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STATE LIABILITY FOR INTERNATIONAL ENVIRONMENTAL DEGRADATION: AN ECONOMIC PERSPECTIVE

RALPH C. d'ARGE* and ALLEN V. KNEESE**

INTRODUCTION

State responsibility and liability are not clearly defined with respect to environmental degradation. But a limited number of cases and declarations by international tribunals do point in a definable direction. In the famous *Trail Smelter Case*, the tribunal declared: "A State owes at all times a duty to protect other states against injurious acts by *individuals* from within its jurisdiction."¹ The Organization for Economic Cooperation and Development (OECD) adopted the "polluter pays" principle (PP) in 1972, which states that the waste discharger must pay for any ameliorating measures which are caused to be undertaken.² This principle does not apply to any residual damages which may remain. However, the German government has recently issued an interpretation which requires payment of an effluent charge which presumably, in some manner, is meant to reflect remaining damages within German territory.³ The Stockholm Declarations could also be interpreted as placing responsibility upon those undertaking the actions which result in environmental degradation, although the emphasis is upon "common action" among states.⁴ The tendency then is to interpret state responsibility as requiring that states within whose boundaries harmful actions occur must pay or cause to be paid the cost of ameliorating those actions and, possibly, must pay for the remaining damages as well.

In this paper, we shall define and analyze four major principles of assigning state responsibility and discuss the economic meaning of those principles. The first principle is that each state is responsible for all waste discharge control costs internally and externally but is not responsible for compensation of remaining damages following

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1. *Trail Smelter Case* (United States v. Canada), 3 R. Int'l Arb. Awards 1905, 1963 (1935) (emphasis added).

2. ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, POLLUTER PAYS PRINCIPLE (1975).

3. See A. KNEESE & B. BOWER, *MANAGING WATER QUALITY: ECONOMICS, TECHNOLOGY, INSTITUTIONS* (1968).

4. U.N. Stockholm Conference on the Human Environment, Declaration on the Human Environment, U.N. Doc. A/CONF. 48/4 (1972).

installation of the agreed-upon controls. This is a variant of the OECD principle cited above in that we apply it, as an area of major concern, to transfrontier pollution problems; application of the principle to such problems was explicitly excluded by OECD member nations. The second major principle is the full costing principle (FC), which requires the state responsible for waste discharge to pay compensation for remaining damages as well as control costs. The third principle is the "victim pays" principle (VP), which requires the affected state to compensate the affecting state (or internal parties creating harmful residuals) for all costs of control and to absorb all residual damages after controls are implemented. The fourth principle, in its simplest form, requires the establishment of an internal or international autonomous agency to regulate the joint use of common property resources by individual or multiple states. In the international case, the various states would give powers to the agency to regulate waste discharges into the commonly shared environment. For lack of a better description, we term this principle of responsibility the common property resource institution principle (CPRI).⁵

With the exception of certain studies on economic warfare in international trade, the international economics literature appears devoid of analyses encompassing non-aggressive involuntary exchanges that are international in scope.⁶ This is in contrast to the very substantial literature on such exchanges internal to a sovereign nation. Environmental interdependencies among sovereign nations, not regulated *a priori* by international market or other forms of transactions, can be viewed as one type of or cause for involuntary exchange.⁷ For example, when one nation's industry emits water-borne residuals which influence the productivity or utility of another nation's citizens, then

5. A fifth principle developed by OECD personnel and consultants is called the "mutual compensation" principle: each country contributes to the solution of the problem by sharing control costs and/or damages. Because of the diversity of possible economic outcomes from this type of principle, it will not be examined in detail here.

6. See M. KEMP, *PURE THEORY OF INTERNATIONAL TRADE* ch. 4 (1964); H. Wan, *A Contribution to the Theory of Trade Warfare* (1961) (unpublished doctoral thesis, Massachusetts Institute of Technology). On transnational public goods problems two enlightening papers by Michael B. Connolly have appeared. Connolly, *Trade in Public Goods: A Diagrammatic Analysis*, 86 Q.J. ECON. 61 (1972); Connolly, *Public Goods, Externalities, and International Relations*, 78 J. POLITICAL ECON. 279 (1970). (Since this paper was written and circulated, a number of economic studies on transfrontier pollution have been written. See ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *PROBLEMS OF TRANSFRONTIER POLLUTION* (1974); I. WALTER, *INTERNATIONAL ECONOMICS OF POLLUTION* (1976).)

7. It must be kept in mind in a historical evolutionary context that externalities and especially diseconomies in social relationships are perhaps one major reason for the existence of discrete nations and the role of national sovereignty as the dominant consideration in world politics.

in effect there is an involuntary exchange of wealth among nations.

External diseconomies in the domestic economy have been characterized as perceptible non-market interdependencies among economic units that arise inadvertently, without anticipation, or with inadequate information by one or more of the parties involved. The externality event is unforeseen as to its effects or not adequately anticipated before occurrence. Coase, Buchanan, Kneese, and Mishan, among others, have explicitly or implicitly applied this characterization.⁸ In what follows we shall adhere to this characterization and omit consideration of involuntary international exchanges which arise by design (i.e., assertion of power and threat of warfare). Thus, the class of problems we wish to address is unanticipated involuntary international exchanges involving environmental interdependencies among nations that lack markets or exchange processes of any kind prior to their appearance.

From an economic perspective, there are two major issues in the interpretation of international doctrines or laws applicable to transnational environmental problems. The first relates to prohibitions on domestic activities affecting other nations, and the second to explicit financial responsibility for harmful effects. There is a body of international law concerned with constraints on a nation's activities which prescribes certain doctrines of behavior. The common maxim applicable as a constraint is: *use your own property so as to not injure your neighbor's* and *every state's obligation [is to] not allow knowingly its territory to be used for acts contrary to other states.*⁹ These general principles delineate both constraints to activities and assertions of responsibility. Note, however, that they are implicit with regard to specification of property ownership, and the allocation of common property resource ownership, or jointly used resources, is not identified. Further, the bulk of common law on oceans, the major common property resource of recognized importance thus far, is concerned with the establishment of principles of access and the "right of use" but not with constraints on use. The precedent-setting *Trail Smelter Case* between the United States and Canada in 1935 established that "under the principles of international law . . . , no State has the right to use or permit the use of its territory in such manner as to cause injury by fumes in or to the territory of another

8. Buchanan & Stubblebine, *Externality*, 29 *ECONOMICA* 17 (n.s. 1962); Coase, *The Problem of Social Cost*, 3 *J.L. & ECON.* 1 (1960); Mishan, *The Postwar Literature on Externalities: An Interpretative Essay*, 9 *J. ECON. LITERATURE* 1 (1971).

9. See C. BRAMSEN, *TRANSNATIONAL POLLUTION AND INTERNATIONAL LAW* (OECD restricted series, Aug. 1972); C. JENKS, *THE COMMON LAW OF MANKIND* (1958).

or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence."¹⁰ More recently, the United Nations General Assembly passed a resolution that each nation has the sovereign right to formulate its own environmental policies, provided "in the exercise of such right and in the implementation of such policies due account must be taken of the need to avoid producing harmful effects on other countries."¹¹ The U.N. Stockholm Conference Declaration went even further in stating that nations have "the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."¹² The Stockholm Declaration begins to introduce a more encompassing criterion of responsibility by referring to all areas beyond jurisdictional limits. Also, instead of "due account" being taken of damages to other countries, the specification is made that no damages be caused.

To summarize this very brief discussion, existing common law and United Nations declarations appear to prohibit domestic activities which cause environmentally harmful effects to other countries. In so doing, this body of law implicitly provides constraints to potential actions within countries but does not provide meaningful economic guidelines of responsibility. Implicitly the responsible country is the one *initiating* the activity that causes damages.

The initiating country, however, may be hard to discover. The following cases illustrate this point: (1) a country's tanker spills oil and damages the coastline of a second country; (2) a country's residents undergo a shift in preferences (due to rising income and affluence) and begin to suffer aesthetic damages due to previously unrecognized air pollution from an adjacent country; (3) a downstream country decides to expand irrigated agriculture onto desert lands where salt flushing is required but finds that an upstream country is contributing salts into return flows to the common river, precluding flushing and efficient production in the downstream country; (4) one downstream country decides to use internal resources—i.e., rivers and airsheds—as total waste disposal resources and common property rivers as predominantly recreational resources.

In the first example, responsibility is quite clearly delineated. But in the other examples, responsibility is imperfectly clear. Certainly in

10. Trail Smelter Case (United States v. Canada), 3 R. Int'l Arb. Awards 1905, 1965 (1935).

11. U.N. Doc. A/RES.2849(XXVI) at 2 (1971).

12. U.N. Stockholm Conference on the Human Environment, Declaration on the Human Environment, U.N. Doc. A/CONF. 48/4, at 4 (1972).

the fourth case there is an element of monopoly of the downstream country working to require the upstream country, provided it is identified as being responsible, to pay for controls exceeding what it would normally need to pay. International doctrines have provided direction on assigning responsibility for external diseconomies and in establishing constraints on *knowingly* initiating activities which create damages transnationally. However, as was argued earlier, externalities have been viewed as inadvertent actions resulting from inadequate prior information and negotiation by the parties involved. The "laws" do not specify which is the responsible country or how such responsibility should be determined.

The classical economic solution to externality problems is to "internalize" them either by developing a well-defined market for the "spillovers" or by controlling them through collective provision of regulations. Neither of these possibilities appears easily amenable to the problem of transnational externalities in general and environmental externalities in particular. First, environmental externalities have arisen because most dimensions of the natural environment on a regional or global scale are resources without defined ownership rights or rights of use. The oceans, stratosphere, and electromagnetic spectrum are examples. These resources are viewed as being commonly owned or not owned at all. A nation that agrees to a particular pattern of ownership could potentially lose some of its implicitly controlled resources and thereby decrease its national wealth.¹³ As long as international entitlements are obscure, any nation can lay implicit claim to the common property resource exceeding any equitable share it may presume to receive if entitle-

13. Christy has emphasized that a major element in the common property problems of oceans is differences in perceived entitlement and consequent wealth of the common property users. Christy also draws a distinction between the production of wealth and the distribution or ownership of wealth with regard to ocean fisheries: the first concept involves issues of access and free use, while the second involves specification of shares. The discussion in this paper will be centered on distributional as opposed to use or access issues. It appears that the issue of open access in fisheries competition and regulation is the polar opposite of transnational external diseconomies, but it has implications for management not highly dissimilar. The distinguishing feature appears to be that with fisheries there are incentives for rapid exploitation if non-coordination prevails between countries. Alternatively, with environmental diseconomies that are reciprocal between countries, there appear to be "built in" incentives for unilateral control in that such control implies at least a small amount of environmental improvement. This idea was first expressed, to our knowledge, by Anthony Scott. However, if one country perceives that regardless of what its actions are, other countries will treat a common property resource as a sewer, it is hard to imagine it would do otherwise. See Christy, *Fisheries: Common Property, Open Access, and the Common Heritage*, in E. BORGESE, *PACEM IN MARIBUS* 183 (1972); Scott, *The Economics of International Transmission of Pollution*, in ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *PROBLEMS OF ENVIRONMENTAL ECONOMICS* (1972).

ment were made explicit. This is not to say that, once some other nation impinges on a nation's implicit entitlement, it will not find a negotiated settlement and explicit entitlement to be superior to an implicit one. However, the affected nation, in negotiating, must revise downward its own perception of ownership of the common property resource. In consequence, proceeding from a situation of implicit entitlement of common property resources to explicit regulation and thereby ownership implies that some (or all) nations must reduce their perception of national wealth.

A second aspect of major importance arises from the concept of national sovereignty. Like consumer sovereignty as conceptualized by economists, national sovereignty involves the idea that governments, acting in their own interest, will, omitting considerations of deviation in power or information, achieve the greatest welfare for themselves by independently pursuing autonomous goals and interacting through organized international markets. The belief in national sovereignty and independent decision-making as an ideal is so embedded that it seems impractical to presume it will be given up easily.¹⁴

In the remainder of this paper we examine assignments of polluter responsibility under the four principles cited earlier, and one perhaps more immediately realizable alternative, in terms of their implications for efficiency of the international economy. We also comment on some related matters—predominantly equity implications and enforceability. In doing so we find it useful to discuss several kinds of case situations separately, since they carry different interpretations for the matters of interest here. First we briefly introduce each of the cases and then discuss each one in more detail.

TAXONOMY OF SITUATIONS

Direct "Technological Externalities"

The archetype of an international environment problem is where activities in one country have a direct (non-market) impact on production or consumption activities in another country. This occurs via some common environmental medium such as a watercourse, the common air mantle, or a large ecological system. Such impacts may

14. This is not to suggest that governments through cooperation or by forming coalitions embodying common interests do not attempt to internalize externalities of a positive sort. NATO, EEC, LAFTA, and EFTA are just a few counterexamples. The important distinction, however, is that each country is not bound irrevocably to accept decisions unfavorable to it or even to continue participation in such collective arrangements. This is demonstrated by the recent discussion on the possible United States withdrawal from several U.N. agencies because of foreign domination of their administrative structures.

be bilateral or multilateral, unidirectional or reciprocal, or various combinations of these. Salt pollution of the Rio Grande is a unidirectional-bilateral case with water as the medium. Destruction of wildfowl habitat in Canada is unidirectional-multilateral (affecting the U.S. and Mexico) with an ecological system as the medium. Pollution of the Baltic Sea is multilateral-reciprocal, again with water as the medium. It is readily seen that these cases vary greatly in both structure and complexity and may have differing implications for a concept of state responsibility.

Effects on a Universal Common Property Resource

Excessive environmental degradation results from adverse impacts on a common property resource (CPR)—that is, one in regard to which market exchange does not function or functions only very imperfectly. Thus the Rhine River and the stratosphere are CPRs because they cannot be easily parcelled into units suitable for exchange in domestic and international markets. But defined state sovereignties do cover their entire reach. The deep oceans and the atmosphere over them are CPRs in an even more far-reaching sense, since they are not even covered by state jurisdiction. We term them *universal* CPRs.

One example of why this situation is important may be helpful. In the case where national sovereignties are directly involved, at least one sovereignty (the damaged one) will have an incentive to generate information and even take action (bribe polluters to reduce waste discharges). Where national sovereignties over the resource are not defined, such incentives are absent until pronounced feedback effects reach a national sovereignty. Accordingly, it is quite possible for an activity (say dumping of high-level radioactive wastes in eventually corrodable containers) to reach a potentially catastrophic level with the only limiting direct incentive being the fear of feedback effects on the party doing the activity. This may not in principle be different from the previous case in terms of ultimate state responsibility. It is importantly different in terms of the indirectness of effects and the different context of incentives within which such responsibility occurs.

Preferences for Fixed Site Environmental Features in Another Sovereignty

Many market-type goods can be produced in one sovereignty and not another and yet be desired there—e.g., Mandarin oranges in England. This fact plus differences in the comparative advantage of

producing other goods are the sources of international trade. But some goods which cannot be exported are produced by nature in certain jurisdictions. Examples are unique biological amenities (those of the Serengeti) and unique geomorphological features (Murchison Falls). The only way citizens of another sovereignty can directly experience their benefits is to travel greater or lesser distances to observe them. Thus the market can function, at least if there are no travel restrictions. But the market does not by any means function perfectly. Since many persons are uncertain whether they will ever experience such attractions, but would like to, an option demand not expressed through markets may exist. Moreover, there seem to be many persons who care greatly about the existence of such amenities even though they never expect, or even hope, to experience them. In principle, the destruction or diminution of such features is a technological externality quite like the direct technological externalities discussed above. They are of the type where an activity in one country enters directly into the welfare of individuals in another. But the often irreversible nature of the destruction of such amenities, the difficulty of evaluating them, and the fact that they are usually located in developing countries while preferences for them are strongest in developed countries have unique implications for state responsibility.

Problems Associated with International Trade

A conclusion derived from economic theory is that if all markets, domestic and international, are competitive and if free trade exists, the processes of exchange will normally generate a Pareto optimum—that is, a situation in which there are no further gains from trade and consumer preferences are fulfilled to a maximum, given the resource endowments of nations and the distribution of resources within and among them. A usually unstated but implied assumption is that there are no CPRs. The theory can be extended to conclude that such an optimum could be achieved anyway if a public agency priced all CPRs in such a way as to obtain a Pareto optimum in their use as well. But even without direct international technological externalities, differences in the way CPRs are handled internally in the various trading nations can cause distortions in the international economy which lead to transitional problems or a permanently less-than-optimal use of global resources. If one country prices CPRs (say by levying effluent charges) and another subsidizes industries to induce them to control use of CPRs, there will be a shift in the international relative costs not adequately reflecting real differences

in factor endowments, including CPRs. Even if all countries wish to "internalize" external costs by using similar policy tools, they may hesitate to act unilaterally for fear of adjustment impacts such as temporary unemployment or balance of payments disequilibrium.

Special Problems Associated with Particular Entities

Developing Countries. In principle, both developing countries and developed countries should act on the same principles with respect to transnational aspects of environment, since both presumably have a common interest in the efficiency of the international system. As a practical matter there are many difficulties. Since technology transfer is, in general, one-directional from the more developed to the less developed world, the former may inadvertently, or by design, create for the developing countries a technology requiring too high a cost for environmental protection given their circumstances and preferences. Also, the developing countries have been the recipients of unilateral financial transfers from the developed world (at least at the governmental level), and they fear that emphasis on environmental improvement in the latter may cut back on these transfers. The ability of developing countries to analyze and monitor adverse environmental effects is vastly less than that of developed countries where, needless to say, it is none too adequate.

Multinational Corporations. In recent years, multinational corporations have grown rapidly; they now conduct much of the business of the international economy. They have the advantage of relatively easy information and experience transfer among countries and may be able to adapt more readily to environmental policies than their domestic counterparts. On the other hand, their vast capacity to generate technological and economic information (or perhaps misinformation) could be used to intimidate local authorities. Similarly, the greater international factor mobility they are said to represent may make them less dependent on specific national locations and may improve their bargaining power with states beyond that of their domestic counterparts. Again new facets of state responsibility show themselves.

DISCUSSION OF SITUATIONS

Direct Technological Externalities

The Bilateral Case. We have mentioned four possible principles of state responsibility in the introduction. There are a number of variants of these basic principles. For example, one may have a "pollu-

ter pays" principle where paying for pollution is acceptable only through reducing emissions in the polluting country. Or the emitter country may be responsible for damage compensation to receptor countries while the receptors are responsible for paying control costs to the emitting country in addition to their own defensive expenditures.

The current implied legal doctrine that each country must pay for transnational pollution by ceasing activities that cause it may for various reasons (including the difficulty of estimating damages, especially internationally) be adopted as the best practical type of polluter pays principle, but it can be shown to be inefficient in many instances. Let us suppose that agriculture in Arizona is very much more productive than downstream in Mexico and that the only way to reduce salt content downstream is to take land out of cultivation upstream. Then the current legal doctrine offers the following choice: let the Mexicans continue to suffer uncompensated losses or take more productive land out upstream and replace it with less productive land downstream. Other considerations aside, a PP principle with compensatory flexibility would be more efficient, since agricultural production across both countries could be maintained at a higher level and the parties involved could share the gain through compensation arrangements to the betterment of both.

Under certain simplified conditions, it can be shown that the VP and PP principles applied to transnational pollution problems both produce Pareto efficiency in the short run and the long run if consumers and factors of production are immobile internationally.¹⁵ The only difference between the two is in the international distribution of income. This result might lead one to favor the VP principle for the simple reason that it can be implemented without international enforcement machinery which in the past has proved so intractable. The damaged party has an incentive both to get information and to bargain with the sovereignty within which the offending activity is taking place. The principle also has the advantage that the willingness of the affected sovereignty to pay for reduction provides a quantitative estimate of the damage loss, which might otherwise be very hard to calculate. But aside from the fact that most people would probably consider the arrangement quite inequitable, it has another basic flaw. If the VP principle is applicable, the exter-

15. See R. d'Arge, *On the Economics of Transnational Environmental Externalities* (1972) (paper presented at the Conference on Economics of the Environment, sponsored by Universities-National Bureau Committee for Economic Research and Resources for the Future, Chicago).

nality-generating country may threaten (by giving high estimates of future loads) to discharge materials as an incidental aspect of the production of other goods simply to obtain compensation for not doing so. One may hypothesize that polluting material could be produced at low cost. Thus, if the VP principle were to be applied, an aspect of state responsibility would have to be structured to remove the incentives underlying "pollution for profit."

Of course, under the PP or FC principles, the injured country could also exaggerate its losses, but it is not in the superior position which would permit it to exact retribution if its demands are not met. Thus, there seem to be significant preliminary grounds for preferring the FC or PP principles for both efficiency and equity reasons.

Before turning to the multilateral case, we should point out that the theoretical symmetry among the PP, FC, and VP principles indicated above is dependent upon the assumption (usually made in the classical international trade literature) that resources are immobile internationally. If this is not the case, capital or labor movements will cause the outcomes of the principles to differ.

We now proceed to a rather technical discussion of the efficiency properties of the various principles in the context of an international economy. The most efficient operation, use, or allocation of a common property resource (CPR), be it national or international in impact, is to design a management-ownership-rights solution which will operate to maximize global rent of the CPR. A full costing principle means that there is a payment between emitter and receptor countries, with the normal presumption that the emitter country will tax (and/or require emissions contracts from) internal polluters and the receptor country will provide payment to the internal damaged parties. In this case, the countries act as neutral (and presumed costless) allocators of funds, but in so doing they perpetrate international inefficiencies unless one or both governments take additional control measures. The inefficiency occurs because other governments or private negotiators are not directly and competitively involved to remove the distorting impact on profit rates of firms or consumer prices. In consequence, with resources internationally mobile, resources will be inefficiently allocated in a global context.

A rigorous proof of this assertion is given elsewhere.¹⁶ What we wish to do here is provide a heuristic argument justifying this conclusion for the bilateral case where emissions from the emitter country's

16. *See id.*

firms raise production costs in the receptor country. To make the case simple and tractable, we shall omit considerations of control costs for the emitter country or defensive expenditures by the receptor country. Thus, reduction in damage can only come about through reduced production in either the emitter or receptor country. We shall also assume that damage costs increase at an increasing rate with increased output of firms in the emitter country for any positive and constant level of output by firms in the receptor country.

If the firms in the emitter country are taxed by their government according to total damages, total damage payments will be less than optimal damage payments because of the assumption of increasing marginal damages with increasing output. The net effect is to decrease the average cost in the emitter industry below that of the optimum but above average cost without compensation. Thus, at the zero profit point for each firm where average costs are minimized, output per firm is necessarily lower than the optimum, while price is also lower. Both price and output per firm are below what is optimum for the emitter country, and this implies that total output is too large for the industry taken as a whole. This result occurs because price for the country's output can only be lower than the optimum if industry output is larger than the optimum, given that market price falls with greater quantity delivered to the market. Thus in the emitter country the price of the domestic product is too low and production is excessive, which means, if there is international mobility of resources, that too many resources will be utilized there. A parallel situation arises in the receptor country. Since all firms are now *totally* compensated for damages, average costs are lower than they would be if payments were made contingent on marginal damages. The net effect is to cause firms to produce at a lower price and lower output, but by the arguments given above, total output in the receptor country must be excessive. In consequence, there is an over-allocation of international resources to the receptor country as well. What we observe is a distortion in the international flow of resources resulting from an implied non-competitive use of the CPR linking the emitter and receptor counties.

The FC principle could be made efficient, allowing for international mobility of resources, if the emitter country taxed its own firms according to marginal damages and then refrained from paying the receptor country, or if for some reason the receptor country's government was convinced that damage payments would not be rebated to the internally affected industry. It might be easier in an

international context to get agreement on the FC principle if a stipulation of no transfer of funds among states was accepted.

With the PP principle, we observe international distortions with mobility of resources even if the level of emissions is agreed upon in advance. Here average costs of the emitting firm rise by less than the optimum, since residual damages are not compensated. The net effect is likely to be a less-than-optimal price and output per firm in the emitting country and thus excess international resources committed in the long run. The receptor country's firms have reduced damages but are not compensated for residual damage. In consequence, average costs will decrease but it is uncertain whether the decrease will be greater or less than what is globally optimal.

Under the victim pays principle, average costs of emitters are below the optimum and, through higher short term profits, entry of new firms will be encouraged. With international resource mobility, new firms will continue to enter until excess profits are eliminated. But as the number of firms expands and prices decline, the amount the receptor country's firms pay will increase to the point where profits are negative or at least not excessive. The long-run adjustment therefore should generally lead to excessive resources being committed to the emitter country and too few resources to the receptor country. Such a situation may also not be stable, since at equilibrium firms in the receptor country must make excess profits to pay compensation, and without further governmental regulation it will be advantageous for individual firms at the margin to break away from the coalition and not pay their share of the compensation. This condition occurs because, with increasing marginal damages, the amount paid by any one firm will exceed its losses at the margin by being subject to an additional amount of waste discharge.

The Multilateral Case. With multi-country environmental problems, assessment of the efficiency of the previously stated principles in allocating global resources is much less clear than in the bilateral case just analyzed. As an example, consider one upstream country with waste discharges affecting two downstream countries. With the FC principle, there is the problem of arriving at an agreement between the downstream countries about which is damaged the most and which should consequently be compensated the most. The PP principle contains similar problems in that there must be joint agreement on acceptable levels of upstream control. Finally, the VP principle is fraught with so-called "free-rider" problems in that, if one country provides a substantial amount of the necessary controls, the second downstream country receives reduced damages at no cost. If,

in general, there are more receptor countries than emitters, then it will be more difficult, in terms of coordination, for a solution to emerge under the VP principle than under the FC principle. This result follows because the agreement on compensation requires a greater number of sovereignties arranging to make a payment, which inherently seems more difficult to negotiate than those same sovereignties agreeing to *receive* a payment.

Summary. The various principles of state responsibility have substantially different impacts on the global efficiency of resources unless there are no transfers of resources among nations. With no transfers or movements, the various principles tend to affect only the distribution of wealth among nations. In terms of allocative efficiency, the "best" principle would be one of converting all CPRs to internationally operated and regulated resources. But such a conversion may imply substantial changes in wealth and therefore may be unacceptable. The principle with the most desirable efficiency properties would appear to be a modified FC principle where the emitter country's government taxed internal firms according to receptor country damages but did not provide compensation to the receptor country.

Solutions for Universal Common Property Resources

It appears that the principle of common ownership among nations of universal common property resources can be presumed. Without offensive actions or viable non-market threats, it is unreasonable to conclude that any single nation could openly appropriate a universal CPR or that it would be in the national interest of any sovereignty to exclude itself voluntarily from ownership. However, the central issue on the efficient use of universal CPRs concerns the right of access and use, as has been demonstrated by the various coastal boundary disputes. A single nation with access to a common property resource has economic incentives to utilize it inefficiently, not unlike a petroleum firm pumping from a common pool. The petroleum firm will pump more than is optimal because if it does not, some other firm will reduce its share. Again, the economic principle which will lead to greatest global efficiency is likely to be the common property resource institution rule (CPRI) cited earlier, which allocates the CPR according to highest-valued use. But such a principle appears absurd in view of national sovereignty and the character of universal CPRs. For example, it seems ludicrous to presume that any nation would formally and voluntarily relinquish allocative choice-making for the

stratosphere and its *services* over the country.¹⁷ None of the bilateral principles for adjudicating economic responsibility appears to offer meaningful guidelines for universal CPRs. However, with a few notable exceptions, the FC principle is the principle of state responsibility with the most desirable economic efficiency characteristics where universal CPRs are not directly regulated by supra-national organizations.¹⁸ This is because the degree of distortion between domestic-international prices and domestic social costs is then minimized. In application it could, at best, resemble the theoretical ideal only crudely because of great difficulties of evaluation and enforcement. There is at present no body of international law that could make the principle enforceable in practice. The same can be said about the less efficient PP principle. Without some substantial innovations and revisions in the international order, we will be stuck, *de facto*, with the VP principle as the main device for dealing with universal CPR problems.

One variant of the CPRI principle which may merit discussion because of its incentive structure and resulting efficiency properties, and which might possibly be practical, is the establishment of an international fund into which each country would automatically pay some proportion of its GNP or a sum related to its actual use of universal CPRs. The fund would be administered by an international body having two major responsibilities: to concern itself with universal common property resources and to act as an international tribunal awarding compensation to sovereignties that suffer damages from transnational externalities. An example of the first kind of responsibility would be cleaning up or controlling an oil spill occurring in international waters. Costs would be assessed against that portion of the fund supplied by the country under whose flag the ship sailed. That country presumably would have an incentive to shift all or at least some of this cost back to the company owning the tanker and thereby provide an incentive for safer operations. In its second role, the agency would hear claims for damages resulting from transnational externalities. The victim's sovereignty could confront the active party, or in reciprocal cases, the parties could confront each

17. It might be noted that in the case of atomic weapons testing and space vehicular travel, involuntary allocation has already occurred. However, the ban on intra-continental travel of SST-type planes is an example of a case where potential involuntary allocation of stratospheric services is at least partially controllable.

18. The main exceptions are the situation of preferences for fixed site assets in another sovereignty and the principle of multilateral action with respect to international trade aspects.

other, in what would amount to an adversary proceeding. After hearing evidence, the international tribunal would make awards, taking the necessary funds from that portion of the fund contributed by the nation judged responsible for the damage. If such damages were of a continuing variety rather than once and for all, the payments would be assessed at an annual rate to be diminished or terminated upon demonstration that ameliorating measures had been taken. The important characteristic of this variant of the CPRI rule is that it provides a form of insurance to nations damaged by use of universal CPRs by other nations, and thus to some extent it recognizes implicit entitlement to universal CPRs. And this "insurance" need not necessarily be contingent on identifying the CPR user nation(s), though for global efficiency in most cases such identification is necessary.

Preferences for Fixed Site Environmental Features in Another Sovereignty

Not infrequently, unique or rare natural environments are destroyed or blemished because of the inability of a state to regulate its internal industrial, mining, or agricultural activities or to foresee the future value of these resources. No doubt there is widespread regret that the Hetchy Valley in California has been devoted to a water supply reservoir and that uranium mining was permitted on the rim of the Grand Canyon. In the discussion that follows, we assume away internal enforcement problems and short sightedness, although these are no doubt important determinants of what is happening to the natural world.

The case we consider here is this: a state within which a unique or rare natural feature resides does not accord it sufficiently high value to wish to preserve it in the face of development pressure, but the residents of another state do value it enough that, if their preferences counted, the feature would be preserved. There are many cases which may fall into this category, and they are often characterized by considerable urgency in terms of a rational decision.

A case in point is Kenya, which occupies some of the best of the East African wildlife country. The net growth rate of population approaches 3.5 percent per year, the highest in the world, and it may remain very high for a long time to come because about half the present population is under 16 years old. Kenya's population is expected to double in less than 20 years. Population pressure has caused a spillover of the human population into drier game-supporting Savannah lands. The time is rapidly approaching when, unless major new lands are brought into cultivation, there will be less than

one acre of arable land per person. Some of the best remaining agricultural lands are in Mosail and on the borders of the Mara game reserve. It is to these lands that 1,500,000 wild beasts, zebras, and gazelles from the Serengeti Park come during their seasonal migration. The results of dense human settlement in this area and of farmers protecting their crops can readily be imagined. Similar situations exist with respect to other African parks.¹⁹ Many visitors, potential visitors, viewers of African films and TV shows, and readers of natural history all over the world must deeply regret the impending damage to, or ultimate destruction of, one of the world's great natural spectacles. Ecologists tell us that the associated loss of genetic information will be irreversible.

In principle, this situation is similar to the technological externality situation discussed earlier. One could readily make an argument for applying the FC or PP principle—i.e., the East African countries should bear the cost of maintaining this international treasure and compensate the rest of the world for damaging it. The situation is not different from that of one country polluting a river and causing environmental degradation in another without regard to the values it destroys.

In practice, however, this type of argument would prove unacceptable. To begin with, the evaluation problems associated with option demands and preferences of citizens of various culturally diverse countries are almost certainly unique and intractable. These problems are vastly complicated by the huge differences in value systems and preferences among countries and the associated complexities in making interpersonal comparisons. Secondly, the distributional implications are so extreme that, even in the absence of any clear criterion of justice for international income distribution, most people would rebel at the thought of wealth transfers from the poorest people on earth to the richest.

It seems that in this case state responsibility consists of accepting the VP principle or some limited form of the PP principle under which the developing country is partially responsible for control costs and other countries bear all residual damages. Since the site is fixed geographically with no non-market environmental dependencies, there are no problems of an efficiency character in its use under a VP principle so long as external values for its use are completely represented when decisions are made. But unless this principle is accepted on a multinational basis and the negotiation-arbitration costs of

19. See Myers, *The People Crunch Comes to East Africa*, 82 NAT. HIST. 10 (1973).

multinational action can be overcome, other nations may suffer a highly regrettable irreversible loss. The essential problem to solve here is the development of an international agency that can facilitate implementation of the VP principle. Limited organizations for specific sites such as the Nubian monuments have already emerged. But a much more encompassing institution subsidized by the common nations appears to be needed. Furthermore, as in all applications of the VP principle, there is the potential for extortion. But in this case, it is more self-limiting than in the case of actual transnational pollution. The maximum the "polluter" country can do in this case is to destroy the internationally valued resource, or threaten to do so.

Problems of International Trade

If external diseconomies associated with waste disposal occur wholly within the boundaries of a single country with no impact on external preferences, national efficiency in production-consumption can be achieved by that country by applying the various principles of individual or state responsibility described earlier, as long as resources are immobile internally or the state provides additional restraints on relocation of internal resources. From the global efficiency perspective, however, such autonomous decisions on internal waste discharge controls may lead to inefficiencies by distorting international prices and creating a comparative advantage among countries. Consider, for example, two countries, one accepting the FC principle internally and the other the VP principle internally. Even though the first country may have a distinct comparative advantage in producing waste-intensive commodities (i.e., commodities that have relatively high waste discharges associated with their production), it will be induced, through profit disadvantages in terms of international trade, to produce commodities with relatively less waste discharge. In effect, there is a loss in world income because of the shift away from comparative advantage of the two countries in providing waste-intensive and extensive commodities. If resources are mobile internationally, the loss in comparative advantage is even more pronounced since resources will move in response to incorrect profit signals. In the long run, the country with a comparative advantage in producing waste-intensive commodities and adopting the FC principle without other controls will lose resources from this sector to the country imposing the VP principle.

To achieve global efficiency in resource use thus necessarily requires harmonization of internal principles of responsibility among nations. The adoption of various principles without harmonization

results in distortions in international trade highly similar to tariffs and export subsidies: relative costs are not reflected internationally in relative prices. It should be pointed out that this is not a direct problem with external preferences for a fixed, unique site except through potential distortions in travel, an increasingly important component of international trade and payments among countries.

While the concept of harmonization of internal principles of responsibility may be important in the long run, it might be difficult to achieve now because of the short-term effects on the balance of payments, national income, and employment. It would appear very useful in an international context for nations to agree to a general principle and then allow flexibility in the timing of implementation to compensate for short-term social effects.

It is important, however, that there be consistency between the principles of responsibility adopted internally by countries and those adopted for external responsibility. To see why this is important, consider the types of incentives that would emerge if a country adopted an FC principle internally but a VP principle as regards state responsibility. Firms within that country would then have incentives to locate and pollute on the boundaries of the country even though this might not result in efficient use of internal or common property resources.

Solutions for Developing Countries and Multinational Corporations

The developing countries exhibit a great range of environmental problems, attitudes, and preferences. National sovereignty requires that developing countries, as well as all others, be given the maximum scope to design their own environmental policies and standards with respect to their internal environments. Still, it would be closing one's eyes to reality not to admit that they will have some special problems in doing so in a way that maximizes the welfare of their populations. Moreover, population pressures and the quest for rapid economic development may induce them to use technologies which produce quick payoffs at the expense of grave, longer term costs to other nations' environments as well as their own.

One of the most striking aspects of environmental problems in developing countries is the rate at which they are getting worse—especially in the rapidly urbanizing areas. In Sao Paulo, huge costs must be incurred soon to try to improve a potentially disastrous water quality situation. Similar situations appear to prevail in many other locations. To some extent this is the result of a conscious policy of delaying expenditures on environmental improvement

while economic development proceeds. But it also reflects the almost complete absence of analytical and planning capabilities with respect to the environment, as well as the primitive state of public policy and public administration in many developing nations.

Accordingly, state responsibility in the more technically advanced countries would seem to involve development of a benign paternalism to replace the often exploitative paternalism of the past and present. Some possible components of this new attitude would be a system of environmental impact statements to accompany and ideally to influence the evaluation and design of projects financed by foreign aid programs. In a primitive way, a program of this kind is already getting underway under World Bank auspices.

Various types of technical assistance can also be imagined. The U.N. agencies might be an especially appropriate medium for a program which could include training as well as the provision of technical personnel to help develop local competence in environmental analysis and planning. Subventions might be provided to make such a program more attractive.

Finally, several of the more developed countries in which the major multinational corporations have their headquarters could use whatever control they have over these corporations in the interest of at least minimal environmental protection in developing countries where these corporations also operate. It is known from a number of studies that rather far-reaching environmental protection designed into a new facility when it is just in place will increase its cost very little. It is often the last 10 or 20 percent of protection which becomes very costly. Also, going back and retrofitting existing installations is usually much more costly because of disruptions and because the range of available technical options is then considerably restricted. Consequently, an arrangement whereby multinational corporations agreed, or were required, to design at least minimal protection into their facilities in developing countries would probably be highly beneficial.

THE PROBLEM OF INFORMATION AND TRANSACTIONS COSTS OUTLINED

Economists have recognized for a long time that one of the major impediments to efficient solutions of common property resource problems is the costs associated with obtaining information, achieving agreement by all interested parties, and maintaining or enforcing the resulting agreements. These costs are all grouped under the term "transactions costs"—the cost of successful negotiation per se. In this

section we briefly outline the ramifications of the various economic principles of state responsibility when transactions costs are a significant barrier in resolving problems of CPRs.

As discussed earlier, there are three major types of externalities. One involves preferences for resource conservation outside one's sovereignty; another, direct environmental linkages among countries; the third, indirect environmental linkages via distortions in trade prices and patterns. Here we shall only examine the impact of transactions costs where direct environmental linkages appear in the bilateral nation case. It must be emphasized that preferences for fixed site resource in other countries offer many unique and difficult problems where information costs are high and there is no incentive to pay for them because of lack of information initially. For example, a country may decide to assert that a particular national treasure is being preserved when in fact it is being degraded, as long as information on the resource is not readily available to the citizens of other countries. The current exploitation of the Amazon jungle is a case in point.

There appear to be four cases regarding transactions costs for transnational externalities: (1) where transactions costs are always or nearly zero between emitter and receptor countries; (2) where transactions costs are positive and significant both before and after emergence of an externality; (3) where transactions costs are positive before the externality appears but zero thereafter; and (4) where transactions costs are zero before the externality appears but positive and perceptively significant thereafter. Case (1) can be easily disposed of as one which rules out the existence of externalities that are not *a priori* resolved by market or internationally public negotiations. The Coase proposition on the neutrality of property rights is a special case of (3).²⁰ Case (4) appears to be logically unreasonable. Finally, case (2) is the important one taxonomically for analyzing "real world" problems. An important subset of cases under case (2) arises where transactions costs are different for the two countries either independent of or dependent upon the prevailing rules for state responsibility and liability.

Transactions costs may affect negotiations in a multitude of ways, depending on their source. These include: uncertainty and information gaps (or costs); known or unknown contracting or negotiation costs; cost associated with organizing and sustaining negotiations between countries, including dissemination of information; and enforcement costs for existing contracts. Of these different types of transactions costs we shall concentrate briefly only on two types—

20. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

those associated with confronting an uncertain prospect of a future environmental externality and those associated with negotiation once the externality has occurred.

A realistic case is one where, under the FC principle, the receptor country incurs negotiation costs, and under the VP principle, the emitter country pays such costs. Thus, those who potentially gain are assumed to initiate negotiation and underwrite the cost of negotiation. Positive negotiation costs, regardless of whether the FC or VP rule is adopted, will impede negotiation so that the optimal level of environmental damage activity *with* zero negotiation costs is never achieved; the cost of additional accuracy of information, monitoring precision, etc., at some point will make it not worthwhile to be closer to this optimum. Costly negotiation where one country incurs these costs may lead to a case where an FC or PP rule results in a higher level of externality-generating activity than a VP rule. This outcome can be induced by differences in marginal utility of income between the emitter and receptor countries as well as a large number of assumptions on initial endowments and preferences. The important point here is that it cannot be *a priori* determined that FC or PP principles will reduce transnational external diseconomies by a greater amount than no such principles when negotiation costs are introduced and must be paid by the country initiating negotiation. If negotiation costs are different for the two countries, the outcome is even less clear. It often has been contended, however, that emitters must have lower negotiation or organization costs than receptors, since receptor countries generally are numerous while the emitter often is viewed as a single country—suggesting that an FC or PP principle might yield a greater reduction in environmentally harmful effects than a VP principle. Whether this greater reduction is globally more efficient cannot be established except by individual case. Under FC or PP rules, the receptor country must undertake negotiation costs since there is no incentive for the emitter to do so unless some provision for punitive damage payments could be agreed upon and enforced. Alternatively, under VP there is an incentive for both nations to undertake negotiations and incur such costs. Thus, with regard to incentives to “discover” the extent of environmental harm, the VP principle appears more efficient. What is important from the above very brief statements is that FC or PP principles or lack of them, with transactions costs, requires for allocative efficiency an additional international rule specifying who must incur these costs. For example, if the FC principle is adopted but there is a negative differential between such costs for emitter and receptor, efficiency is

not obtained if the receptor must always pay them. Without such an international rule, negotiation in some instances may be completely stopped and inefficiencies will result.

SUMMARY AND CONCLUSIONS

We have attempted to demonstrate that there is no overarching principle of state responsibility such as "the polluter pays" which is politically or economically (in the efficiency sense) applicable to the entire spectrum of transnational environmental problems. In bilateral cases of transnational pollution, the adoption of a full costing principle by all nations appears to be relatively efficient if the emitter country does not compensate the receptor and the receptor country does not utilize the payments by the emitter country to compensate firms (or individuals) for damages. In multilateral cases, the FC principle also appears to be the most efficient if the number of receptor countries is large relative to the number of emitters, because negotiation costs can be expected to be lower. It should be noted that in both cases, if negotiation or other transactions costs are significant, a viable internationally agreed-upon rule for identifying who must incur these costs and setting penalties for not doing so needs to be specified.

No nation will easily accept international agreement on entitlements of universal common property resources without compensating payments to retain its perception of national wealth. In consequence, the classical answer to externality problems—internalizing the decision-making process for the resource—is not easily transferable to these transnational problems. A new overriding element of distributional gains and losses must be simultaneously included in efficiency considerations. We suggest that with universal CPRs a special environmental insurance fund be set up under international auspices, with an agency empowered to allocate such funds to damaged nations and limited authority to establish annual payments or rebates.

In the case of fixed site preferences in other sovereignties, efficiency is achieved by adoption of either the full costing or victim pays principle. In consequence, the particular principle of state responsibility is not of major concern as long as all diverse interests in the use of the resource are represented. This can be most easily resolved with the VP principle, provided the requisite information and mechanisms for negotiation are available. Here we recommend

the creation of an international agency with the explicit duty of facilitating information flow and possibilities for negotiation.

Finally, for global efficiency in the utilization of internal as well as common property resources, we find that the principles of state responsibility internally need to be harmonized with external principles.