Global environmental media are jointly used as a public good by the world as a whole. Diffusion processes are not too important. Examples are the ozone layer and the global warming of the atmosphere. Instead of the diffusion function 12.1, Eq. 12.2 holds defining an international public good.

Global environmental media can be interpreted as open access resources, as a commons with no scarcity price being charged for their use. In principle, each country can take the free-rider position, hoping that the other countries will care for the public good. In addition to the free-rider position other features complicate the solution to the problem:

- Countries or their people may have different preferences with respect to global environmental media and they may have different risk attitudes.
- Even assuming identical preferences and risk attitudes, income per head varies considerably among the countries of the world; this implies a different evaluation of the global environment.
- Although global environmental problems can be interpreted as a public good for mankind, countries may be affected differently if the quality of the public good changes. This indicates that in spite of Samuelson’s definition (1954) that the public good “is used in equal amounts by all” the user intensity varies among countries. For instance, global warming and the resulting melting of the ice caps would negatively affect the low lands of the earth such as Bangladesh and the Netherlands.

If a new institutional arrangement is sought, two questions arise: i) Can an agreement be reached? ii) Will the countries stick to the agreement once the agreement is in place? In order to discuss these questions we first analyze the properties of the noncooperative and of the cooperative solution.

The Noncooperative Solution to Global Media

In contrast to the transfrontier problem, the damage for a specific country \( i \) now depends on reductions of emissions in country \( i \) and \( j \), \( D^i(S_0 + S_0 - S_i - S_j) \) whereas costs of abatement are country specific \( C^i(S_j) \).

In the noncooperative setting each country minimizes its total cost taking abatement in the other countries as given

\[ 1 \]

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H. Siebert, *Economics of the Environment*  
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yielding the optimality conditions for the optimal abatement levels $S^1_r$ and $S^2_r$

\[
-\frac{dD^1}{dS_r^1} (S^1_o + S^2_o - S^1_r - S^2_r) = \frac{dC^1}{dS_r^1} (S^1_r)
\]

\[
-\frac{dD^2}{dS_r^2} (S^1_o + S^2_o - S^1_r - S^2_r) = \frac{dC^2}{dS_r^2} (S^2_r)
\]

In the noncooperative solution of the Nash game, each country abates pollutants up to the point where its marginal benefit is equal to its cost of abatement. The optimal solution of the individual country takes the emission level in the other country as given. It is assumed that both countries take a decision simultaneously. In Fig. 13-1 the optimal points of the noncooperative solution are illustrated by $A^1$ and $A^2$, respectively. In Fig. 13-1, $OS^1_o$ is the quantity of emissions contributed to the global public good by country 1 if no abatement measures are introduced; likewise $OS^2_o$ for country 2. $OS_o$ is the total quantity of emissions of both countries. Abatement in the noncooperative solution by country 1 ($S^1_o D$) and country 2 ($S^2_o E$) add up to $S_o A$.

Equations 13.2 and 13.3 define the reaction functions $R^1 (S^2_r)$ and $R^2 (S^1_r)$ of both countries. The reaction function is the set of the minima of the indifference curves which are to be interpreted as curves of equal total costs $\tilde{a}^1 = D^1 (S^1_o + S^2_o - S^1_r - S^2_r) + C^1 (S^1_r)$. For country 1, the curve of equal total costs has the property

![Fig. 13-1. Global environmental media](image-url)