators and the environmental bureaucracy are risk-neutral.

Contrary to the international game the parties to domestic negotiations possess the outside option of appealing in the courts.<sup>7</sup> In particular a project operator's outside option is given by

$$(10) \quad e_i \equiv e_A = \frac{k \cdot \Pi(\tilde{S}) + (1-k) \cdot [\Pi(\tilde{S}) - \Delta S^G]}{\Pi(\tilde{S})} > 0,$$

representing the fact that the private project value after a court decision is  $\Pi(\tilde{S})$  with probability  $k$  or  $\Pi(\tilde{S}) - \Delta S^G$  with probability  $1-k$ .

In determining the outside option of the bureaucracy note that the domestic country receives  $M(S^G) = m^i \cdot C(S^G)$  from the international agreement if it wins in court. If it loses in court  $S = \tilde{S}$ . Hence, in this case it follows from (6) that  $M(\tilde{S}) = 0$ . The bureaucracy is therefore indifferent between court litigation and agreeing on safeguards  $\underline{S}(k)$ ,  $\underline{S}(k) > \tilde{S}$ , satisfying

$$(11) \quad (1-k) \cdot M(S^G) = M(\underline{S}(k)).$$

Note that  $\underline{S}(k)$  may be interpreted as the reservation safeguards of the bureaucracy. It would never agree on safeguards below  $\underline{S}(k)$  as in this case the domestic country would receive benefits from the international agreement below the expected benefit of triggering a court decision. It follows straightforwardly from equation (11) that  $d\underline{S}(k)/dk < 0$  whereby the bureaucracy's reservation safeguards are smaller the smaller the chance of winning in court.

Let  $\Delta \underline{S}(k) \equiv \underline{S}(k) - \tilde{S}$ . The value of the outside option of the bureaucracy, defined as the share in the private project value  $\Pi(\tilde{S})$ , may now be expressed by

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<sup>7</sup> Note that the environmental bureaucracy can itself trigger a court decision simply by "imposing" safeguards  $S^G$  by way of command and control instruments. If  $k > 0$  project operators will always react by appealing in courts.

$$(12) \quad e_j \equiv e_B = \frac{\Delta S(k)}{\Pi(\bar{S})} > 0.$$

As for as long as domestic negotiations continue the status quo of safeguards  $\bar{S}$  applied is preserved, the domestic country remains deprived from any benefits accruing from the international agreement until an agreement is reached in the domestic game. Hence the discount factor of the bureaucracy  $h_j \equiv h_B$  is below 1.

Contrary to the bureaucracy a project operator remains in the best of all possible states of the world for as long as negotiations are underway, as he may continue to operate the project under safeguards  $\bar{S}$ . Hence in domestic negotiations the project operator does not possess time costs of bargaining with the bureaucracy. This may be represented by setting  $h_j \equiv h_A = 1$ .<sup>8</sup>

Letting  $m_i \equiv m_A$  be the equilibrium share a project operator receives, then from the definitions (10), (12)  $h_j \equiv h_B < 1$  and  $h_i \equiv h_A = 1$  it follows for the equilibrium partition (3)-(5)

$$(13) \quad m_A = 1 \quad \text{if} \quad \begin{cases} e_A \leq 1 \\ e_B \leq 0 \end{cases}$$

$$(14) \quad m_A = 1 - h_B \cdot (1 - e_A) \quad \text{if} \quad \begin{cases} e_A > 1 \\ e_B \leq h_B \cdot (1 - e_A) \end{cases}$$

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<sup>8</sup> For  $h_A = 1$  a project operator is indifferent between making a deal of a given value today or tomorrow. In fact project operators prefer to reach an agreement involving safeguards in excess of  $\bar{S}$  rather later than earlier. This would have to be represented by setting  $h_A > 1$ . This "play on time" game would potentially further improve the bargaining power of project operators. The partition of the cake under domestic negotiations, derived from the "patience" game  $h_A = 1$  must therefore be interpreted as a limiting case, indicating the maximum the bureaucracy can obtain in a "play on time" game involving  $h_A \geq 1$ .



$$(15) \quad m_A = 1 - e_B \quad \text{otherwise.}$$

Upon noting from equations (10) and (12) that  $e_A < 1$  and  $e_B > 0$  it follows from (13)-(15) that the equilibrium partition is given by (15). This result is easily interpreted upon noting that equation (15) represents the case where the environmental bureaucracy possesses a credible outside option. Would the bureaucracy's outside option not be credible, i.e. would the bureaucracy not be prepared to quit negotiations, then the project operator could preserve the status quo of safeguards  $\tilde{S}$  forever. However, in that case and given  $e_B > 0$  it would be better for the bureaucracy to seek a court decision. Hence the bargaining equilibrium must at least involve a share  $e_B$  for the bureaucracy. Apparently, in this situation the project operator would neither offer the bureaucracy more nor accept a share for itself which is smaller than  $1 - e_B$ .

Additional safeguards,  $\Delta S$ , agreed upon in domestic negotiations must satisfy  $m_A \cdot \Pi(\tilde{S}) = \Pi(\tilde{S}) - \Delta S$ , from which one obtains upon substituting in the equilibrium partition (15) and the RHS of equation (12)

$$(16) \quad \Delta S = \Delta \underline{S}(k).$$

Hence in the domestic game the project operator and the bureaucracy agree on additional safeguards which are equal to the reservation increment of the environmental bureaucracy.

## 7. Repercussions on the International Environmental Agreement

If  $k > 0$ , safeguards agreed upon in the domestic game  $\tilde{S} + \Delta S$  are smaller than the globally optimal safeguards  $S^G$ . This follows from equations (11), (16),  $\Delta \underline{S}(k) = \underline{S}(k) - \tilde{S}$ ,  $M(S) = m^i \cdot C(S)$  and  $dC(S)/dS > 0$ . If property rights rest in part with a domestic project operator then international negotiations are unable to produce the globally optimal allocation of the environment even if side-payments are permitted. The folk theorem therefore does not hold anymore. In our model, the reason for this

result is because the domestic government, although being enticed by the international agreement to press for globally optimal safeguards, simply does not possess enough punch in the domestic game.

For  $k \rightarrow 1$  it follows from equation (11) that  $M(\underline{S}(k)) \rightarrow 0$ . It follows from  $M(\underline{S}) \equiv m^i \cdot C(\underline{S})$  and equation (6) that this requires  $\underline{S}(k) \rightarrow \tilde{S}$ . As  $\Delta \underline{S}(k) \equiv \underline{S}(k) - \tilde{S}$  it follows from (16) that  $\Delta S = 0$  if  $k \rightarrow 1$ . If property rights rest (almost) exclusively with the project operator the domestic government is unable to negotiate tighter safeguards. The performance dependent benefit from the international agreement is therefore  $M(\tilde{S}) = 0$ . The upstream (domestic) country has lost the ability to negotiate any side-payments to be paid by the downstream country.

For  $k \rightarrow 0$  it follows from (11)  $\underline{S}(k) = S^G$ . Being sure to win in court the bureaucracy is not ready to agree on safeguards below  $S^G$ . The international bargaining game produces the results which are in accordance with the folk theorem as a limiting case.

As from (11)  $d\underline{S}(k)/dk < 0$ ,  $d\Delta \underline{S}(k)/dk < 0$  so that from (16) the safeguards agreed upon are smaller the smaller the probability that the bureaucracy wins in court. Hence the contingent benefit received by the upstream country from side-payments decreases if the government's title to the domestic environment diminishes.

The model implies that side-payments are in general not sufficient for an optimal environmental quality to emanate from international environmental agreements. If property rights are not exclusively held by the parties to international environmental agreements then, in general, environmental quality obtained is suboptimally low. Finally, the observation that transboundary environmental spillovers are not taken care of optimally need to be due to the downstream government's constituency's reluctance to accept the "victim-pays" principle.

## 8. Conclusions

The paper has analysed international environmental negotiations under a set of complications which were to represent in an admittedly rather abstract form a number of real world phenomena. These were:

(1) Domestic environmental policy being undertaken by command and control instruments.

(2) International side-payments obtained in accordance with international environmental agreements not being (necessarily) passed along to the group of individuals having to pay for the costs of tighter safeguards.

(3) A legal system giving private parties the right to fight environmental command and control in the courts.

It has been tried in this paper to show that non-exclusive domestic property rights emanating from these complications need not thwart international environmental negotiations. The idea behind the emergence of international cooperation in this paper was that in the face of these complications international agreements must stipulate performance dependent arrangements such as to entice contract compatible behaviour of governments. In the model analysed such incentive compatible international agreements were, however, unable to ensure optimal environmental quality.

In this paper it was not tried to account of the interrelation between non-exclusive domestic property rights and international environmental negotiations comprehensively. Even within the special framework chosen many questions remain unanswered. For example, international agreements may affect the legal system such that the *ex ante* distribution of environmental property rights are altered. Another gap still to be closed pertains to the set of parties to international negotiations. Instead of bargaining with the domestic government it might be advantageous for the foreign government to bribe domestic project operators directly.

## Appendix

If  $m_i$  denotes the supremum of the share of the cake under negotiation which party  $i$  can reap in a negotiated settlement in period 2, say, then, by backward induction, the shares party  $i$  and party  $j$  can reap by an earlier settlement are depicted in Box 1,

Period	Offer made by	Party i receives at most share	Party j receives at least share
t = 0	i	$m_i = \begin{cases} 1-h_j \cdot (1-X) \\ 1-e_j \end{cases}$	$1-m_i = \begin{cases} h_j \cdot (1-X) \\ e_j \end{cases}$
t = 1	j	X	1-X
t = 2	i	$m_i$	$1-m_i$

Box 1

where

$$X = \begin{cases} h_i \cdot m_i \\ e_i \end{cases} \quad \text{if } i \left\{ \begin{array}{l} \text{does not take} \\ \text{takes} \end{array} \right\} \text{ the outside option.}$$

Solving the first row in Box 1 for  $m_i$ , we obtain the share country i receives in a subgame perfect bargaining equilibrium. It is given by equations (3)-(5) in the main body of the paper.

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Diagram 1

