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Internationally tradeable emission certificates: efficiency and equity in linking environmental protection with economic development

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Internationally Tradeable Emission Certificates
Efficiency and Equity in Linking Environmental Protection with Economic Development

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Abstract

Three topics dominate the formulation an international greenhouse-gas regime as part of an effective *global environmental policy. Efficiency, equity,* and *uncertainty.* And three major policy instruments are discussed as regards the implementation of the 1992 Framework Convention on Climate Change: A *carbon tax/C02-charge, joint implementation,* and *tradeable emission certificates.*

This paper tries to answer a question that has not been rigidly asked before: How could tradeable emission certificates be tailored in such a way as to be of benefit to the *developing countries,* to facilitate global environmental protection *and* economic development at the same time, and to meet *both* the efficiency and the equity criterion in international relations.

Next to market organization and rules of procedure, allocation of the entitlements is crucial. The author suggests a *dynamic formulae,* by which the initial allocation of certificates starts on the basis of *current greenhouse-gas emissions* but over time turns towards equity in the form of *equal per capita emissions.* In this way, making emission entitlements tradeable among countries implies not only that a globally effective limit to total emissions is attained with certainty, but also that the current unfair allocation of emission entitlements is consecutively shifted in favour of the poor countries.

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"The neat resolution of a free market that so beautifully reconciles byers and sellers does so far not reconcile growthists and earthists. Something new is needed." *Nathan Keyfitz*

I. The Idea and its Political Context

With respect to the formulation and implementation of a global climate policy, the "Berlin Mandate", the most important concluding document of the first Conference of the Parties to the Framework Convention on Climate Change, adopted on 7 April 1995, says the following:

> "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of *equity* and in accordance with their common but differentiated *responsibilities* and respective *capabilities".*

It continues:

> "The global nature of climate change calls for the widest possible *cooperation* by all countries [...]; developed countries [should] set quantified target limitation and reduction objectives within specified time frames, such as 2005, 2010 and 2020".

Finally, it states that

> "the process should begin without delay" (Berlin Mandate, 1995, italics added).

As regards "joint implementation", an instrument which affects both industrialized and developing countries, the Conference of the Parties decided

> "to establish a *pilot phase* for activities implemented *jointly* among *Annex I Parties* and, on a voluntary basis, with *non-Annex I Parties* that so request".

During this pilot phase, a framework should be established

> "for *reporting* in a transparent, well-defined and credible fashion on the possible global *benefits* and the national economic, social and environmental *impacts* as well as any practical *experience* or technical *difficulties* encountered" (Berlin Mandate, 1995, italics added).

The idea for the present paper arose out of this complex context of ethics and environment. The specific question to be answered is the following one: What form should a future policy instrument for the reduction of greenhouse gas emissions take if it is to enable both *global environmental protection* and *global development* while satisfying both the criteria of *economic efficiency* and *equity?* The answer, which will be explained in the following, is: by creating a market where so far no market exists, i.e. by introducing carefully designed internationally tradeable emission certificates.

II. Theoretical Context

Three main issues dominate the formulation of an international greenhouse-gas regime, in the form of a "Climate Protocol" within the Framework Convention on Climate Change that came into force in 1994: *Efficiency, equity,* and decision-making under *uncertainty.* And three policy instruments dominate the question of practical implementation of such a protocol: Introduction of an international *carbon tax* and/or CO2 *charge, joint implementation,* and *tradeable emission certificates (Emissions trading*[1]*).* The following discussion will cover all these instruments but will focus on the interactions between the equity issue and tradeable emission certificates.

1. International Emission Charges

Pearce has summed up the arguments in favour of introducing a carbon dioxide charge or carbon tax as an instrument of a global climate policy

> Incidentally, a concept for which twelve different names were found by the author in the English literature.

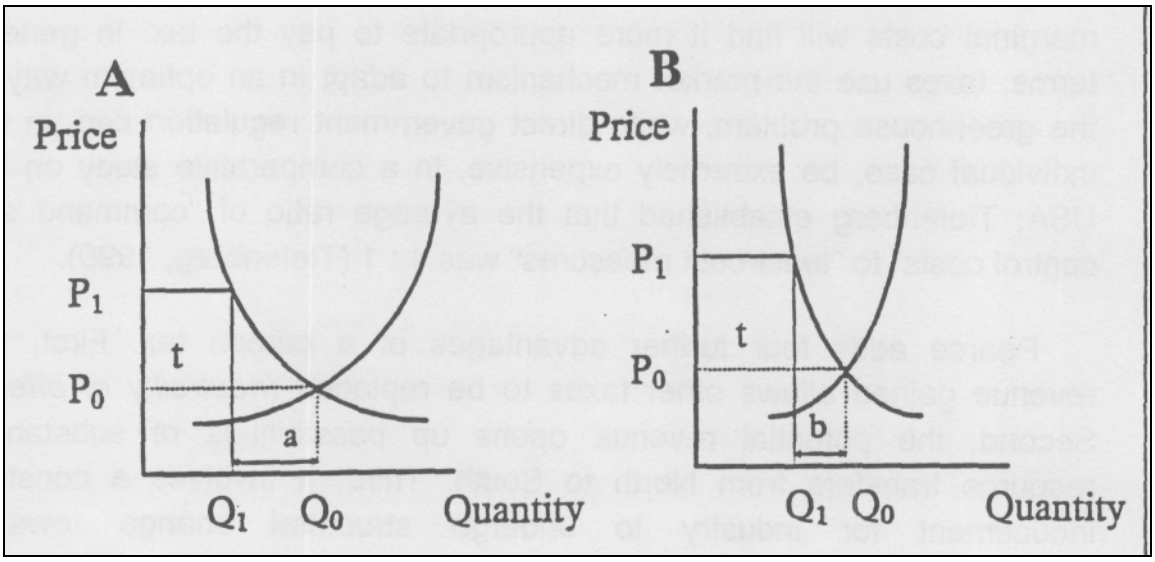
(Pearce, 1991).[2] As his central argument he cites Baumol and Oates, who pointed out that a tax allows total emissions to be reduced at minimum cost (Baumol & Oates, 1975). A given tax will induce emitters with low marginal avoidance costs to reduce emissions, while those with high marginal costs will find it more appropriate to pay the tax. In general terms, taxes use the market mechanism to adapt in an optimum way to the greenhouse problem, while direct government regulation can, in the individual case, be extremely expensive. In a comparative study on the USA, Tietenberg established that the average ratio of "command and control costs" to "least-cost measures" was 4 : 1 (Tietenberg, 1990).

Pearce adds four further advantages of a carbon tax. First, the revenue gained allows other taxes to be replaced *(neutrality of effect).* Second, the potential revenue opens up possibilities of substantial resource transfers from North to South. Third, it involves a constant inducement for industry to undergo structural change towards environment-friendly production. Fourth, if new (scientific) information about the climate problem and its impacts becomes available, the tax can be modified relatively easily.

However, there are also several disadvantages of an international carbon tax, which should not be ignored. As we have only a rough idea of the price elasticity of the supply of and demand for fuel, particularly as concerns the great dimensions we would be dealing with in practice, there is considerable uncertainty as to how large a reduction in emissions would be (two examples are shown in *Figure 1).* Furthermore, it is widely held that the final incidence of a carbon tax is regressive. In addition, the real distribution effect of a tax solution is usually concealed, while that of a quantitative solution — as will be shown below — is transparent, at least in the initial stage.

The following concrete examples of greenhouse gas emissions refer to carbon dioxide (CO_2) emissions or the equivalent amount of carbon (C) — calculated at a ratio of 3.67 :1. If other greenhouse gases such as methane (CH4) and nitrous oxide (N2O) are included in the discussion about climate policy, it is recommended that they be expressed as equivalents of CO_2. in order to introduce a common "currency unit" on the emission certificates market.

Figure 1: Emission reduction effect of a carbon tax on fossil fuels - two *examples*



Probably the weightiest argument against the introduction of an international carbon tax is not concerned with economics but with organizational factors: the tax volume needed to initiate an appreciable global reduction in emissions would be so immense (the literature speaks in terms of several hundred billion dollars) that centralized administration would be unacceptable, yet an acceptable decentralized redistribution would probably be very difficult to organize (but see Hoel, 1991 and his comments on *reimbursement parameters).*

There is also, however, an important ecological argument against an international carbon tax: in situations with rapidly increasing marginal environmental damage, taxes symbolize a possible economic compromise which the ecological system itself does not (can not) accept. In this case, quantitative (and immediate) restrictions are the only meaningful solution. Nor should one forget the problem of non-harmonized tax systems from country to country and region to region (particularly in the case of a mineral oil tax), which would be no less acute in the case of a carbon tax and, of course, the apparent reluctance of the OPEC

countries (particularly Saudi Arabia) to compromise on the subject of global climate policy, especially a tax solution.

It needs also to be mentioned that a tax on *carbon* (or carbon equivalents) would be necessary as a response strategy to the climate problem, not a tax on *energy* in general. This has to do with the fact that the main task lies in extensively replacing fossil fuels by renewable sources of energy; this substitution effect would not occur if solar energy, for example, were also to be taxed on a global scale.

While efficiency and equity are central criteria of the Framework Convention and the "Berlin Mandate", it is surprising to see that in these documents no specific proposal is made of an international tax solution. This is different in the case of the two other policy instruments, which are referred to explicitly or implicitly, and will be dealt with in the following sections.

2. *Joint Implementation*

As concerns the choice and structure of the policy instruments of global climate policy, Article 3, section 3 of the Framework Convention is especially relevant. This provision calls on the Parties to implement the measures agreed on in a cost-effective way: the desired reductions in emissions are to be achieved at minimum cost. In view of the ecological and economic context of a global climate policy, this efficiency clause is particularly significant: ecologically speaking — i. e. as regards the effect of greenhouse gases on the climate — it is completely irrelevant where in the world action is taken to reduce emissions, but if the costs of those reductions are to be kept at a minimum, then account will have to be taken of the fact that the marginal costs of reducing emissions *(marginal avoidance costs)* vary largely across the globe. In other words, strong economic arguments enter the climate policy arena. It was with this in mind that the instrument of "joint implementation" found its way into the Framework Convention (especially Article 4, sections 2a and 2b). At the first Conference of the Parties in Berlin in 1995, it was decided to introduce a pilot phase in order to gain respective experience.

Basically, joint implementation is an offset version of a quantitative policy with tradeable certificates: a country (a branch of industry, a company) can fulfill its reduction obligations through a combination of national (internal) reductions and international (external) offsets (offsets here means emission reduction credits which, once they have formally been certified, could be traded internationally). Until recently, this has usually been interpreted as meaning that an *Annex I* Party to the Framework Convention on Climate Change (i. e., OECD countries and countries with economies in transition) can fulfill its emissions target not only by domestic reductions, but also by investing in avoidance activities in other Annex I countries. The 1995 Berlin Conference resolved that non-Annex I states can also be included, on a voluntary basis. Joint implementation has thus become a policy instrument in the North-South context, and this provision can be seen as a first step towards a global climate policy of quantitative control and a system of internationally tradeable emission certificates.

A series of questions will have to be answered before it can be said how significant this policy instrument is or can become in the future (Jepma, 1995). Those questions which I feel to be most important, particularly from an ethical point of view, will now be dealt with in some detail.

The Framework Convention on Climate Change does not contain any definite target for the reduction of global emissions. According to Article 3, section 1, the industrialized countries, because of their 'historical debts' and their high emission levels, should

> "take the lead in combating climate change and the adverse effects thereof.

Along with their general commitments, i.e. developing inventories, promoting research etc., the industrialized countries assume certain additional obligations, particularly as regards the reduction of greenhouse gas emissions and the financial and technological transfer to developing countries. Since March 1994, all industrialized countries, including Eastern European States and the Russian Federation, are obliged

> "[to] adopt national policies and take corresponding measures on the mitigation of climate change, by *limiting* its anthropogenic emissions of

> greenhouse gases and *protecting* and *enhancing* its greenhouse gas sinks and reservoirs." (Article 4, section 2, italics added)

The exact legal scope of the term 'limiting[1] is difficult to assess, since the Convention does not provide any exact definition, but only a range of different aspects to be taken into account, *inter alia,* the corresponding need to maintain strong and sustainable economic growth in the developing countries.

Despite the lack of any precise timetable, Article 4, section 2a, clearly stipulates that the national policies to be adopted by the Parties have to be directed toward the 'limitation' of emissions, which should, according to the ordinary meaning of the term in the light of its object and purpose, amount to a significnt modification of present emission trends, but does not have to amount to the return to 1990 levels by the year 2000. The duty under that paragraph is therefore not merely a duty of conduct - as in paragraph 1, which applies to all Parties - but a duty of *result.* However, since no definite time-frame has been agreed upon, a certain increase in carbon dioxide emissions after 1994 may be considered as still falling under the scope of 'limiting[1]. On the other hand, if the United States, for example, would entirely ignore their duty to *limit* their emissions for a long time, they would certainly act in breach of the Framework Convention. The agreed final aim as stipulated in the 1992 Convention is still

> "returning *individually or jointly* to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol." (Artikel 4, section 2b, italics added).

So far, then, there does not exist a *binding* global reduction target on absolute reductions below the (ecologically much too high) 1990 emission level nor any *country-specific* reduction target. Certain countries and groups of countries have, however, unilaterally committed themselves to definite reductions in emissions, including Germany, which, at the Berlin Conference, confirmed its assertion that by the year 2005, it would

> "reduce its emissions of CO_2 to a level 25% lower than that of 1990" (speech by the Federal Chancellor, 5 April 1995).

In this respect, joint implementation is for the time being only a policy instrument to make *unilateral* targets more flexible. However, in view of

the varying marginal avoidance costs for greenhouse gases, from country to country and especially between North and South, a clear reduction in the cost of reducing emissions can be achieved. Or, to put it differently, an additional reduction in emissions can be achieved at no extra cost.

Joint implementation can also unlock positive economic effects via the transfer of low-emission technologies to developing countries. The otherwise tremendous increase in emissions that is to be expected, for example, when China and India become ever more motorized and industrialized, could be neutralized or even reduced. This positive effect of joint implementation is especially important, as no targets for the reduction of emissions have hitherto been set in these and (almost all) other developing countries.

One further important argument in favour of this policy instrument is that it can be applied without further delay, even if there is no global agreement on reduction obligations, or if no such agreement can be reached in the next few years.

Joint implementation, then, is a potentially powerful policy instrument, both for the ecologically necessary reduction of emissions and for the economically desirable transfer of efficient technology. However, its implementation is faced with potent obstacles, which can be summed up under the categories of *search costs, transaction costs* and *control costs.* These obstacles have been analyzed in quite some detail (see e.g. the 1994 Annual Report of the German Advisory Council on Global Change (1995, pp. 21 ff.) and need not be repeated here.

The success of the joint implementation instrument will depend crucially on the institutional arrangements that are agreed upon. Several models are conceivable:

- simple bilateral systems of negotiation and information — the participating states report the reductions in emissions they have achieved to the other Parties to the Convention;
- inclusion of an international institution (such as the Secretariat of the Framework Convention); this would act as a clearing house promoting the emergence of a joint implementation market;

- in addition to that, an international institution (the Secretariat) monitors and verifies the reductions in emissions achieved as a result of joint implementation.

One important component of these arrangements would consist in ascertaining the reduction in emissions effected by joint implementation in the form of "emission credits" for the investing country (branch, company). These credits are essential for two reasons. First, they provide the necessary incentive for investing capital abroad and, second, they must not run counter to the reduction of emissions at home (allegation of "modern sale of indulgences"). The Berlin Mandate, however, stipulates that

> "no credits shall accrue to any Party as a result of greenhouse gas emissions reduced or sequestered during the pilot phase from activities implemented jointly".

In order to avoid possible failure of the joint implementation policy instrument inherent in this restrictive condition, the following compromise can be suggested: Emission credits should not be credited in full to the national emissions account, but only in part — 50%, for example (as suggested by France), or 75—80% (as suggested by WBGU, 1995). In this case, if the reductions in emissions that have been achieved were used to strengthen national reduction targets (for the EU, OECD or Annex I states), then joint implementation would indirectly lead to more stringent climate protection effects.

It must be recalled that participation in joint implementation projects should not lead to any reduction in the overall financial obligations resulting from the Framework Convention or, indeed, in the actual and otherwise pledged development aid payments (Norway has submitted a proposal to this effect).

Taken together, then, the debate about joint implementation ought to be seen as an opportunity to sound the trumpet that political possibilities exist for stabilizing the climate and for coupling them with proactive development policy. Nevertheless, the quantitative significance of joint implementation in the global context should not to be overestimated. This policy instrument will only allow the industrialized countries to fulfill the minor part of their obligations to reduce emissions. Even so, in the developing countries a process can get underway which would otherwise

only get off late (or even too late) — and in the end, this process could lead to a more comprehensive system of internationally tradeable emission certificates.

3. *Internationally Tradeable Emission Certificates*

Tradeable emission certificates differ in various ways from joint implementation (or "external offsets"). Binding global obligations to reduce emissions will (must) result from the pending negotiations. The German *Bundestag's* Enquete Commission on Climate Policy, and also the Inter-governmental Panel on Climate Change (IPCC) assumes that a reduction of global CO2 emissions by 50% compared to the 1987 levels (requiring an 80% reduction in the industrialized countries) must be reached by the year 2050 if the target of stabilizing the climate system is to be attained (see *Table 1).*

For the present, let us assume that an agreement of this kind (or similar) is reached in the "Climate Protocol", to be negotiated on and resolved at the Third Conference of the Parties in Kyoto in 1997, or at a later stage. What could this mean for the choice and structure of a system of internationally tradeable emission certificates?

Table 1: CO_2 emission plan, Enquete Commission on Climate Policy (benchmark 1987, in %)

Year	Industrialized countries	Developing countries	Whole world
1990	+5	+11	+6
1995	+6	+24	+10
2000	- 4	+37	+4
2005	- 20	+50	- 5
2020	- *40*	+60	- 20
2050	- 80	+70	- 50

Source: Enquete Commission (1990).

As part of the system of agreed quantified permissible global emissions, tradeable certificates would be handed out — for the whole duration of the agreement or, better still, for certain time periods — to the participating Parties on the basis of an allocation procedure that would also have to be

agreed on (which both would probably be negotiated in parallel). When the agreement comes into force, the participants would receive certificates corresponding to the emission quantities they have been allocated. If this initial allocation were insufficient for a participant (a country, a branch, a company), the participant would have to acquire additional certificates via trade. For those participating in the system, therefore, an incentive to reduce emissions would be established, be it to minimize payments for the purchase of additional certificates or to maximize earnings from the sale or lease of surplus certificates. If the initial allocation to developing countries leads to substantial quantities of surplus certificates there, a potent mechanism for the transfer of resources would be created: developing countries could sell or lease their surplus certificates to industrialized countries for money, technologies or patents.

So, there are certain similarities between an international emission charge *(price solution)* and tradeable emission certificates *(quantity solution):* the issue of the initial allocation of certificates is similar to the issue of allocating the revenue from a charge. However, there are also several differences.

The most important of these is that emission certificates exactly meet the emission reduction target in terms of quantity; the concurrent financial expenditure would be the result of the costs connected with achieving this target. This contrasts with an emission charge, which regulates financial expenditure but does not directly regulate the volume of the emissions. A further difference is that a charge generally means monetary transfers, while certificates could easily be traded for gratuities other than money (such as technologies or patents). A system of tradeable emission certificates, therefore, increases the scope of the negotiations between North and South — and might therefore be met with broad (possibly sufficient) political approval for precisely that reason.

Unlike in joint implementation projects, monitoring a system of tradeable emission certificates would be concerned with the (relatively simple) measurement of total emissions from a contracting state rather than the (more difficult) measurement of emission reductions of specific projects. The question of responsibility for adhering to the rules of procedure (i.e., compliance) is also easier, as one is not dealing with

direct investments but with the sale or lease of a tradeable good (i.e., certificates).

There are other theoretical and practical issues connected with a system of emission certificates (Victor, 1991) — the issues connected with implementation will be dealt with in the following section. Let me end the present section with a quotation from the 1995 IPCC Report, which in its chapter on response strategies (Chapter 10) states the following:

> "The consequences of climate change policy will be determined by the choice of policy instruments [...] For a global treaty, a tradeable quota system is the *only* potentially efficient arrangement where an agreed level of emissions is attained with certainty (subject to enforcement) [...] A choice of tradeable quotas at the international level would (at the same time) provide maximum flexibility for instrument choice at the domestic level". (italics added)

III. From Theory to Practice

As was said at the beginning, a practicable agreement on policy instruments to limit or reduce greenhouse gas emissions has to satisfy several criteria, in particular those of *efficiency, equity,* and decision-making under *uncertainty.* The weight given to the individual criterion will determine which of the possible policy instruments or combinations of instruments is being recommended. If, unlike on the national level, the criteria of equity and uncertainty (particularly because of irreversible ecological processes) play a special role on the international level, then there is much to be said in favour of tradeable emission certificates. Yet, their practical organization entails many potential snares which can be decisive for their acceptance. The following section will look in some detail at the questions of market organization, rules of procedure, and the initial allocation of emission certificates; other issues, which, I feel, are less problematic, will not be addressed here (see Epstein & Gupta, 1990).

1. Market Organization

Creating a market for internationally tradeable emission certificates is no easy undertaking, to put it mildly. Monitoring, certification, market access and market extension require careful management — what is more, in a highly complex area of policy. A debate about these implementation issues has at least begun, and thus one may expect the system to become established in the not too distant future. An UNCTAD study of 1992 had looked already into the institutional issues of market organization.

One such issue is the number of actors on this market. A "mixed" trading system in which both governments *and* companies participate could be optimal. Governments would remain subject to their international obligations, particularly to ensure that the certificates tally with actual emissions. Trade at the company level would enlarge the technical options of emission reduction. Yet, this could also mean that the volume of trade becomes too large. However, the major worry in the literature is that cartels could be formed. Whether or not this threat can be conquered will in the first place depend on the number of market participants, which speaks in favour of a more substantial number. If one were, for example, to start with the producers and importers of raw materials containing carbon, then, according to Maier-Rigaud, there would be about 500 actors on an EU certificates market.

There are several ways of avoiding cartellization on the emerging certificates market. Regular rounds to re-allocate or replace certificates could ensure a liquid and flexible market, and rules against hoarding and price rigging could be agreed on. And the final, drastic sanction against improper conduct could be "exit", although this would have an adverse effect on all the market participants.

2. Rules of Procedure

One question is whether emission certificates should be valid endlessly. Although any such "perpetual certificate" would not necessarily prevent the revision (and especially the tightening) of the global emission reduction target — a part of them could be withdrawn from the market or

devalued regularly — much speaks in favour of certificates with only limited validity. For one thing, not all Parties to the Framework Convention will participate in the system from the start and, for another, this would counter existing fears of certificates being *bought up* by industrialized countries or multinational corporations. The other extreme version, whereby certificates would be *leased but never sold,* would only lead to more flexibility if a (more) frequent new issue was agreed on. One must say that the question of an *optimum* term for emission certificates is still an open one. In the literature, the ideas range from two to 20 years.

In this context, Bertram (1992) has proposed an *overlapping procedure,* under which ten-year certificates would be issued and 10% withdrawn from the market every year. This proposal could be summed up by the following formula:

> "If certificates are valid for L years and a certain proportion *P/L* is withdrawn from the market every year, then a new tranche of certificates valid for L years can be issued."

At any given time, therefore, the market would consist of a mix of certificates, some long-term, some short-term; countries (branches, companies) could accordingly maintain a mixed portfolio and a futures market (comparable with existing other 'futures markets') could emerge.

The benefit of such a flexibilization of the system is obvious: it would be possible, on the basis of the most recent *natural* science evidence about pollution and the adaptability of the ecosystem, and of *social* science evidence as regards the limits to adaptability of the economic system, to hold subsequent negotiations on permissible emission limits, to include new sources and sinks of greenhouse gas emissions, and to allow additional countries to participate.

Whatever happens, this benefit should not turn into a disadvantage as a result of excessive complexity or bureaucracy. Grubb & Sevenius (1992) have shown that revision periods in an overlapping system of between two and four years might be the best possible solution. Given the probable workings of the global climate regime that is to be established (such as annual conferences of the Parties, two-thirds majorities, gradual tightening of the climate protocol), this may well be a realistic assumption.

3. *Allocation of Certificates*

The crucial factor for the political acceptance of tradeable emission certificates will probably be that their design be ethically based, and their initial allocation be perceived as fair. Indeed, for many authors (including myself), the system hinges on the "equity factor".

While the initial allocation of certificates does not predetermine the final distribution effect (i.e., real incidence), which ultimately is the result of market decisions (certificate price and quantity), it does predetermine the direction and possible volume of transnational resource transfer the system will involve. A certain distribution effect will, of course, result from all conceivable instruments of climate policy, especially where the dimensions are globally significant, but also in national solutions, be they price or quantity solutions.

There are different ways of effecting the initial allocation of emission certificates. One distinction is that between *burden-based* and *responsibility-based criteria,* the former laying emphasis on the burden of adjustment involved in the desired reduction in emissions, while the latter stresses the polluter-pays principle, either in terms of the current emissions or of historical and accumulated emissions.

To a certain extent, the search for an ethically acceptable allocation formula in global climate policy reflects the old debate between "realists" and "idealists" in development policy (Sterner, 1994).

- "Realists" would argue that certificates (and the rights to pollute they entail) must be allocated on the basis of either the *current emissions* or of the Gross Domestic Product (GDP), since any other formula would be unacceptable (see, for example, Pearce, 1991). Ethically, this position is extremely weak and completely fails to satisfy any criterion of equity. In no way neither current emissions nor historical and accumulated emissions can be defined as "fair". Furthermore, this position ignores one, if not *the,* crucial advantage of an international system of certificates, which is that an *additional* transfer of resources can be set in motion. The "realistic" position is also unrealistic in that it almost completely ignores the developing countries, which are beginning to take an interest in global climate policy precisely because ecological necessity may turn out to be to their economic blessing.

- On the opposite side we have the "idealists", who insist, explicitly or implicitly, on the inclusion of historical and accumulated emissions (as a sign of "ecological guilt" or "historical debt" — indeed, some of them even argue that developing countries, for the time being, should not be integrated into the global climate regime (see, for example Hayes & Smith, 1993).

Various allocation proposals have been put forward, with *globally uniform per capita allocation* presenting the strongest ethical claim. In this case, the initial allocation of emission certificates would be directly proportional to national population (in the current year or, as a softer version, in a base year, like 1992, for instance). It can be said that the practical consequences of this proposal would be considerable, if not revolutionary. Any industrialized country with above-average per capita emissions would have to purchase certificates from developing countries, not only in respect of fossil fuel consumption but also of all other sources and sinks of greenhouse gases, possibly with the exception of deforestation (slash-and-bum, clear-felling). Even under moderate projections as to the certificates prices that would ensue, there would then be a complete reversal of the presently existing net South-North transfers. (Grubb & Sebenius assume that it would be at least as much as current official development assistance (ODA), which is in the order of US$ 60 billion per annum.)

Of course, the alternative to any extreme position is to find a *mixed formula* — a formula which will at least guarantee that there is a net transfer from the industrialized to the developing countries (and not *vice versa)* in implementing a global climate policy. Personally, I find the formula developed by William R. Cline (1992) extremely appealing:

$$Q_i = Q_g \left[wh\Phi^{h}_{0,i} + wy\Phi^{y}_{0,i} + wp\Phi^{p}_{0,i} \right]$$

where Q_g is the global emission target; Q_i is the emission target of country i; *w* the weight of the criterion in question (sum of w = 1); *h* is historical emissions, *y* is GDP at purchasing power parity, and *p* is population; *p* is the share of country i in the global total; *0* is the benchmark year.

This allocation formula includes the most important alternative criteria under discussion and weights them, a practice that has also been applied by the IMF (definition of country quotas), the United Nations Committee for Development Planning (definition of Least Less Developed Countries; LLDCs), and other institutions (Levi, 1991). The formula could be described as the necessary mixture of efficiency, equity *and* realism.

Cline provides an illustrative example of this formula in action: the USA currently (1992) accounts for 25.7% of global GDP, 17.5% of global greenhouse gas emissions (including deforestation), and 4.8% of the world's total population. The simple average of these three figures comes to 16%. Were a global emissions target of 4 billion tons of carbon to be agreed on by the Conference of the Parties to the Framework Convention, the USA's initial share would amount to 640 million tons. Current emissions, however, total 1.2 billion tons. Accordingly, the USA would either have to reduce its emissions by 50%, or purchase an additional 100% of its initial share of allocated certificates.

By contrast, India's share would come to 8% of global emissions or 320 million tons of carbon, which would correspond to a surplus of some 50 million tons (or 17% above current emissions), which India could then sell or lease on the international emission certificates market.

As befits the logic of a mixed formula, the weighting of the *three* components could be *modified* in the course of time. For example, the weighting of the first criterion (historical, accumulated emissions) could be reduced from one-third down to zero over a period of, say, 20 years ("phasing out") and that of the second criterion (GDP) from one-third down to zero over a period of 40 or 50 years. The final result then would be an ethically strong position, namely globally uniform per capita emission rights (i. e., the population criterion).

A less formal, more 'political' solution of the allocation problem might lie in a compromise that could be described as follows:

> "The allocation of emission certificates changes over time, from a position based (more or less) on *current emissions* to a position of (more or less) *equal per capita emissions."*

A strategic compromise of this nature might be acceptable both for the industrialized countries and the developing countries, since it offers a strong incentive for a fair (a fairer) future emissions situation for the whole world in general, and for the linking of environmental protection with economic development in particular — even though this perspective was not aimed for at either the 1992 Rio de Janeiro Conference on Environment and Development or at the 1995 Berlin Climate Conference.

V. Conclusions

As far as *national environmental policy* is concerned, and in view of the high degree of institutionalization and the specific historical and cultural background of policy formulation and implementation in the industrialized countries, the author is very much in favour of a *balanced instrumental mix,* which includes market-oriented and regulatory, price-based and quantity-based policy instruments. As regards the state of the international system and the emerging contours of the structure and function of the *global climate regime,* however, I do favour market-oriented quantity solutions, especially *joint implementation* in the regime's initial phase and *tradeable emission certificates* in its final phase. If their form is prepared with the necessary care, then Peter Bohm's succinct judgement seems justified:

> "Making emission quotas tradeable among countries implies not only that a globally efficient limit to total emissions is attained with *certainty, ...* but also that the initial emission quota distribution of the treaty is shifted in favour of *the poorer countries"* (Bohm, 1992, p. 112, italics added).

This first best solution does not exclude regulation or taxation as second best solution. In particular, if the institutionalization of the *Global Environment Facility* (GEF) is to be pushed forward, then it will have to be financed by taxes, as conventional multilateral development assistance would otherwise be affected negatively. In this case, other forms of taxes and bases of assessment again appear on the political agenda, such as a tax on arms exports (see *Brandt Report,* 1983), on long-distance tourism (see *Mishan,* 1970), or on international financial transactions (see Brundtland Report, 1987, and *Qureshi/von Weizsäcker Report,* 1995).

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