Staff Papers Series

Staff Paper P90-15 March 1990

PUBLIC CHOICE IN INTERNATIONAL POLLUTION

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Staff Papers are published without formal review within the Department of Agricultural and Applied Economics.

Public Choice in International Pollution

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1. Introduction

Around the globe, the demand for environmental quality is growing. In some cases, as in the impact of acid rain on forests, the growing demand for environmental quality has met a shrinking supply. In other cases, environmental quality has improved but supply growth has been outstripped by the growth in demand. Throughout the world, major efforts are now underway by national governments to increase the supply of environmental quality. National governments acting alone can, in principle, be successful in improving environmental quality when the sources of pollution are located within the government's jurisdiction. This is not possible, however, when the domestic pollution originates abroad as is the case with international air and water pollution and their consequences, including acid rain, the greenhouse effect, or the degradation of the earth's ozone layer. In essence, the rules that govern the regulation of transboundary pollution, i.e. of pollution that crosses the boundaries of autonomous jurisdictions, represent an international institution and thus an international public good. No government can supply itself with such a good other than in cooperation with other countries. Here, we define cooperation as one country's reduction in the externality conditional upon other countries doing the same.

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Following, we will focus on the political economy of international pollution using a public choice approach. First, we will develop a theoretical framework that captures the incentives of governments for regulation of pollution by domestic industries. Then, we will discuss the incentive structure of countries for international cooperation in transboundary pollution control. We will conclude with a brief discussion of some practical implications for policy coordination.

2. A Public Choice Approach to International Pollution

The theoretical framework focuses on domestic pollution control policy decisions in the presence of transfrontier movements of pollutants. We will adopt the nomenclature of economics and refer to pollution as externality. The models represent supply-side approaches to policy modeling in that they are based on the political economic calculus of the regulator as the supplier of environment policy.[1] Following, a non-cooperative model based on Nash behavior will be developed. The results of this model will then be compared with a cooperative solution.

Symbols

W = policy maker's utility

V = political support

U_c = utility of consumers

π_b = profit of producers

π_c = income of consumers

b = externality (bad)

b_d = domestic externality consumed domestically

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[1] Notice that political economic models typically result in optima different from social welfare optima.

b_e = domestic externality exported to and consumed in third countries

b_m = externality from abroad; imported externality

b_t = total externality consumed domestically

2.1 A Nash Model

In this section of the paper the amount the externality from abroad is considered given by the regulator ($b_m = \bar{b}_m$). As will become evident, this assumption implies in a Nash equilibrium from which the regulator can not deviate unilaterally without being worse-off. Following, the domestically produced externality that is consumed abroad will be referred to as 'exported' and the domestically consumed externality from abroad as 'imported'.

Assume a single regulator's strictly concave utility function that contains as arguments the political support from consumers and from a group of producers that also produce an externality in the form of pollution. The political support of the regulator from producers and consumers can be thought of as votes. Campaign contributions and other lobbying activities can be seen as generating votes from these two groups.

(1) $W = W(V_b, V_c)$

The regulator maximizes utility subject to the following two concave constraints:

(2) $V_b \leq V_b\ (\pi^*_b + \pi_b\ (b))$

(3) $V_c \leq V_c\ \{U_c\ [\pi_c(\pi_b),\ b_d,\ \bar{b}_m]\}$

where

(4) $b_d = \beta\ .\ b$

(5) $o \leq \beta \leq 1$

Eqs. (2) and (3) represent the political economic constraints that the regulator faces. According to eq. (2) the political support of producers is a function of their total profits where π^*_b denotes the actual profits when the externality is internalized, and π_b denotes the additional profits that result from the production of the externality, where π_b is a positive function of b. Denote the externality at the private optimum as $\tilde{b}$, then total profits at the private optimum are the profits at the social optimum (where b=s) plus the additional profits that result if the output of the externality is not regulated and the industry produces at the private optimum:[2]

(6) $\tilde{\pi}_b = \pi^*_b + \pi_b\ (\tilde{b})$.

In eq. (3), the regulator's political support from consumers is a positive function of consumers' utility, where the utility is a positive function of consumer incomes and a negative function of the amount of the externality that is consumed domestically. Consumer incomes are related to producer incomes. How close this relationship is depends on the share of total inputs owned by consumers that are used in the externality producing industry. It also depends on the structure of the markets for production factors, as this determines how much the price and/or use of a production factor changes when profits change.

In eq. (4), the total externality produced is consumed in fixed proportions by domestic and foreign consumers. That is $b = b_d + b_e$ where b_d is defined as in eq. (4) and, therefore, $b_e = (1-\beta)\ b$. If $\beta = 1$, the externality is only consumed domestically; in this case, the maximization

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[2] As we have formulated the model such that the externality may partially or in total affect foreign countries, the term social optimum refers to a global social optimum in the tradition of welfare economics.

problem is reduced to one of optimal regulation of domestic pollution. If $\beta = 0$ the externality is entirely exported to third countries.

The solution to this maximization problem is:

$$(7)\quad (\partial W/\partial V_b) \cdot (\partial V_b/\partial \pi_b) \cdot (\partial \pi_b/\partial b) + (\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot (\partial U_c/\partial \pi_c) \cdot (\partial \pi_c/\partial \pi_b) \cdot (\partial \pi_b/\partial b)$$

$$= - (\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot (\partial U_c/\partial b_d) \cdot \beta$$

Eq. (7) has an obvious political economic interpretation. It can also serve as a basis for the formulation of hypotheses about the political economic optimum amount of the externality.

The two terms of the sum on the left hand side of eq. (7) represent the marginal political economic benefits of a growing output of the externality. These benefits arise via increased political support from producers and/or consumers as their incomes grow with increasing b. The right hand side of eq. (7) represents the marginal political economic costs of increasing the output of b, as consumers' utility is negatively affected by an increase in the consumption of the externality. Hence, the optimal amount of b is chosen such that the marginal political economic benefit of an increase in b equals its marginal political economic cost.

According to eq. (7), any change in the control variable has a distinct effect on the political support by the industry that produces the externality. A reduction of b results in declining profits and thus reduced political support from the industry. A decline in b raises consumers' utility, but simultaneously it may also have the opposite effect. In particular, consumer income, and thus consumer utility, declines as a consequence of declining profits in the polluting industry. Hence, the net change in political support from consumers that results from a reduction in b is not determined a priori. The direction of its change is determined by the aggregate effects of the respective partial derivatives in eq. (7).

The political economic optimum condition for the regulator's control variable b in eq. (7) can be illustrated graphically. Denote

(8) $A = (\partial W/\partial V_b) \cdot (\partial V_b/\partial \pi_b) \cdot (\partial \pi_b/\partial b)$

(9) $B = (\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot (\partial U_c/\partial \pi_c) \cdot (\partial \pi_c/\partial \pi_b) \cdot (\partial \pi_b/\partial b)$

(10) $C = -(\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot (\partial U_c/\partial b_d) \cdot \beta$

In figure 1, the horizontal axis denotes the quantity of the externality and the vertical axis denotes the marginal political economic costs and benefits of deviating from the social welfare optimum (s).

In eq. (8), A is positive, as all partial derivatives of A are positive. The regulator's utility is positively affected by an increase in political support from producers; their political support grows with increasing profits; and producer profits are a positive function of b. Therefore, A is in the first quadrant.

Convexity of the constraint in eq. (2) implies that the private optimum in production is finite, that is, the marginal profit of an additional amount of the externality must be declining with increasing b, and A (in figure 1) has a negative slope.

Figure 1

In eq. (9), B represents the marginal political economic benefits to the regulator that result from an increase in b via the consumer income effect. The sum of A and B represents the total marginal political benefits (MB) of an increase in the externality. All partial derivatives of B are non-negative for obvious reasons. The only partial derivative that in reality may be zero is the change in consumer incomes as a consequence of a change in producer incomes. This would be the case when the price of consumer owned inputs or its quantity is not affected by the change in producer profits either because of a lack of consumers' market power on input markets, or if all inputs of producers are owned by non-consumers (e.g. foreigners). As long as none of the partial derivatives is negative B is in the first quadrant.

The slope of B is negative for the same reason that A's slope is negative. Hence, the total marginal political economic benefit of deviating from the social optimum (the sum of A + B) decline with increasing b.

C represents the marginal political economic costs (MC) of a growing deviation from the social optimum via the loss in political support from domestic consumers that is the consequence of the increasing disutility of consuming b_d. For reasons discussed above the first two derivatives are positive, while $\partial U_c/\partial b_d$ is obviously negative. As the expression on the right hand side of eq.(10) is negative, C must be in the first quadrant. The slope of C is non-negative and determined by β as defined as eq. (5).[3]

All other things being equal, the slopes of the curves are given by $\partial \pi_b/\partial b$ and β respectively. The position of the curves in space is determined by the other components that determine the political economic costs and benefits of government regulation of the externality, that is, these partial derivatives act as shifters of one or more of the curves in figure 1. According to eq. (7) the political economic equilibrium is determined by the intersection of MB (=A + B) and MC (=C). In figure 1, this is the case at b^o.

[3] Of course, if $\beta = 0$ the entire amount of the externality is 'exported' the private and the political economic optimum are identical.

The model discussed here has several implications for the amount of the externality produced domestically which are as follows:

(i) Political weights ($\partial W/\partial V_b$; $\partial W/\partial V_c$): The marginal political weight of consumers do not determine, a priori, how much of the externality will be produced at the political economic optimum. This is the case because consumer utility declines with increasing b. However, consumers may also benefit from the production of b via $\pi_c(\pi_b)$. That is $\partial W/\partial V_c$ affects both MB and MC. For instance, a growing marginal political weight of consumers would not only shift MC to the left but would also shift B and thus MB (=A + B) to the right. Whether this results in an increase or decline of the optimal b depends on the magnitude of these shifts, which are also affected by the other components of B and C.

This can easily be illustrated by rewriting eq. (7) as follows:

$$(7a)\quad (\partial W/\partial V_b) \cdot (\partial V_b/\partial \pi_b) \cdot (\partial \pi_b/\partial b) =$$

$$-(\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot [(\partial U_c/\partial \pi_c) \cdot (\partial \pi_c/\partial \pi_b) \cdot (\partial \pi_b/\partial b)$$

$$+(\partial U_c/\partial b_d) \cdot \beta]$$

In eq. (7a), the left hand side depicts the marginal political economic benefits of deviating from the social optimum via growing support from producers, whereas the right hand side contains the net cost of doing so via changing political support from consumers. As the first three partial derivatives in brackets are larger than or equal to zero while $\partial U_c/\partial b_d < 0$ and $0 \leq \beta \leq 1$, the sum in brackets can be positive or negative and thus can be the net political support from consumers; that is, whether the net support from consumers is positive or negative is determined by the expression in brackets on the right hand side of eq. (7a) where the marginal political weight attached to consumers acts as a multiplier (as does $\partial V_c/\partial U_c$; see below). Of course, a regulator who is indifferent with regard to the origin of the votes will attach the same weights to producers and consumers.

The effect of the marginal political weight of producers is unambiguous. The larger the weight the larger will be the obtimum b.

(ii) Political influence of producers ($\partial V_b/\partial \pi_b$): All other things being equal, the more sensitive the political support from producers is to changes in profits ($\partial V_b/\partial \pi_b$) the farther A (and thus MB) will be to the right in figure 1 and the higher will be b. According to a central hypothesis of public choice theory, a group can be expected to react the more pronounced with political support and thus will be the more influencial the more efficiently it can organize its lobbying efforts. Typically, relatively small groups, groups with fairly homogenous interests, groups that can supply its members with selective benefits, or those which have low costs of organizing a lobby for other reasons (e.g. because they are regionally concentrated) are more successful on political economic markets (see Olson, 1965).

(iii) Political influence of consumers ($\partial V_c/\partial U_c$): Arguments similar to (i) and (ii) hold for the determinants of the marginal change in political support from consumers when their utility changes. Group characteristics determine the sensitivity of political support to changes in consumer utility. However, the direction of impact on the optimum b can not be determined a priori; $\partial V_c/ \partial U_c$ acts as a multiplier and the direction of its impact depends on whether the expression in brackets on the right-hand side of eq. (7a) is positive or negative.

(iv) Income level ($\partial U_c/\partial b_d$; $\partial U_c/\partial \pi_c$): It appears immediately plausible that the marginal utility of consuming the externality and the marginal utility of income depend on the income level. The higher the income the larger is the marginal disutility of consuming the externality ($\partial U_c/\partial b_d$), and the smaller is the marginal utility of income ($\partial U_c/\partial \pi_c$) generated by an additional unit of the externality. In figure 1, the higher the income level the more will both MC and MB be to the left and thus the lower will be the optimal b, all other things being equal. Hence, one can expect the regulation of a negative externality to become tighter when incomes rise.

It appears plausible that there is some kind of 'dilution effect'; i.e. that the marginal disutility of consumers resulting from an increase in the output of the externality also is affected by a size factor. The more of a natural resource is available the less will an additional unit of the externality affect the average pollution of the resource and the lower will be consumers' marginal disutility and thus the optimum b.

To illustrate this, assume two countries, one having a large inland lake and one having a small inland lake. The countries are identical otherwise and the externality affects the use of the lake by consumers. Of course, any given quantity of b affects the lake quality per unit of water less in the country with the large lake than in the other country. Hence, the scarcer the natural resource that is affected by the externality the more will MC be to the left in figure 1 and the lower will be the optimum b, ceteris paribus.

(v) Structure of input market ($\partial \pi_c/\partial \pi_b$): The marginal change in consumer incomes as a consequence of a profit change in the industry that produces the externality and thus the position of B is affected by the structure of the input market and the amount of production factors of the industry that is owned by consumers. The latter, of course, is also influenced by the size of the industry in terms of employment.

The structure of the input market directly affects the incidence of consumer incomes and the profit of producers and thus $\partial\pi_c/\partial\pi_b$. Curve B will be further to the left and the optimum b will be the lower the less factor prices and/or total factor inputs increase with growing profits. For instance, if the capital of producers is predominantly owned by foreigners and/or the share in total employment is small a change in profits will only marginally affect domestic consumers. Therefore, such industries will face relatively tight environmental regulation, all other things being equal.

(vi) Sensitivity of producer incomes to environmental regulation ($\partial\pi_b/\partial b$): The more sensitive producer profits are to changes in b the more inelastic will be both A and B in figure 1. With increasing sensitivity of producer profits environmental regulation will be less affected by a shift of MC to the left. Hence, one can expect that those industries which are crucially dependent on a process that results in the externality will face less tight environmental regulation than those which can more easily substitute such a production process, ceteris paribus.

(vii) Domestic consumption and export of the externality (β): In eq. (10), β represents the share of the total output of the externality that is consumed domestically. If β is zero, that is, if the externality is consumed entirely by foreigners the marginal political economic costs of environmental regulation are zero unless either altruism is introduced or some form of strategic behavior with regard to mutually exported externalities.[4] With increasing β less of the externality is exported and more is consumed domestically and the slope of MC in figure 1

[4] We will come back to this issue in the next section.

increases. Consequently, the optimum will be at a lower b. For $\beta = 1$, the externality is entirely consumed domestically. If in addition to this there is no import of the externality from abroad the problem is reduced to one of the political economic optimal environmental regulation in a closed country with no transfrontier movements of the externality.

(viii) Import of the externality (b_m): When domestic consumers are affected by an exogenously given externality from abroad that cannot be avoided, MC in figure 1 shifts to MC', where the difference between MC' and MC results from the loss in political support by consumers who also consume the imported externality. As a consequence, the political economic optimum would shift to the left (b'); that is, the optimal domestic output of the externality is lower in the presence of a given externality from abroad. From figure 1, it is also clear that any reduction in the externality from abroad increases the domestic political economic optimum output of b.

2.2 A Cooperative Model

In a two country world, cooperation, as it is defined here, implies that one country agrees to reduce the domestic output of an externality that also affects the other country provided the other country does the same. This is, the amount of the externality from abroad is a positive function of the export and thus the domestic output of the externality (eqs. (11) and 12)).

(11) $b_m = b_m \ (b_e(b))$

where

(12) $\partial b_m/\partial b_e > o$

Notice that non-cooperative, non-Nash behavior would imply $\partial b_m/\partial b_e < 0$.

The basic idea behind eqs. (11) and (12) is analogous to explaining the provision of public goods (e.g. Runge, 1984). It has been formally anlayzed in the theory of reciprocity which stipulates that every economic agent is obliged to contribute more to the production of a public good conditional upon others doing the same (Sugden, 1984). The domestic regulator's maximization problem now is different from before in one of the constraints:

(13) $W = W\ (V_b,\ V_c)$

s.t.

(14) $V_b = V_b\ \ [\pi_b^* + \pi_b(b)]$

(15) $V_c = V_c\ \{U_c[\pi_c(\pi_b^* + \pi_b(b)),\ b_d\ (b),\ b_m\ (b_e(b))]\}$

The resulting optimum condition is:

(16) $(\partial W/\partial V_b)\ .\ (\partial V_b/\partial \pi_b)\ .\ (\partial \pi_b/\partial b) + (\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot (\partial U_c/\partial \pi_c) \cdot$

$(\partial \pi_c/\partial \pi_b)\ .\ (\partial \pi_b/\partial b)$

$= -(\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot (\partial U_c/\partial b_d) \cdot \beta$

$-(\partial W/\partial V_c) \cdot (\partial V_c/\partial U_c) \cdot (\partial U_c/\partial b_m) \cdot (\partial b_m/\partial b_e) \cdot (\partial b_e/\partial b)$

To simplify the notation let $\partial b_m/\partial b_e = \gamma$ where γ is given. Obviously, as $\beta = \partial b_d/\partial b$, it follows that $\partial b_e/\partial b = 1 - \beta$. If consumers' disutility of consuming the externality is indifferent with regard to the country of origin then $\partial U_c/\partial b_m = \partial U_c/\partial b_d$. To simplify matters further, let the environmental regulator be indifferent with regard to the origin of political supports, i.e. $\partial W/\partial V_c = \partial W/\partial V_b$.

Hence eq. (16) becomes:

(17) $(\partial V_b/\partial \pi_b) \cdot (\partial \pi_b/\partial b) + (\partial V_c/\partial U_c) \cdot (\partial U_c/\pi_c)\ .$

$(\partial \pi_c/\partial \pi_b) \cdot (\partial \pi_b/\partial b)$

$= -(\partial V_c/\partial U_c) \cdot (\partial U_c/\partial b_d) \cdot [\beta + \gamma(1-\beta)]$

If $\gamma = 0$, eq. (17) represents the political economic optimum discussed in the previous section. For $\gamma < 0$ and $0 < \beta < 1$, eq. (17) is the non-cooperative, non-Nash solution. If $\beta = 1$, eq. (17) is identical to eq. (7) as well. However, this is not a particularly interesting case to study cooperation, as there would be no exports of the externality to other countries. Therefore, the range of β will be restricted in the following to $0 \leq \beta < 1$.

The case of interest is the cooperative solution where $\gamma > 0$. Obviously, if $\beta + \gamma(1-\beta) = 1$, then the optimal domestic output of the externality is equal to the case in which the domestic externality would be completely consumed domestically with no externality from abroad. The reason for this result is that in this case any change in the domestic output of the externality is followed by an equal change in the total domestic consumption in the externality from both domestic production and from abroad; in other words, the change in the exported externality would equal the change in the externality from abroad. Obviously, this result occurs when $\gamma = 1$; i.e., when two countries have negotiated an equal reduction in the mutual export (and thus import) of the externality.[5]

If the negotiated γ is such that $0 < \gamma < 1$ ($\gamma > 1$) the optimal degree of cooperation would result in a production of the externality in any country which is larger (smaller) than the one that would prevail in the absence of transboundary movements of the externality. The reason is simply that when $0<\gamma<1$ ($\gamma>1$) a reduction in the export of the externality by one unit results in a decline in the import of the externality by less (more) than one unit.

[5] The expression is equal to one also if $\beta = 1$. As mentioned above this case has been excluded from discussion here.

The potential for cooperation can be illustrated graphically by deriving for a single country the domestic political economic rents in international pollution. In figure 2, the horizontal axis denotes the various components of the externality and the vertical axis denotes the marginal political economic costs and benefits. The marginal cost curve MC is based on the assumption that $b_m - \overline{b_m} > o$ and $o \geq \beta > 1$. The political economic optimum amount of domestic production of the externality is b^o.

If the externality from abroad would be zero the marginal cost curve would be to the right and parallel to MC (MC - $\overline{b_m}$). Therefore, the domestic production plus the import of the externality are $b^o + b^o_m$. If the total domestic output of the externality would be consumed domestically the resulting marginal cost curve would be MC + b_e; hence, the difference between domestic production and export of the externality would be $b^o - b^o_e$. Total domestic consumption is $b^o_t = b^o + b^o_m - b^o_e$. In figure 2 the net export of the externality happens to be negative and therefore $b^o_t > b^o$. Of course, net imports can be positive as well.

<u>Figure 2</u>

As MB represents the marginal political economic benefits of deviating from the social optimum the area under MB from s to b^o represents the total political economic benefit of regulating the output of the externality at b^o. By analogy, the area under the MC from s to b^o represents the total cost of allowing the production b^o. Hence, the political economic rent at the optimum is represented by the area sax.

As mentioned earlier, the assumption that $b_m = \overline{b_m}$ implies a Nash equilibrium. Hence, the environmental regulator cannot deviate unilaterally from b' without being worse off. However, a coordination of regulation between this country and the country from which b_m is imported may have the potential to increase the domestic political economic rents.

Policy coordination, as it has been defined here, implies an agreement on a mutual reduction in the production, and thus, export of the externality to the respective other country. Let MC′ represent the total marginal cost under policy coordination which implies that $\partial b_m/\partial b_e > o$. The new political economic optimum output is b'. Of course, in a two country world the negotiated γ must result in $b' \leq b^o$ in order to be acceptable for the other country

In order to be acceptable for the country depicted here the negotiated γ must result in a gain in political economic rents. That is, sax′ > s′ax, which obviously is the case in figure 2, as the horizontally shaded area is clearly smaller than the vertically shaded area.

Non-identical countries which differ much, (e.g. because of preferences, income level, political system, technology or extent of the exported and imported externality) may not cooperate without one country directly compensating the other. In these cases, one country's regulator may benefit from a mutual reduction in the output of the externality while the other may not. Hence, a bilateral agreement may only be brought about if the compensation that the benefiting country is willing to provide exceeds the reduction of political economic rents in the other country.

Figure 3

The essence of this kind of cooperation can be illustrated graphically as well. Figure 3 depicts such a situation which is typical of undirectional air or water pollution where one country pollutes (at least) one other country but does not receive pollution from this country. This case is quite common in the pollution of rivers that cross jurisdictional boundaries as well as in airsheds with prevailing winds from one direction.

In figure 3, it has been assumed that the country depicted does not export any externality at all; i.e., $\beta = 1$ and thus $b_e = o$. Moreoever, MC and MB intersect at s ($=b^o=b_d$), and production occurs at the social optimum. As there is a given externality from abroad ($b_m = b_t$), the regulator could gain by a reduction in b_m. However, as $b_e = o$, this country cannot offer a reduction in exports of the externality in exchange for reduced imports from abroad. Still, there is a potential for international cooperation, as it may be possible to induce the other country to reduce the externality via a direct transfer to (consumers and/or producers in) the other country. Here cooperation would imply that one country is willing to reduce its exports of the externality conditional upon the other (non-polluting) country making compensating payments. If the willingness to transfer income from this country to the other country is high enough to compensate for the loss in political economic rents resulting from a reduction in output of the externality, regulators in both countries can gain from such a transfer and cooperation would occur.[6]

A similar situation in which this form of cooperation may be brought about is the common resource use by high and low income countries. Due to high incomes the marginal political benefits of a more generous environmental regulation are relatively low whereas the marginal cost of doing so tend to be high. Hence, wealthy countries tend to do more to

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[6] Notice that his cooperative solution to an international pollution problem is not in accordance with the popular normative "polluter pays" principle.

constrain the domestic consumption of an externality, all other things being equal. Regulators in high income countries may well increase their political economic rents by buying out a low income country's right to (produce and thus) export the externality.[7]

3. Summary and Conclusion

The analysis in this paper suggests several reasons for the existence of policies that allow the private sector to deviate from the social optimum if there are externalities in production. If part of the domestically produced externality is exported to third countries total domestic output of the externality is higher than in the case in which the total domestic production of the externality is consumed domestically.

The additional externality from abroad leads to a somewhat lower domestic output of the externality but to a higher total consumption. This represents an incentive for policy coordination. The incentive effect is due, in essence, to a leverage effect; regulators in each country can gain politically by a joint reduction in the production of the externality, as any reduction in the domestic production (and thus export) of the externality results in a reduction of the externality from abroad as well.

The existing incentives for coordination in international pollution control policies, however, do not imply that such cooperation will actually occur. Besides transactions costs which can be substantial and which can inhibit international cooperation each country involved needs assurance over other countries compliance under an agreement and the

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[7]In these or analogous cases cooperation may also be brought about by widening the scope of the negotiations.

distribution of the net benefits of international pollution control policies need to be perceived as fair.

Any agreement on international policy cooperation consists of a set of rules that specifies the signatories' rights and obligations. Such an agreement represents a global public good. Public goods are frequently difficult to supply efficiently because of free-riding. The free-rider problem can be solved in principle, however, through a system of conditional commitments to contribute to the production of a public good (Sugden, 1984). Each economic agent would contribute to the production of a public good conditional upon others doing the same. The key for international agreements on transboundary pollution is that they have to provide the assurance that everybody 'plays by the rules' (Sen, 1967). This assurance is crucial for the production of any public good (Runge 1984).

Moreover, a public good will only be produced if there is agreement on the distribution of its benefits. To date, economic theory can only predict the range of outcomes of negotiations over the benefits of such agreements in principle, which is usually illustrated using Edgeworth diagrams. Recent advances in economic theory, however, may help to further narrow the range of distributions that is acceptable to the parties involved (e.g. Baumol, 1982).

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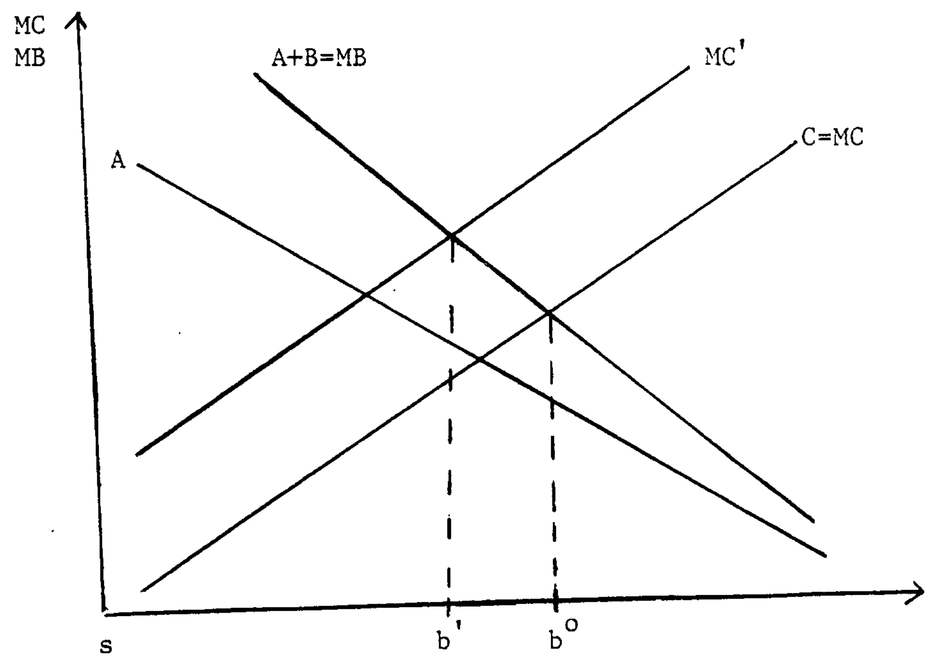

Figure 1: The marginal political economic benefits and costs of government regulation of a negative externality.

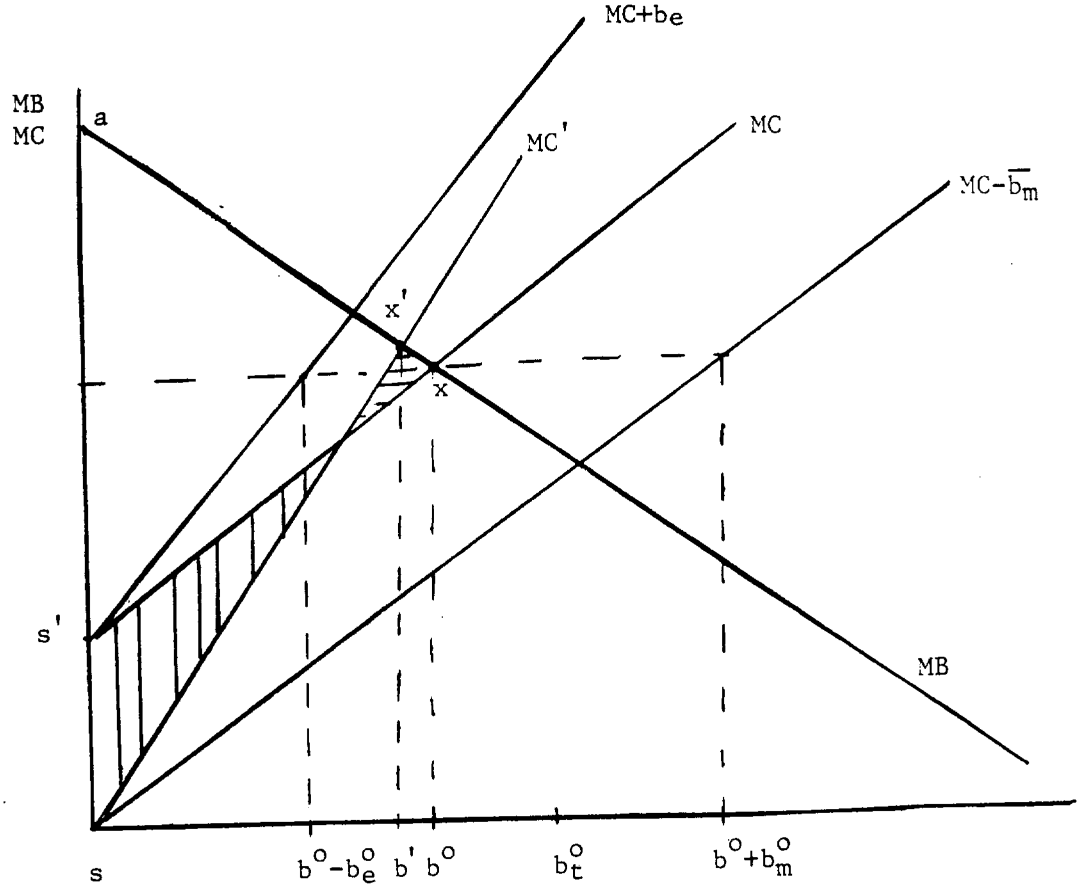

Figure 2: The potential for international cooperation in transboundary pollution control.

Figure 3: The potential for international cooperation in unidirectional transboundary pollution control.