# 5 Applying Fairness Criteria to the Allocation of Climate Protection Burdens: An Economic Perspective

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## Introduction

Article 3 of the United Nations Framework Convention on Climate Change (UNFCCC) states that: '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' (emphasis added). However, the UNFCCC is quiet on the criteria according to which the equitability of different policy proposals on the negotiation table should be judged. Therefore, the demand for equity has provided little guidance until now.

This is not surprising because arguments based on equity considerations are often treated with great suspicion. Two popular reservations, which are also common among economists, go as follows: 'equity is merely a word that hypocritical people use to cloak self-interest'; and 'it is so hopelessly subjective that it cannot be analysed scientifically' (Young, 1994:xi). In many respects, negotiations about climate change seem to offer a perfect confirmation of those reservations because nearly every actor – no matter whether it is a low-lying island state or an oil exporter – has defended its policy proposal as the truly equitable one.

This chapter intends to show that there have been some important research efforts by economists towards a consistent analysis of equity and that the developed apparatus can be applied profitably to fairness concerns in climate change.[2] More specifically, it will introduce a small number of general

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2 Several monographs have been published recently with the intention to survey and improve our understanding of equity with methods that are commonly used in economics; see Young (1994), Moulin (1995), Brams and Taylor (1996), Roemer (1996) and Kolm (1997). Yet, most of these contributions focus on equity issues on the national level or among individual agents, and only few efforts have been undertaken to apply economic theories of justice to the international level, or even more specifically to problems related to climate change.

equity criteria and explore their consequences for the allocation of emission reductions and associated costs in a climate protection regime (fifth and sixth sections). Previously, it will discuss some of the approaches towards equity which have received particular attention in the report of the International Panel on Climate Change (IPCC, 1996) (second section), will describe some common proposals for a just distribution of emission reduction burdens (third section), and will discuss some general prerequisites for the approach chosen in this chapter (fourth section).

## DIFFERENT APPROACHES TOWARDS EQUITY

Climate change raises a number of different equity issues, of which the most important ones are classified in the IPCC's chapter on equity and social considerations as follows (IPCC, 1996:85):

- international equity in coping with the impacts of climate change and associated risks;
- international equity in efforts to limit climate change;
- equity and social considerations within countries;
- equity in international processes; and
- equity among generations.

Certainly, each of these points is highly relevant and deserves a detailed analysis. This, however, is far beyond the scope of this contribution, in particular because one cannot apply the same methodology to the analysis of all equity issues stated above. Therefore, this chapter largely confines itself to the question of 'international equity in efforts to limit climate change' – that is, the just distribution of emission rights and abatement cost, which is one of the most important and at the same time one of the most controversial equity issues in current negotiations on climate protection strategies (IPCC, 1996:103). This has also become clear in the disputes about the involvement of developing countries in a climate protection regime, which gained in intensity during the negotiations of the Kyoto Protocol.

The IPCC report distinguishes five broad traditions to approaching this question: parity, proportionality, priority, classical utilitarianism, and Rawlsian distributive justice (IPCC, 1996:86; see also Young, 1994:8). The last two approaches are not so much concerned with a specific problem, but instead raise the more general question after the 'just social order'.

*Classical utilitarianism* starts from the assumption of a social welfare function and advocates an allocation that maximizes the sum total of individual agents' utility – Bentham's principle of achieving the greatest good for the greatest number:

$$W_G = U_1 + U_2 + \ldots + U_n, \tag{1}$$

where – applied to the international level – $W_G$ is global welfare and $U_i$ the utility of the population in country $i$. A common objection against such an additive social welfare function is that it neglects distributionary aspects in so far as extremely different *utility* allocations would be represented by the same

welfare index $W_G$, as long as the sum of the utility levels remains constant. However, this does not imply indifference towards the *wealth* distribution, because the marginal utility of wealth is usually assumed to be higher in poorer countries. Neglecting the production side of the economy for the moment, global welfare maximization would require marginal utility to be equalized in all countries, thereby supporting a rather egalitarian wealth distribution.

A second critique against the social welfare function of classical utilitarianism is that the additive aggregation requires interpersonal, cardinal comparisons of utility – that is, statements such as *A*'s utility from consuming good $x$ is twice as high as *B*'s utility from consuming good $y$. Today, economists often eschew these kinds of judgements and prefer an intrapersonal, ordinal utility concept, which relies only on statements such as agent *A* prefers good $x$ to good $y$.[3]

Rawls, on the other hand, has advocated the distribution principle that the worst off group in the community should be made as well off as possible. This has sometimes been represented by a maximin social welfare function:

$$W_G = min \{U_1, U_2, \ldots, U_n\} \qquad (2)$$

However, Rawls was not so much looking for a decision that would somehow maximize the social good, but he rather emphasized the process or context in which decisions are made: he was concerned with the establishment of a set of just institutions in which decision-making could take place. In particular, Rawls did not focus on the subjective well-being of the individual agents, but on the means and instruments – the so-called primary goods (Rawls, 1971) – with which they could foster their well-being. However, Rawls himself has argued that his 'difference principle', according to which inequalities can only be justified if they improve the conditions for the worst off individual, cannot be applied to the level of states (Rawls, 1993).

In summary, the additive social welfare function of classical utilitarianism as well as the Rawlsian distributive justice both refer to the just social order, that is, to the just distribution of resources at large. To analyse the equity issues of climate change, we therefore have to take into account the global distribution of wealth so that environmental policies have to be linked to development policies.

An interesting example of how this can be done is provided by Chichilnisky and Heal (1994). They characterize the level of greenhouse gas concentrations in the atmosphere as a 'privately produced public good'. Accordingly, countries' utility levels $U_i(X_i, Q)$ depend on the consumption bundle of private goods $X_i$ and on the quality of the world's atmosphere $Q$. A trade-off among the two exists in that abatement efforts to increase the quality of the atmosphere are paid for with lower private consumption levels. Furthermore, Chichilnisky and Heal modify the simple utilitarian social welfare function (equation 1 above) by incorporating country-specific welfare weights $\lambda_i$, which represent the marginal social welfare of utility increases in the individual countries:

3 But see Harsanyi's (1955) defence of an additive social welfare function, which is based on von Neumann-Morgenstern utility functions.

$$W(X_1,\ldots,X_n,Q) = \sum_{i=1}^{N} \lambda_i U_i(X_i,Q) \qquad (3)$$

Maximization of equation 3 yields that at a Pareto efficient allocation, marginal abatement costs are inversely proportional to the marginal valuation of the private good, at least if lump sum transfers are not feasible. As the marginal utility of consumption is usually regarded to be higher in poorer countries, this would imply that the industrialized countries should shoulder higher marginal abatement costs than developing countries. However, it should be noted that marginal abatement costs are currently much lower in developing countries (IPCC, 1996). Accordingly, the extent to which developing countries have to undertake abatement efforts depends crucially on their marginal utility of consumption relative to that in industrialized countries, and this value is very difficult to determine.

There are a number of reasons in favour of adopting a holistic perspective as is done by approaches which are based on social welfare functions. In particular, it was agreed in the UNFCCC that countries' different ability to pay for climate protection measures should be taken into account, and the marginal social welfare losses of abatement efforts can be used as a good proxy for this. However, there are also good arguments against such an approach. Most importantly, it is likely that disputes about the 'just international order' – the specification of the functional form of the social welfare function, welfare weights $\lambda_i$ and marginal utilities of income – would make agreement on a 'just climate policy' even more difficult. Nevertheless, any solution, including the one elaborated on in the following sections, will ultimately have to be judged according to its effect on the global distribution of welfare.

The other three equity criteria mentioned by the IPCC are more straightforwardly applied to the distribution of a particular common resource, such as the sink capacity of the atmosphere for greenhouse gases, at least at first sight.[4] *Parity* means that all actors should be treated equally. The criterion of *proportionality* goes back to Aristotle's equity principle and claims that burdens or benefits should be distributed in proportion to the contributions of claimants. Finally, *priority* means that those with the greatest need should be advantaged (Young, 1994:8).

However, these equity principles are relatively meaningless without a precise determination of the perspective or starting point from which they are applied. For example, in the IPCC report it is stated that 'parity is a formula for equal distribution of burdens or benefits' (IPCC, 1996:86). Nevertheless, it is of course a fundamental difference whether the *benefits* of the atmosphere's sink capacity or the *burdens* of emission reductions are shared equally. Similarly, the criteria of proportionality and priority can be applied to such different issues as the extent of climate change impacts and the relevance of oil exports for the national income, leading to completely different results. Even differentiation among the three criteria depends on the perspective. For example, an *equal* per capita allocation is the same as an allocation *proportional* to the countries' population.

4 Actually, it would be more appropriate to speak of the sink capacity of the *biosphere*; in this case, *net* emission rights would have to be allocated.

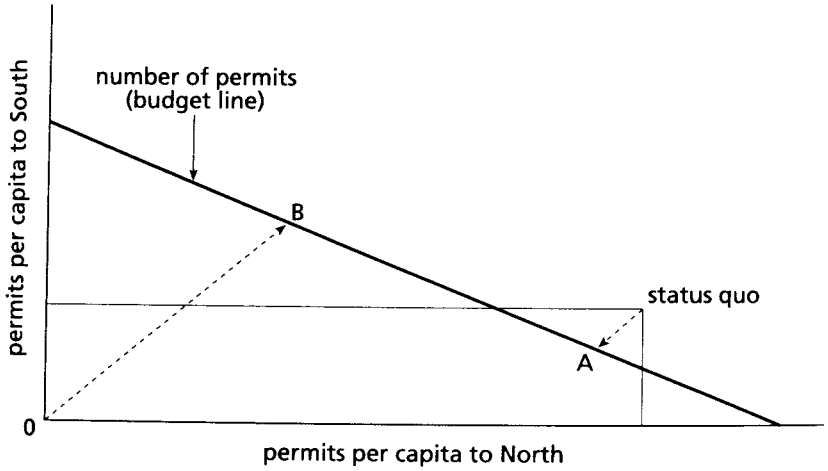


***Figure 5.1*** Equal distribution of burdens or benefits

Figure 5.1 illustrates the point that not only the choice of the appropriate equity principles is crucial, but also the choice of the perspective from which to apply them. The budget line gives the total number of permits which are allocated between two groups called North and South on the basis of the equity principle of parity. Because total population is higher in the South than in the North, the maximum feasible number of permits per capita is lower in the South. Allocation B says that every country is entitled to emit the same quantity per capita. Allocation A says that every country must reduce its per capita emissions from current levels by the same amount. Even though both allocation procedures are based on the equity principle of parity, the choice of a different reference point leads to completely different results.

## COMMON PROPOSALS FOR A 'JUST' DISTRIBUTION OF EMISSION REDUCTION BURDENS

A systematic presentation of the different proposals for a just distribution of climate protection measures is simplified if one separates the question of a just distribution of emission rights from the question of financial transfers (see IPCC, 1996:106–110). The proposals regarding the distribution of emission rights can be classified along the following two extreme positions: equal per capita allocation versus equal percentage reductions. Often, a dynamic allocation scheme has been advocated which starts from a position close to the status quo and moves successively towards an equal per capita allocation (see Cline, 1992:353). Consequently, equity considerations are mixed with those of political feasibility.

Regarding the distribution of abatement cost by monetary transfers, the following approaches can be distinguished:

- Transfers should be paid according to the provisions of the UNFCCC. Of particular relevance is the principle first employed in the ozone regime

that industrialized countries should pay the 'full incremental cost' of developing countries.[5]
- Monetary transfers should result from the distribution of tradeable permits.
- Transfers should be based on the different responsibilities for the environmental problem. This point includes the polluter pays principle and the principle of historical responsibility.
- Transfers should be based on the different ability to pay for climate protection measures.

Supporters of a particular criterion often use one of the above equity principles as justification. Yet, this happens mostly in an ad hoc fashion and is rarely based on a systematic analysis (for a good overview see Grubb et al, 1992; Shue, 1995; IPCC, 1996).

In contrast, this chapter now explores the fruitfulness of an axiomatic approach towards a fair allocation of climate protection measures; the approach is based on five general equity axioms which have received widespread attention in economic theories of justice. However, not only the formulation of the axioms but also the choice of the starting position from which to apply them needs to be justified. This will be done in the following section.

## THE CHOICE OF A PERSPECTIVE

Firstly, the fair division problem is treated as one of local justice as opposed to social justice. For the distribution of emission reductions of greenhouse gases and associated reduction costs, this implies an abstraction from the justice of the current global welfare distribution. In contrast to this, some authors have explicitly argued that climate change protection strategies should be designed such that they favour the South (see Simonis, 1996). With the approach followed in this chapter, the author does not deny the legitimacy of such claims but wishes to emphasize that it is important to distinguish whether the justification of the advocated wealth transfers rests on the perceived injustice of the current global welfare distribution or on the characteristics of the climate change problem. On the other hand, the ignorance of superordinate aspects of social justice certainly becomes questionable if the proposed solution for a (local) fair division problem significantly accentuates existing injustices in the social welfare distribution.

Secondly, in concentrating exclusively on justice in efforts to limit pollutive emissions, the author abstracts from other important fairness concerns in climate change, such as justice in coping with the impacts of environmental problems and associated risks. In some cases, emission reduction targets might actually be chosen so that no environmental damages occur. In principle, this has been done in the international regime on stratospheric ozone depletion. Furthermore, the critical loads concept agreed to in the European regime to combat transboundary acidification seeks to reduce emissions to a level below

5 See UNFCCC, Art 4 (cf Biermann 1995: 62ff, 106–109).

which significant harmful effects on specified sensitive elements of the environment do not occur (see Biermann, 1995). However, in climate change some damages will not be negligible. The author's intention is not to deny the importance of justice in coping with those impacts, but it is assumed that this and other issues of justice can be analysed separately from the fair division of emission reductions and associated costs.[6]

Thirdly, no intertemporal equity trading is allowed: the allocation has to be just at every time point. This excludes situations where the unfair treatment of agents in one period is compensated for by preferential treatment in other periods. The main reason for this assumption is to simplify the analysis. However, as a consequence of this, the fact that during the past emissions in the South have been much lower than in the North is ignored and also the corresponding question of whether the South should be compensated for this, as some have argued (Ghosh, 1993). Furthermore, intertemporal equity trading might be a reasonable device if the transition from an unfair to a fair allocation involves a sharp increase in the efforts of some agents. An analysis of those dynamic equity issues is certainly a valuable area of further research.

Finally, the application of fair division criteria requires the preceding specification of entitlements to a common property resource – for instance, to a particular service of the environment such as its absorptive capacity for greenhouse gases. In inheritance problems, which are sometimes used to illustrate the theory of fair division, entitlements may indeed be exogenously given through the will of the deceased. However, this is not the case for climate change and the specification of entitlements involves some substantial ethical judgements. In this respect, equal per capita entitlements, which correspond to the justice principle of 'equality of resources', have received particular attention. This is also the case for climate change, where the environment's absorptive capacity for greenhouse gases is often regarded as a global common, as if it were 'manna fallen from heaven'; accordingly, equal per capita entitlements is the proposal mentioned most often in the literature (IPCC, 1996:106; Shue, 1995).

The main objection against this allocation is that even though it might be equitable from an *ex ante* perspective, *ex post* it would lead to an unfair distribution of emission reduction burdens. With tradeable equal per capita permits, the South could sell a large number of permits to the North, which would result in substantial North–South resource transfers (Grubb et al, 1992). Without tradeable permits, the additional abatement cost in the North would be even higher than those transfers, due to the lower efficiency of abatement measures. In arguing this, most writers assume that the initial allocation of emission rights would quasi automatically determine the allocation of abatement cost. However, this need not be the case if one allows for the possibility of additional transfer payments. Accordingly, the main focus in the rest of this chapter is on the fair division of the gains from the exchange of the initial permit allocation, which arise from differences in marginal abatement cost across countries.

6 The IPCC report states that 'there are few, if any, ethical systems in which it is acceptable for one individual knowingly to inflict potentially serious harm on another and not accept any responsibility in helping or compensating the victim or to pay in some other way' (IPCC 1996: 101). This would imply that, in view of the unequal distribution of historical and current emissions, the cost of climate change damages would primarily have to be borne by the North.

## THE CHOICE OF EQUITY CRITERIA

The following axiomatic approach to the fair division of common property resources is based on an ordinal utility concept as is commonly used in economic theory. Accordingly, a distribution's equitability is not judged from the allocation of goods but from the allocation of the utility derived from the consumption of these goods. There are five fundamental criteria which will be used to judge the equitability of an allocation mechanism for common property resources.

### Efficiency

An allocation is said to be efficient or Pareto optimal if no individual can be made better off without making another individual worse off. Sometimes this has been termed as the criterion of *unanimity*. This already shows that the Pareto criterion is no more than a smallest common denominator, the only normative argument on which the economic profession could agree.

If lump sum transfers are feasible, Pareto efficiency implies that emission reductions have to be allocated such that corresponding marginal costs are equalized in all countries.[7] This is a far reaching result because it determines the allocation of emission reductions. However, it does not say who should bear the cost. After the cake has been maximized, it now has to be shared – as equitably as possible.

### The no envy criterion

Probably the most prominent equity criterion within the economic profession is the no envy test (Foley, 1967); indeed, fairness has sometimes been defined as envy freeness plus efficiency (Varian, 1974). With equal entitlements to a common resource, an allocation is said to be envy free if each agent values his share at least as much as anybody else's share. Take the most simple example of parents who bequeath their fortune – consisting of two (identical) apples and bananas – to their two children in equal shares. If one of them likes apples and the other one bananas, they are free to exchange their entitlement to the inheritance. The no envy criterion requires that after this reallocation every heir should be satisfied with his share and not feel the desire to change it against the share of the other heir.

However, the set of envy-free allocations of rights to pollute the atmosphere and the corresponding compensatory payments are quite large, at least if one simplifies the allocation problem so that there are only two agents. There are different allocations where the North compensates the South for a greater share of per capita permits, while neither of them would prefer the per capita permits and compensatory payments of the other one.

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7 It has been pointed out in the second section that the equation of Pareto efficiency with equal marginal abatement cost across countries depends on the possibility of lump-sum transfers, which will be assumed to exist throughout the rest of this chapter (see Chichilnisky and Heal, 1994; see also Chapter 3 by Linnerooth-Bayer in this book).

## The fair share guaranteed criterion

The fair share guaranteed criterion has been introduced by Steinhaus (1948) and it expresses the idea that every agent should be guaranteed at least the utility from consuming its fair share: its entitlement to the common property resource. This means that if there are overall gains from a reallocation of the initial shares, everyone should be weakly better off after this reallocation has taken place. Other common names for this criterion are *individual rationality* or *acceptability* because one will usually not agree to a reallocation if one becomes worse off than in the starting position.

Applied to climate change, the fair share guaranteed criterion guarantees each country at every time point the utility from the consumption of its fair share of the atmosphere's sink capacity. This can be stated formally as:

$$U_i(P_i) + M_i \geq U_i(FP_i) \tag{4}$$

With $U_i(P_i)$ signifying country $i$'s utility from the permits it receives in the efficient allocation, each country has to be compensated by monetary transfers $M_i$ such that it is at least as well off as with its fair share of permits $U_i(FP_i)$.[8] It should be noted that the fair share guaranteed criterion does not determine what constitutes a 'fair share' of the common property resource, but rather states the implications that follow from a particular specification of fair shares or entitlements.

It can be argued that the utility which an actor receives from a particular number of permits is nothing else but the cost of abatement measures he or she would have to undertake without those permits. Therefore, equation 4 can be rewritten as:

$$M_i \geq C_i(P_i) - C_i(FP_i) \tag{5}$$

where $C_i(P_i)$ and $C_i(FP_i)$ are the abatement cost to reduce emissions from the business-as-usual path to the levels $P_i$ and $FP_i$ respectively.[9] In summary, the fair share guaranteed criterion requires that those countries which receive less than their fair share of permits in the efficient allocation have to be fully compensated for their additional abatement cost. In contrast, those countries which receive more permits than their fair share in the efficient allocation need not pay a higher compensation than the savings in abatement cost that accrue from the permits they receive on top of their fair share. In a nutshell, no country should lose on the way from the original to the efficient allocation.

8 Technically, it is assumed that compensatory payments are feasible via a single good (money), in which utility is linear. This representation of preferences by a quasilinear utility function follows from the assumption that the absorptive capacity is given exogenously, and each agent's demand for a share of it depends only on its relative price – ie whether it is cheaper than the emission reductions required otherwise – but not on available income.

9 $U_i(P_i) = C_i(0) - C_i(P_i)$ and $U_i(FP_i) = C_i(0) - C_i(FP_i)$.

## The resource and population monotonicity criteria

The criteria of resource and population monotonicity set some limits on how agents' individual utility levels should respond to changes of the allocation problem with respect to the size of the common property resource to be allocated and the number of claimants.

*Resource monotonicity* requires that if the common resource – in our case the global number of emission rights $P_G$ – grows from $P_G$ to $P_G'$, each agent should be at least as well off as from the fair division of the smaller resource (Roemer, 1986):

$$P_G' \geq P_G \Rightarrow U_i(P_i') + M_i' \geq U_i(P_i) + M_i \tag{6}$$

In climate change and in many other environmental problems, this criterion may indeed have high political relevance. Our best assessment of the environment's absorptive capacity is only preliminary and likely to change as the scientific knowledge improves. Furthermore, reduction targets will often be approached only stepwise. In both cases, the size of the common resource to be divided changes and, due to the commonality of ownership, this should affect the welfare of all agents in the same direction.

The criterion of *population monotonicity* stipulates that if the number of agents entitled to the common resource increases from $N$ to $N'$, no agent should be better off than before (Chichilnisky and Thomson, 1987):

$$N' \geq N \Rightarrow U_i(P_i') + M_i' \leq U_i(P_i) + M_i \tag{7}$$

Similar to resource monotonicity, the criterion of population monotonicity is also based on the ethical argument that common ownership implies a minimum degree of solidarity, namely that everyone should contribute to satisfy the legitimate claims of newcomers.

## The stand alone criterion

The monotonicity axioms can be used to deduce the stand alone utility $U_i(P_G)$ – that is, an agent's utility from the consumption of the whole common resource $P_G$ (Moulin, 1992) as an upper bound on the utility an agent may receive from the fair division of a common property resource. To see this, imagine that there is only one country. It would receive its stand alone utility by definition. Population monotonicity requires that the utility of this country does not increase as the number of countries with legitimate claims to the common resource increases – in other words, it may not receive more than its stand alone utility. The same conclusion can be derived from the criterion of resource monotonicity. Applied to climate change, this can be stated formally as:

$$U_i(P_i) + M_i' \leq U_i(P_G) \tag{8}$$

Following the specification of utility functions as introduced above, this is equivalent to:

$$M_i \leq C_i(P_i) - C_i(P_G) \tag{9}$$

While the fair share guaranteed test fixed a lower bound to the compensatory payments, the stand alone test sets an upper bound, namely that no country will receive a higher compensation $M_i$ than the abatement cost it would save with the global number of permits $P_G$.

More generally, it follows from the monotonicity criterion that no agent should be better off when the environment's absorptive capacity for pollutive emissions is a scarce resource compared to the case where the environmental problem does not exist. Moulin (1992:1333) justifies the stand alone test by arguing that 'fair division conveys the idea of no subsidization: the presence of other agents who are willing to pay higher monetary transfers than me for consuming the resources should not turn to my advantage'. This argument seems particularly justified if the willingness to pay higher monetary transfers is related to efforts to reduce a problem which affects all agents – such as climate change. In this context one could state the stand alone test bluntly as: 'no one should benefit from the abatement burdens of others', which reflects the solidarity idea underlying the monotonicity axioms.

## TOWARDS A FAIR DIVISION OF CLIMATE PROTECTION BURDENS

Taken for itself, the fair share guaranteed and stand alone criteria sound rather mild, but their combination leads to far reaching results. As long as the South's fair share of emission rights is higher than its business-as-usual emissions, it will not have to undertake any abatement efforts to reduce emissions to the level of its fair share of permits: $C_S(FP_S) = 0$. If one assumes realistically that global emission budgets are reduced only stepwise, this will be the case if entitlements are specified in equal per capita terms, but it suffices that the South's entitlements are not much lower than this. Because a country's fair share $FP_i$ is always smaller or equal to the global number of permits $P_G$, it follows from $C_S(FP_S) = 0$ that $C_S(P_G) = 0$. Therefore, the fair share guaranteed criterion (equation 5) and the stand alone criterion (equation 9) can be combined to yield:

$$C_S(P_S) \leq M_S \leq C_S(P_S) \text{ or } M_S = C_S(P_S) \tag{10}$$

This means that as long as business-as-usual emissions in the South are lower than its entitlements, there exists only a single solution that is efficient and which satisfies the fair share guaranteed and the stand alone criteria. The North will have to pay the full incremental cost of emission reductions in the South – but not more. On the other hand, the South will have to agree to an efficient allocation of abatement measures. It should be noted that this solution is also envy free, because the South would not prefer the permits and compensatory payments of the North or vice versa (Helm, 1998).

So far, attention has been restricted to the first phase of a climate protection regime where the South's fair share of permits is greater than its business-as-usual emissions. At least a short look will be taken at later periods.

Within the economic theory of justice, the distribution of divisible common property resources via the assignment of property rights, and a subsequent allocation via competitive markets, has a very prominent position (Young, 1994:161). This mechanism does not only lead to an efficient allocation, but it also satisfies the equity criteria of fair share guaranteed and envy freeness (Moulin, 1990). However, due to the initially very large differences in per capita emissions and marginal abatement cost in the South and North, the competitive allocation would violate the stand alone test and the criteria of resource and population monotonicity respectively. Nevertheless, the market solution still constitutes a primary focal point as soon as per capita emissions and abatement cost in the North and South approach each other. But when exactly should the transition to this allocation mechanism take place?

If it begins immediately after the first period – when the South's fair share of permits equals its business as usual emissions – the South can still sell permits to the North until marginal abatement costs are equalized globally. Because with competitive markets the permit price would be equal to the (increasing) marginal cost of the last unit reduced, a profit similar to the producers' surplus would accrue to the South. This again would be a violation of the stand alone test.

This suggests a solution in which the South receives the minimum of the competitive allocation and the stand alone value. The transition from the first solution to the second would roughly take place when those abatement costs in the South, that result from the necessity to share the atmosphere's sink capacity with the North, are equal to the North–South transfers in the market allocation. The North, on the other hand, would receive its share of the competitive allocation, including the money that the South would receive on top of its stand alone utility in the competitive allocation.[10]

## CONCLUSION

Starting from some general criteria for an equitable solution, a precise proposal has been developed for allocating emissions and abatement costs in a climate protection regime. In particular, it has been suggested that the South should initially be fully compensated for the abatement cost it has to undertake in order to foster the efficiency of emission reductions. In many respects, this solution is surprisingly similar to the international agreement to combat stratospheric ozone depletion, which has been praised for its fairness. In this case, low emission countries have been fully compensated for their incremental abatement cost by high emission countries (see Biermann, 1995).

Unfortunately, exact implementation of the proposed solution is not straightforward, because it requires information on countries' abatement costs, which serve as a basis for compensatory payments. Yet, from a political point of view, this can also be seen as an opportunity since it opens a certain leeway for negotiators. Perhaps the most obvious procedure would be to start with an initial phase of joint implementation, which would later be succeeded by a tradeable permit system. Interestingly, this is not so different from the provi-

10 For a general formulation of this allocation mechanism with more than two agents, see Helm (1998).

sions in the Kyoto Protocol which provide for a permit system among industrialized countries and a system similar to joint implementation – the clean development mechanism – between industrialized and developing countries.

Certainly, not everyone will perceive this proposal as equitable. This might be due, partly, to the decision of separating the distribution in the climate protection regime from the higher level of the global welfare distribution. This was necessary for the chosen axiomatic approach, and the author believes that in the present case the breaking down of the problem into its individual parts can improve the view on the whole. But one might postulate that the South's share, as determined above, should be regarded as a minimum, and if global welfare differences were taken into account it should, rather, receive more.

Similarly, some might not agree with the equity criteria themselves. In this case, the axiomatic approach could at least help to focus discussions on those disputed criteria. However, perhaps it has become clear that something more scientifically can be said about equity than that it is 'simply a matter of the length of the judge's ears', as Elbert Hubbard once put it provocatively.

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