

International equity in climate change policy

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Equity discussions in climate change policy focus on mitigation. Climate change impacts, adaptation and decision making are also important. General equity principles can be related to specific proposals for equitable sharing of mitigation but no objective preference for any principle exists. Most promising are mixed approaches, that combine various equity principles in a process oriented setting.

Keywords: equity, climate change policy, burden sharing, international agreements

1. Purpose

This paper aims to give an overview of the most important international equity aspects that play a role in the formulation of climate change policy. It also attempts to assess what the scientific literature tells us about how these international equity aspects can be analysed and what that means for policy formulation. Since value judgements are inherent to the debate on equity issues the paper tries to show what the various approaches to equity aspects are, together with the underlying value judgements. It is not the intention to express preferences for one equity view above another.

2. What is international equity?

Equity issues are interpreted as issues of fairness or justice. In fact these terms are used more or less at random in the literature and the policy debate. A distinction is made between three types of equity issues:

International equity	equity between different countries
National or social equity	equity between different social or stakeholder groups within a country
Intergenerational equity	equity between different generations

This paper concentrates on equity issues between countries. As will become clear further down, it is not always easy to keep the various equity aspects separate given the long-term character of the climate change problem and the policy response to it. Dealing with international equity over a longer time frame is encroaching upon intergenerational equity.

3. Which climate policy issues are affected by equity considerations?

International equity issues play a role in dealing with:

- *Climate change impacts:* Who is suffering from negative consequences of a human induced changed climate and who is benefiting and to what extent? What is the imbalance between contribution to the problem (emissions of greenhouse gases) by a country and the severity of the impacts on that same country? Should there be compensation by industrialised countries to those developing countries that face negative impacts but did not contribute much to the problem?
- *Adaptation to climate change:* What are the differences between countries in ability to adapt to a changed climate? What are the costs in different countries to adapt? Should there be compensation by industrialised countries to those developing countries that face adaptation costs but did not contribute much to the problem? Should there be technical assistance to those countries to build capacity for and to implement adaptation?
- *Climate change mitigation* (= international climate community jargon for limitation and/or reduction of greenhouse gas emissions that lead to climate change): What are the efforts different countries have to undertake given the present international agreements in the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto protocol? And what does the internal redistribution of the Kyoto quota to the Member States of the European Union mean in equity terms? What are the equity implications of various modes of implementation of Kyoto protocol provisions, such as the coverage of carbon sequestration (the “sinks” paragraphs) and the provisions on Joint Implementation, Clean Development Mechanism and emissions trading? What are the impacts on developing countries from the mitigation action that Annex-I countries are undertaking? And last but not least: What should the contribution of countries be to the future mitigation efforts?

In addition, there is the general issue of *equity (fairness) in decision-making procedures:* Who participates? How equitable is the process of decision making?

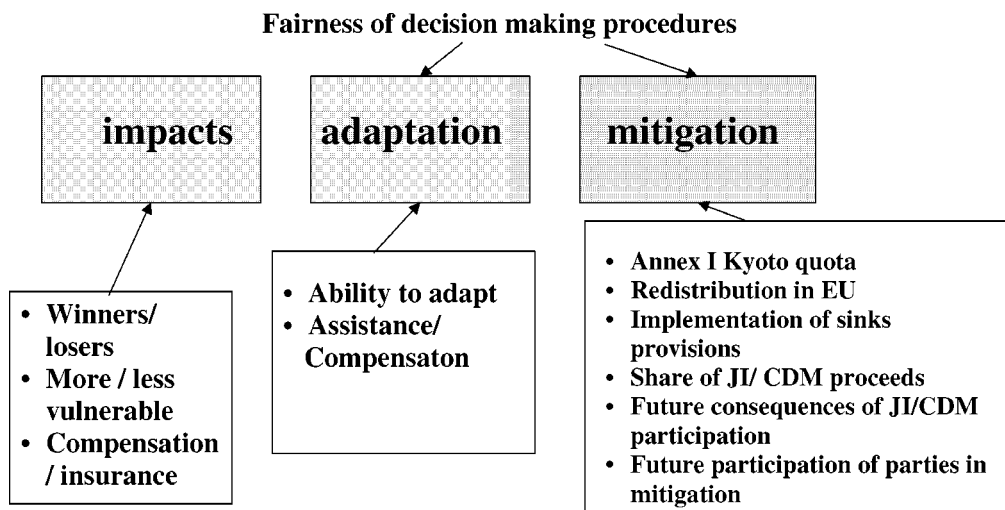


Figure 1. Schematic overview of international equity in climate policy.

And for all these questions the background is formed by all sorts of existing inequities between countries, irrespective of the climate change issue.

Figure 1 gives a schematic overview.

4. How do the international climate change agreements deal with equity?

The UNFCCC and its Kyoto protocol have extensive equity provisions, both in terms of procedures and in terms of the commitments for different categories of (country) Parties [1–4].

As far as procedures are concerned, the UNFCCC has established a transparent and open system of participation by (country) Parties with provisions for decision making that are requiring a high degree of consensus. Combined with a strong coordination by the developing country parties through the so-called “Group of 77 and China” (covering about 130 developing countries) this minimises the risk of dominance by the group of OECD countries. The main features of the procedural provisions and how they are operating in practice are given in figure 2.

The commitments in the UNFCCC for Parties are substantially differentiated. The group of rich industrialised countries, the so-called Annex-II parties (equivalent to members of the OECD at the time the UNFCCC was signed¹), has obligations to reduce its emissions as well as provide technical and financial assistance to developing countries. The group of industrialised countries with economies in transition (most countries in eastern Europe and countries that formerly were part of the Soviet Union) have no financial obligations but the same obligations as the Annex-II countries in reducing emissions, with some flexibility in choosing their own base year. They form together the so-called Annex-I group. The other countries

(non-Annex-I group) have only general obligations to minimise emissions as far as possible, protect forests and other carbon reservoirs and report on their emissions and their actions.

This differentiation in commitments is the reflection of the equity principle that is enshrined in the principles part of the UNFCCC. Article 3.1 specifies that “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. Accordingly, the developed country parties should take the lead in combating climate change and the adverse effects thereof”. On top of that all countries, in implementing their commitments, are supposed to take into account the interests of developing countries that are specifically vulnerable to the impacts of climate change, of least developed countries and of countries whose economies depend very much on fossil fuels as specified in articles 4.8, 4.9 and 4.10 of the UNFCCC.

The Kyoto protocol adds some specific provisions that address equity aspects: articles 2.3 and 3.14 require Annex-I countries to minimise the negative impacts on other countries of implementing their emission reductions. Negative impacts refer both to negative impacts of a changed climate as well as the negative (economic) impacts of mitigation actions through changes in product demand and changes in trade flows. The Kyoto protocol also creates an additional source of funding for developing countries that face costs of adapting to a changed climate: the provisions of article 12 on the Clean Development Mechanism include a mandatory adaptation fee on each project that will be paid into an adaptation fund.

5. Equity principles

There is extensive literature about the application of equity principles to climate change policy, reported both in

¹ Turkey is on the list of Annex-I and II countries, because of its OECD membership, but has not signed nor ratified the Convention because it says it cannot accept the obligations that come with this.

<p>Equity in the FCCC (consequences)</p>	<ul style="list-style-type: none"> • Art 3.1: “The parties should protect the climate system <i>for the benefit of present and future generations</i> of humankind, <i>on the basis of equity</i> and in accordance with their common but differentiated responsibilities and respective capabilities.” • Art 4.1- 4.5: Structure of <i>differentiated commitments</i>: all Parties (4.1), Annex I (mitigation action 4.2), Annex II (financial and technical assistance, 4.3-4.5) • Art 4.6: “flexibility’ for economies in transition • Art 4.7: dependence of developing country actions on technical and financial assistance and poverty eradication as overriding priority • Art 4.8-4.10: in implementing 4.1/4.2 full consideration should be given to consequences for (developing) countries, particularly vulnerable ones and those heavily dependent on fossil fuels • Art. 4.2.a: (developed country parties commit to) “.. Adopt national policies and take corresponding measures<i>taking into account the differences</i> in these parties’ starting points and approaches, economic structures, available technologies and other individual circumstances, <i>as well as the need for equitable and appropriate contributions</i> by each of these Parties to the global effort”
<p>Equity in the Kyoto protocol</p>	<ul style="list-style-type: none"> • Art 2.3:implement policies and measures ... in such a way as to minimise adverse effects of climate change, effects on international trade, and social, environmental and economic impacts on other Parties, especially developing country Parties and in particular those identified in art 4.8 and 4.9 • Art 3.14: Each Party included in Annex I shall strive to minimise adverse social, environmental and economic impact on developing country Parties, particularly those identified in art 4.8 and 4.9 of the Convention. The COP ...shall.....consider what actions are necessary to minimise the adverse effects of climate change and/or the impacts of response measures..... Among the issues to be considered shall be the establishment of funding, insurance and transfer of technology. * Art. 12.8 (on Clean Development Mechanism): The COP ... shall ensure that a share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
<p>Equity in the FCCC (procedural)</p>	<ul style="list-style-type: none"> • Art 11: (the financial mechanism should) “...have an equitable and balanced <i>representation</i> of all parties within a <i>transparent system of governance</i>. ...” • Decision making: amendments 3/4 majority; rest consensus (due to absence of formal voting procedure) • Advance availability requirements for amendment proposal (art. 15) • Open ended Subsidiary Bodies and informal consultations • Regional representation rules in Bureau of Conference of Parties • Transparent system of national communications; review provisions

Figure 2. The international equity provisions in the UNFCCC and the Kyoto protocol [1,3].

the most recent IPCC Report [5] and after that [6–11]. The most commonly quoted principles are:

- The egalitarian principle (sometimes called the parity principle): every person has the same right to use the global environmental resources and to emit the same quantity of greenhouse gases.
- The sovereignty principle (sometimes called the proportionality principle): current emissions are the basis to discuss equity; these current emissions reflect the specific circumstances of the respective country and no circumstance has prevalence over another.
- The polluter pays principle: those that have caused the problem should resolve it (further refined in current versus historical responsibility).
- The ability to pay principle (sometimes called the comparable burden principle): those with the biggest re-

sources should cover most of the cost of resolving the problem.

- The Rawlsian justice principle (also called maximin principle): the underprivileged should be favoured in dividing costs or benefits.
- The “basic needs” or “priority” principle: ensure basic needs for environmental resource. Variants of this principle are the “do no harm”, “compensation” and “fair share guaranteed” principles (compensate net losers).

These principles get a specific meaning depending on the context they are used in. For mitigation questions for instance the meaning is further influenced by the approach that is chosen. A useful distinction [9] is between:

- allocation based approaches (equity is sought in allocation of emission quota),

- outcome based approaches (equity is sought in net (financial) burden as results from allocation and implementation, including trading) of quota, and
- process based approaches (equity is sought in fairness of decision making process).

Table 1 gives an overview of the various principles and the meaning they get in specific situations as found in the literature.

The literature stipulates that there is no objective basis for selecting equity principles, which means that application of equity principles is strongly value laden [9]. Another important point is that decision making does not necessarily require the selection of only one equity principle since people are used to judge fairness in complex situations [12].

6. What are the main equity aspects of climate change impacts and adaptation to a changed climate?

The IPCC Second Assessment Report makes very clear that the impacts of human induced climate change will vary greatly between countries [13]. In hotter climates and developing countries with natural resource dependent economies, the impacts are widely expected to be adverse. Institutional and social structures in developing countries tend to be weaker and these countries lack financial resources to adapt. Small islands, low-lying areas and very dry regions are exceptionally vulnerable. The regions that contributed least to the problem are often the most vulnerable, which creates a very important equity tension. Adaptation options vary widely and might not even exist [5].

Equity discussions should therefore take into account these impact and adaptation aspects and not only look at the mitigation side of the equation. That calls for a comprehensive and net benefit approach, where the total costs and benefits of impacts, adaptation and mitigation are being looked at [10]. Evaluating and valuing impacts is extremely difficult however and strongly influenced by value judgements [14]. Monetised damage functions should therefore be used with extreme caution in equity analyses, which makes the overall net benefit approach somewhat difficult [7,8,15].

7. How is equity in mitigation linked with efficiency and political feasibility?

Efficiency in terms of the amount of greenhouse gas emissions per unit of economic activity is often used as an important consideration in discussing the contribution to reduction of emissions. The underlying thought is: the lower the efficiency the more should be done to improve that efficiency. This approach is founded in theories about eco-efficiency [16], that argue for a decoupling of economic activities and economic growth from the accompanying environmental pollution as a way to reach a sustainable development pattern. Eco-efficiency is a useful concept, but it

does not say anything about having access to fair shares of global resources. The more economic activities a country performs, the more it can in principle emit. For poor countries with low levels of efficiency it would be unfair to have to improve efficiency while rich countries with high efficiency levels would not have to do much. Eco-efficiency should therefore not be confused with equity.

Another important efficiency dimension in mitigation is achieving the lowest possible costs per ton of greenhouse gas emission reduced. Given the global character of the climate change problem it basically does not matter where greenhouse gases are emitted in the world. All emissions are leading to an increase in the atmospheric concentrations. It does make sense therefore to aim for the lowest possible costs in emission abatement. So the cheapest reductions should be done first. This cost-efficiency is of course not a good basis for an equitable distribution of the mitigation efforts since countries with low abatement costs are not necessarily the ones that can pay nor the ones that have contributed most to the problem of climate change.

An interesting feature of systems of tradable emission quota is that they are able to separate equity from cost-efficiency. According to the Coase theorem [17] a system of fully tradable quota always leads to achieving minimum total costs of a given mitigation effort, irrespective of how the initial allocations were made. The allocations of quota directly influence the costs for each participant and are thus to be based on an equitable distribution. There is much literature that therefore treats the issue of equity in climate change mitigation in terms of allocations of tradable quota [8,9]. Given the fact that the Kyoto protocol allows in principle the use of emissions trading, Joint Implementation and the Clean Development Mechanism where tradable quota are an inherent feature, this literature is quite relevant for mitigation questions in the context of the UNFCCC and the Kyoto protocol. This literature will be further discussed in one of the subsequent sections.

An important issue that is intimately linked with equity is the political feasibility of operationalising equity principles. The consequences of adopting certain equity principles can be enormous in terms of the distribution of the global resources and the related emission quota and can therefore lead to significant increases in mitigation costs. Such a decision can be politically very painful and, depending on the transition process, be politically totally unacceptable. The transition process therefore is a critical factor that needs to be taken into account in dealing with equity issues. In discussing specific proposals in subsequent sections this aspect of transition will be further discussed.

8. Does it matter what indicators are used for comparing countries in analysing equity aspects of mitigation?

Rose [18] extensively discussed this issue. He used the word "reference base", which he identified as "essentially

Table 1

An overview of equity principles and their specific variants as used in climate policy studies (based on Banuri et al. [5], unless other source is specified).

General formulation of equity principle	Specific variant of general principle	Application to mitigation	Specific proposals
Allocation based			
<ul style="list-style-type: none"> No nation has more or less right to inflict damages than any other 	<ul style="list-style-type: none"> Proportionality/status quo Sovereignty [8,9] 	<ul style="list-style-type: none"> Allocation based on current emissions 	<ul style="list-style-type: none"> Allocation based on current emissions with decreasing (AnnI) and growing shares (non-AnnI)
<ul style="list-style-type: none"> Every human being has right to emit the same amount 	<ul style="list-style-type: none"> Parity/egalitarian Egalitarian [8,9] 	<ul style="list-style-type: none"> Equal per capita emission entitlements 	<ul style="list-style-type: none"> Immediate allocation of equal per capita quota based on running population Ibid. based on fixed population Cumulative emission allocation, incl. historical
<ul style="list-style-type: none"> The more you pollute the more you reduce 	<ul style="list-style-type: none"> Polluter pays/historical responsibility 	<ul style="list-style-type: none"> Responsibility for reduction proportional to contribution to the problem of climate change 	<ul style="list-style-type: none"> Brazilian proposal: emission reduction efforts proportional to contribution to global average temperature increase [35]
<ul style="list-style-type: none"> Ensure basic need for environmental resource 	<ul style="list-style-type: none"> Priority/basic needs approach No envy [6] Do no harm [12] 	<ul style="list-style-type: none"> Give developing countries room to increase emissions until they reach an income level at which they can afford to limit and reduce emissions 	<ul style="list-style-type: none"> Survival and luxury emissions
<ul style="list-style-type: none"> Contribute according to your possibilities 	<ul style="list-style-type: none"> Ad hoc (special consideration to national circumstances) Sectoral approach [29] 	<ul style="list-style-type: none"> Mixed systems 	<ul style="list-style-type: none"> Population and GDP (50/50) based Ibid. with transition to per capita Cut back from current levels in proportion to past contribution Participation threshold and dynamic allocation based on proportional reduction efforts, leading to per capita convergence [21,34]
Outcome based			
<ul style="list-style-type: none"> Pay proportionally to your wealth 	<ul style="list-style-type: none"> Comparable burden/ability to pay [8,9] Utilitarianism/willingness to pay Horizontal [8,9] 	<ul style="list-style-type: none"> Equalise abatement costs as % GDP Equal % net GDP loss (abatement costs minus avoided damages) 	
<ul style="list-style-type: none"> The strongest shoulders should carry most of the burden 	<ul style="list-style-type: none"> Utilitarianism Vertical [8,9] 	<ul style="list-style-type: none"> Distribute (net) costs inversely proportional to GDP 	
<ul style="list-style-type: none"> Maximise benefits to poorest 	<ul style="list-style-type: none"> Rawlsian distributive justice/ Rawls' Maximin [8,9] Historical advantages of industrialised countries to be returned to developing countries Fair share guaranteed [6] 	<ul style="list-style-type: none"> Give additional emission quota to poor countries from which they can generate additional income 	<ul style="list-style-type: none"> Allocate BAU permits to developing countries, with global trading [7,15] ("Kyoto forever" case) Immediate allocation of equal per capita quota based on running population
<ul style="list-style-type: none"> Compensate net losers 	<ul style="list-style-type: none"> Compensation/Do no harm [8,9] 	<ul style="list-style-type: none"> Give so many emission quota to developing countries that no net loss of wealth occurs 	<ul style="list-style-type: none"> Payment of full incremental costs by Annex II countries for abatement by developing countries through FCCC financial mechanism
<ul style="list-style-type: none"> No one should benefit from abatement burdens of others 	<ul style="list-style-type: none"> Stand alone test, Population and resource monotony, No envy criterion, Fair share guaranteed criterion [6] 	<ul style="list-style-type: none"> Allocate quota and ensure capital transfers in such a way that some are better off but no one is worse off 	<ul style="list-style-type: none"> Payment of full incremental costs by Annex-II countries for abatement by developing countries and developing countries accept maximum use of CDM [6]
Process based			
<ul style="list-style-type: none"> Use fair negotiation process 	<ul style="list-style-type: none"> Consensus 	<ul style="list-style-type: none"> Negotiate acceptable distribution of the reduction requirements 	<ul style="list-style-type: none"> Multi criteria formulae [32,33]
<ul style="list-style-type: none"> Market is fair 	<ul style="list-style-type: none"> Market justice 	<ul style="list-style-type: none"> Rely on tradable quota system 	<ul style="list-style-type: none"> Auction emission quota to highest bidder [18]

indices against which to gauge the equity implications of policy designs". In this article the term "indicator" will be used in line with the current sustainable development literature. Rose listed a number of indicators that can be used to compare countries in equity analyses: economic welfare, population, land area, energy use, energy reserves and CO₂ emissions. He also showed to which equity principles these indicators could be related. Economic welfare comes out as the most versatile indicator that can be used to analyse application of almost all outcome based equity principles. With respect to CO₂ emissions as an indicator he pointed out that the past emissions, the current and the future ones are all relevant.

Current equity analyses are frequently allocation oriented and using emissions as the preferred indicator. Therefore, some further discussion of this indicator is warranted. Countries differ a lot in their patterns of emissions of greenhouse gases due to their specific economic development status, their national endowments of energy sources, the specific national social and economic conditions and economic specialisation [5,19]. They also differ in the relative share that specific greenhouse gases have in the total. Agriculturally oriented economies usually have a much higher share of methane and nitrous oxide in their greenhouse gas mix than industrialised countries. Emissions of the new gases, SF₆, HFCs and PFCs are predominantly found in industrialised countries. The way the different gases are summed through the use of the Global Warming Potential and the decision of the FCCC Parties to use the GWP for

a 100 year timeframe determines the contribution countries are making to the total emissions. So choices about inclusion of gases and the way they are aggregated do have immediate implications for the use of emission indicators in equity analyses [20]. The emissions indicator should be broadened to include the absorption of greenhouse gases, mainly CO₂, in soils and forests ("sinks"). The Kyoto protocol in articles 3.3 and 3.4 allows for the possibility that countries use their man-made enhanced fixation of carbon as a contribution to their mitigation obligations. The definitions and the implementation rules that are still to be decided can have significant implications for using the absorption as part of the emission indicator in equity analyses.

The emission indicator can be further developed into an indicator for the contribution to the climate problem. Instead of actual emissions at a given time, the total cumulative emissions from the start of the industrial revolution can be taken, since these are responsible for the build-up of concentrations of greenhouse gases. A better indicator might even be to take the contribution to current concentration increases, which is a more precise reflection of the net result of all historically cumulated emissions. Instead of concentrations also the climate effect, for instance the increased global average temperature could be used as the basis to compare the contribution of countries. Although the indicators themselves have no ethical content, the choice of indicator can have major consequences for equity analyses as is demonstrated in figure 3 [21]. This figure shows that the answer to the question "when do con-

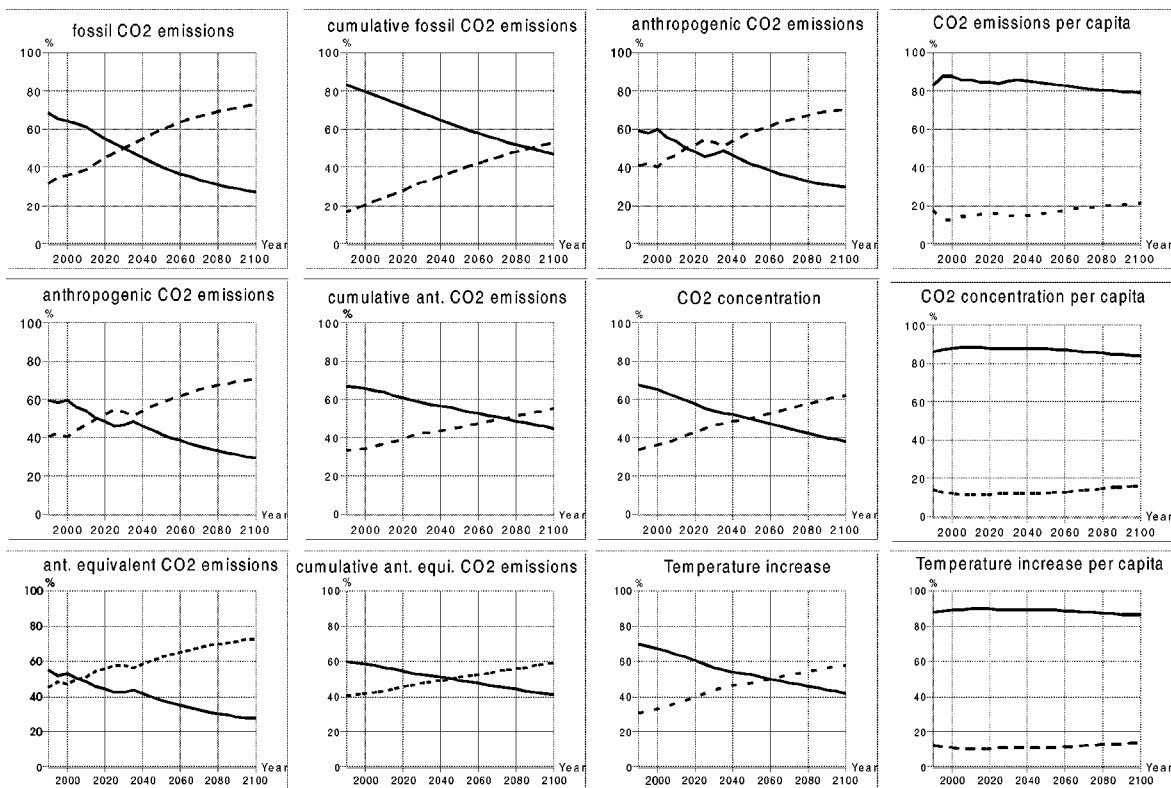


Figure 3. Contributions of Annex-I (—) and non-Annex-I (- -) countries for various indicators for contribution to climate change, based on the IMAGE Baseline A scenario and EDGAR-HYDE historical database [21].

tributions from Annex-I countries get equal to those from non-Annex-I countries?" is totally different depending on the choice of indicator.

9. International equity and implementation of the Kyoto protocol

International equity will play a major role in implementing some of the most important elements of the Kyoto protocol: (1) the provisions on land use change and forestry ("sinks"); (2) the impacts of Annex-I actions on other countries; and (3) the design of the rules and regulations for the Clean Development Mechanism, Joint Implementation and Emissions Trading.

The so-called "sinks" provisions in articles 3.3 and 3.4 of the Kyoto protocol require further decisions on the precise definition of the categories of land use change and forestry whose net carbon sequestration due to human intervention can be subtracted from the required emission reductions for each Annex-I country. The actual definition chosen can have significant advantages or disadvantages for countries and, therefore, have an impact on the relative emission reduction burden. Implementation of article 3.4 can even have much bigger equity implications because additional categories of land use change and forestry activities will be selected under this article and countries have the option of applying net carbon sequestration from those additional categories even for the first commitment period of 2008–2012. Developing countries can be affected by the eventual decisions on projects that qualify for the Clean Development Mechanism. When land use change and forestry projects would qualify, then payment for conservation of forests could become reality. Some literature in fact supports this option by arguing that the service of forest conservation has an important global benefit and that, in line with the established practice of the Global Environment Facility, the incremental costs of forest conservation can be identified [22,23].

As indicated above, articles 2.3 and 3.14 of the Kyoto protocol require Annex-I countries to minimise adverse effects on other countries, in particular the most vulnerable developing countries, of implementing the policies and measures they are undertaking to meet their commitments on emissions. This is a clear equity issue, although a complex one. It involves both the assessments of avoided damages of climate change (due to the reduction of emissions by Annex-I countries) as well as social and economic impacts of the mitigation actions themselves through reduced demand for products and changes in trade relations. The first category (avoided damages) is very uncertain as already stated above. The second category is extremely complicated: how to identify precisely what the impacts of specific country measures are?

The questions regarding the rules and regulations for the CDM, JI and emissions trading have received a lot of attention recently. The following issues can have major equity implications:

- *Restrictions on the use of these mechanisms by Annex-I countries:*

Restrictions can take different forms: (1) caps on the amounts that can be used towards meeting the assigned amounts of emissions in the 2008–2012 period, in accordance with the provisions of articles 6, 12 and 17 of the Kyoto protocol; (2) types of projects that are eligible; (3) regulation of distribution of project credits between participating countries; (4) administration and adaptation fees on transactions; (5) restrictions due to sustainability and social requirements. The economic analyses that have been published [8,24] generally conclude that these restrictions reduce cost efficiency and increase the costs of meeting the Kyoto requirements of Annex-I countries. They also have major distributional effects on countries with economies in transition and developing countries. It is however not a simple economic optimisation question. There are good arguments to regulate the system and not treat it as a free market. The requirement in the CDM article (article 12) that CDM projects should contribute to sustainable development would for instance require intervention [25]. African countries have taken the position that they should equally benefit from the benefits of the CDM and that not most of the projects should go to China and India as some of the analyses indicate [24].

- *Banking of emissions (reserving unused emission quota for future commitment periods):* the use of this option that is explicitly included in the Kyoto protocol for Annex-I countries could be attractive for central and eastern European countries that currently face an economic recession but hope to recover soon. When they would not sell their unused emissions the market price for emission quota will go up, which will affect countries that want to buy emission quota [8].

- *Preserving "low hanging fruit" (keeping low cost emission limitation and reduction options in developing countries for future domestic use and exclude them from the CDM):* This is a similar phenomenon as banking for Annex-I countries. There are some analyses available about the validity of the argument that "selling" cheap emission reductions through the CDM now will lead to economic disadvantages by the time developing countries would also have to limit or reduce their emissions [26]. They conclude that the argument is valid, but that the negative impacts can in principle be offset. Offsetting could be achieved by:

- technology transfer (which lowers the cost over time of emission limitations and reductions),
- market power (getting a higher price for the CDM reductions than what they actually cost, so that the benefits can be invested in the economic development of the country) or
- some form of compensation (a financial compensation that would be comparable to the market price issue

or agreements that future obligations for developing countries will take the CDM reductions into account).

- **Transaction costs:** Additional costs of project based mechanisms (JI and CDM) can be significant, but are difficult to assess given the limited experience with these kinds of projects so far [27]. Transaction costs are likely to go down over time, because more efficient ways will be found to match investors and potential interested host parties. This could take the form of funds, such as the current Worldbank pilot Carbon Fund, brokerage mechanisms, country portfolio programmes (such as the current programmes in Costa Rica) or market intermediaries. Depending on initiatives that countries take this can have significant implications for the distribution of benefits over countries.

10. International equity and differentiation of developed country emission quota

There is limited experience now in differentiating developed country emission quota or emission reduction obligations. First, the UNFCCC article 4.2 contains obligations, albeit expressed in fairly soft language, for OECD countries to return their emissions to 1990 levels by the year 2000. In principle this distribution seems to be based on the Sovereignty principle (0% reduction based on “current” emissions). However, neither different levels of energy efficiency, different carbon intensities of the energy supply system nor different economic growth rates in the 1990–2000 time period were taken into account. In fact this makes such an equal percentage reduction from a base year over a relatively short period much more demanding for countries with high economic growth, high energy efficiency and a low carbon energy supply than for countries with low energy efficiency, a high carbon intensity of energy supply and low economic growth rates. Whether this factor has contributed to the rather poor compliance by OECD coun-

tries with the UNFCCC obligations is hard to tell. Developed countries with economies in transition were given a less demanding target by allowing them to take an earlier base-year. Given the economic downturn in these countries accompanied by decreasing emissions this allowed them to work on economic recovery without too much of an emission constraint.

The second example of developed country differentiation was the negotiated differentiation between European Union Member States in the run-up to Kyoto. As part of the European Union position during the Kyoto protocol negotiations that a 15% reduction by 2010 compared to 1990 should be achieved, a differentiated contribution to that figure by each EU Member State was agreed [28]. Although it only covered 15 countries this decision process had all the complexities of a UNFCCC Annex-I group, given the large differences in per capita income and accompanying differences in national circumstances and emissions. Equal reduction percentages (so-called flat rate approach, linked with the Sovereignty principle) appeared totally unacceptable for the less wealthy Member States in that context, while per capita emissions (the Egalitarian approach) was equally unacceptable for the more industrialised and fossil fuel dependent Member States.

This situation of strong disagreement between Member States (that in fact had emerged already in 1990 when the first decision within the EU to stabilise CO₂ emissions by 2000 at the 1990 level had been taken) was “unlocked” by applying a more detailed analysis to the national circumstances in the individual Member States. This approach, the so-called “tritych approach”, was based on a three-sector analysis combined with the application of equity principles for each of the sectors considered [29]. The three sectors distinguished in the analysis were: (1) the electric power sector, (2) the sector of energy intensive internationally operating industries and (3) the remaining or “domestic” sector, covering households, service sector, small scale industry, agriculture and transport (see figure 4 for

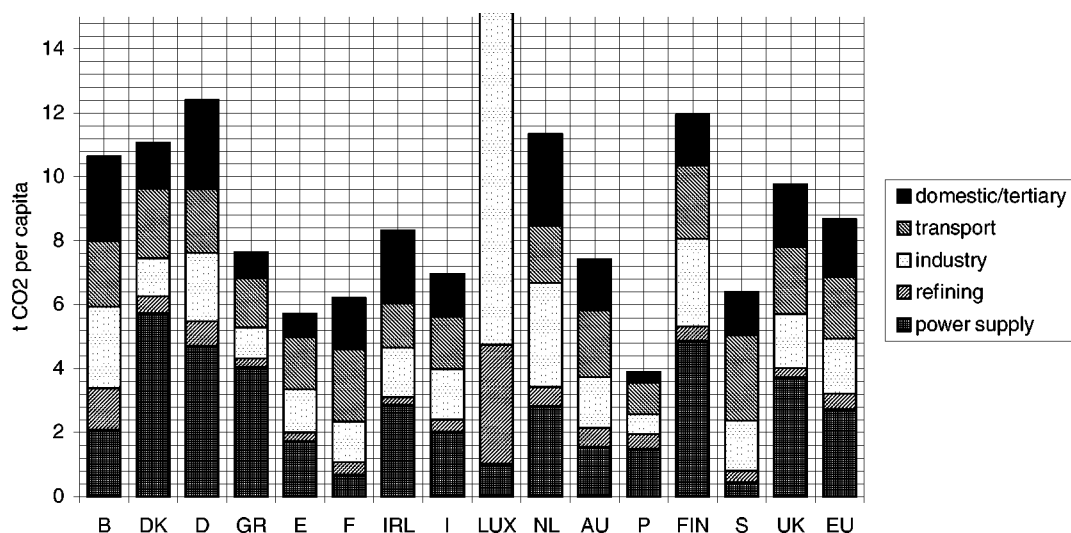


Figure 4. CO₂ emissions per capita for EU Member States in 1990, broken down according to sector (data from Phylipsen et al. [29]).

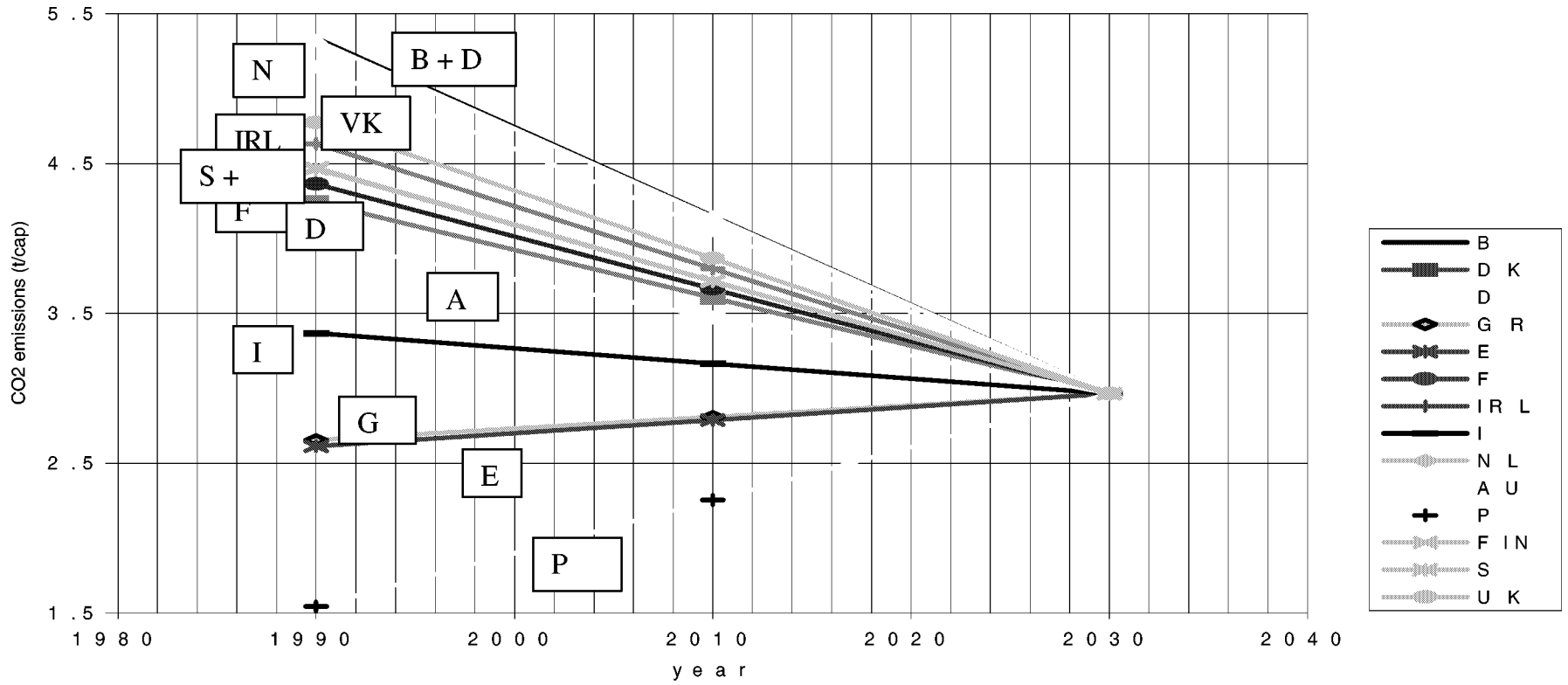


Figure 5. The per capita convergence for the domestic sectors according to the triptych approach (2030 convergence of climate corrected per capita emissions at a level 30% below 1990 EU level; data from Phylipsen et al. [29]).

emission breakdown). The idea was to apply different equity approaches to each of the sectors, allowing to take the specific national circumstances of countries into account. For the domestic sector a per capita emission convergence was chosen as the equity rule, given the fact that “equal rights” for domestic emissions exist in a group of countries that is economically converging rapidly (see figure 5). For the industrial sector an equal efficiency improvement rate (emissions per unit of product) was chosen, considering a dominant role of multinational companies in that sector, a limited difference in existing overall efficiency and the lasting need for products from the sector. Some allowance was given for a stronger growth of production capacity in the less developed Member States, thereby combining the sovereignty principle with the “maximin” or “compensation” criteria. The electric power sector was tackled on the basis of an equal reduction rate of the carbon intensity of the sector, combined with exemptions for very low carbon intensity electric power states, extra requirements for high coal intensity countries and an EU-wide obligation to

expand the non-fossil fuel power capacity. This approach can be seen as relying more or less on the sovereignty and polluter pays principles.

Results of this analysis were significantly different from the more traditional distributions, using other more common equity rules. The analysis assisted in finding political agreement amongst EU Member States on the contributions towards a reduction target, because it provided arguments for increasing the contribution of certain Member States that had not been so forthcoming initially and arguments for allowing certain Member States to increase their emissions or keeping their emissions stable [28] (see also figure 6). Others that analysed this case, including the final internal EU renegotiating after Kyoto in 1998, [30], claim that the resulting differentiation between EU Member States is closer to application of the “ability to pay” principle (see figure 7).

The third case of developed country differentiation is the Kyoto Annex B agreement [3]. It is very hard to find any systematic approach in the outcomes. Per capita incomes, CO₂ emissions per capita, nor CO₂ emissions per

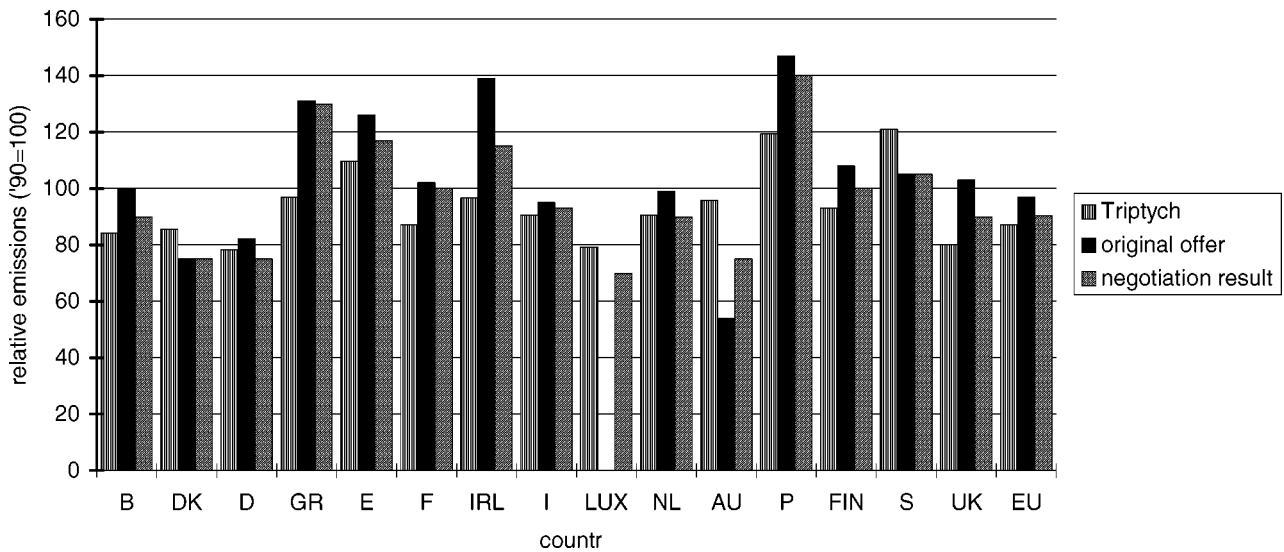


Figure 6. A comparison of the results of the triptych approach with the outcome of the EU negotiations at the EU Environment Council in March 1997 and with the initial offers of emission reductions from Member States (data from Phylipsen et al. [29]).

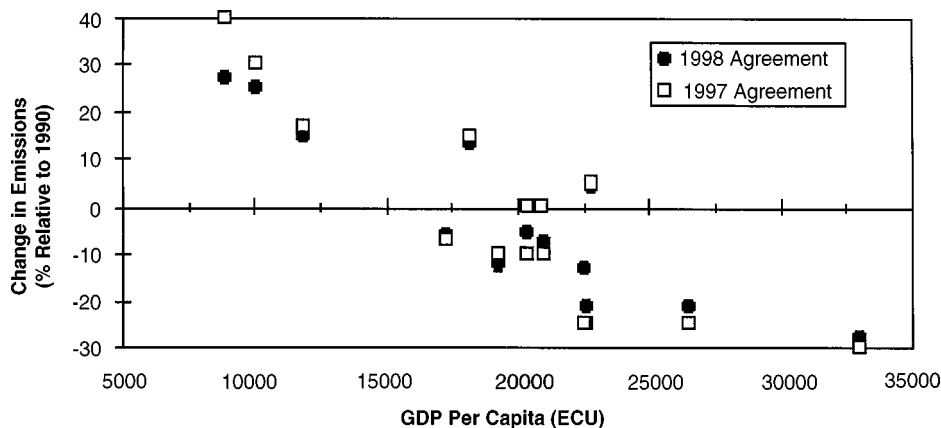


Figure 7. EU Member State burden sharing contributions (1997 and 1998 agreements) versus per capita GDP. Reflects implicit influence of ability to pay principle [30].

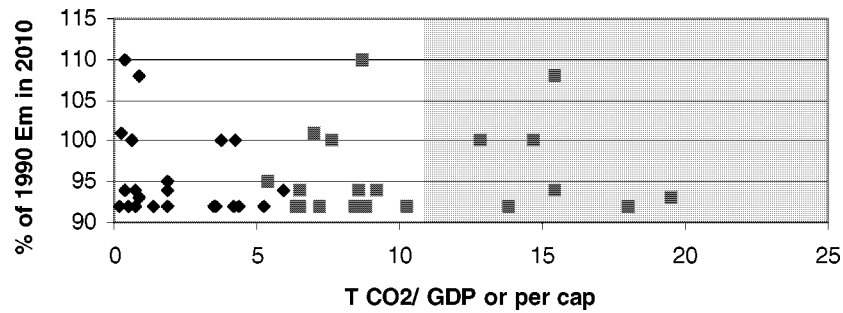


Figure 8. Correlation of Kyoto protocol Annex B emission quota and indicators for equity and efficiency (data from UNFCCC [3] and IEA [38]). (◆) CO₂/GDPmer (1990) and (■) CO₂/cap (1990).

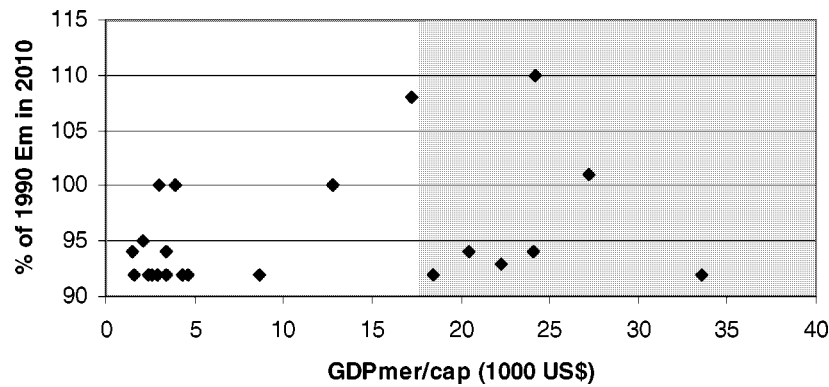


Figure 9. Correlation of Kyoto protocol Annex B emission quota and per capita income at market exchange rates (data from UNFCCC [3] and IEA [38]).

unit of GDP show a good correlation with the emission quota agreed (see figures 8 and 9).

11. International equity and the issue of increasing participation of countries in emission limitations and reductions

Increased participation of developing countries over time in a global regime to limit and reduce emissions is necessary if stabilisation of greenhouse gas concentrations in the atmosphere at reasonable levels in accordance with article 2 of the UNFCCC is to be achieved [21,31].

The first question that comes up is of course how the UNFCCC and the Kyoto protocol regimes in terms of country participation compare with criteria for international equity. Although developing countries do have significant obligations under these agreements and although it is certainly the idea that all countries, including the developing countries do sign and ratify the Kyoto protocol (as they ratified the UNFCCC), participation in emission reductions is at this stage limited to the Annex-I countries (with OECD countries taking the lion's share). In the light of the historic contributions of these countries to the current increased greenhouse gas concentrations in the atmosphere and the large differences in ability to pay, these agreements can, at this stage, be considered to reflect the "do no harm to developing countries" and "polluter pays" principles. The inclusion in the Kyoto protocol of the CDM introduces el-

ements of "Rawlsian justice" and "compensation", while at the same time, together with JI and emissions trading, cost efficiency of the regime can be made high. The Kyoto regime with an operational CDM can in fact be interpreted as a system of global participation in emission reduction with a distribution of costs that reflects these "Rawlsian maximin" and "compensation" principles [7,15]. The debate in the USA about ratification of the Kyoto protocol, that indicates that ratification is unlikely because of perceived unfairness in the participation of developing countries to the emissions reductions, shows that there can be totally different interpretations.

There is a considerable amount of literature that studies possible future regimes for global participation in emission control. There are both studies that consider the issue from an allocation based approach as well as studies that use an outcome-based approach (see table 1 above).

11.1. Allocation based studies

The IPCC Second Assessment Report [5] gives an overview of many proposals that have been made. They range from typically egalitarian (immediate allocation of equal per capita emission quota using running population or fixed population at a certain time; both with actual emissions and cumulative emissions) via typically "status quo" proposals (allocations based on current emissions, sometimes with a decreasing Annex-I and increasing non-Annex-I share) to so called "mixed proposals" (based on population

and GDP or reduction from current emissions in proportion to past contributions). More recent studies can be divided into two categories:

- Multi-criteria formulae, that combine different principles in one mathematical equation including weight factors for the respective components [32,33].
- Dynamic, process oriented approaches that use gradual change towards an equitable situation and allow choice and combination of principles; these approaches are designed to be used in negotiated decision making [21,34,35].

Table 1 gives an overview of the various proposals made and how they relate to equity criteria.

Multi-criteria studies using mathematical equations and weight factors for the different criteria have the disadvantage that they soon become a “black box”. It is not easy to attach a certain fairness vision to any particular proposal, because of the rather abstract weight factors for the various equity principle related terms. In the climate policy context there are no examples of cases where this approach did work.

The Brazilian proposal [35] that was specifically developed for differentiation of emission reduction obligations for Annex-I countries in the context of the Kyoto protocol negotiations is an interesting application of the polluter pays principle. It takes the climate effect of a country’s emissions as the basis for determining its contribution to the emission reduction effort. The global average temperature increase of the country’s historic emissions is used as a proxy for the climate effect. In theory this approach can also be applied universally as a way to define the “common but differentiated responsibility” that is the basis in the UNFCCC of equitable sharing of the efforts to address climate change.

When increasing participation of countries in the global emission limitation and reduction efforts is oriented on more egalitarian or “Rawlsian” equity principles, political feasibility requires some form of transition from the current to a future situation. There is a growing body of literature that tries to formulate proposals in such a dynamic context [21,34]. These studies assume that non-Annex-I countries follow an unrestricted baseline until sometime in the future they reach a threshold that triggers some form of emission limitation or reduction. Onigkeit and Alcamo [34] use per capita income (GDP) as a first trigger that would require newly participating countries to stabilise emissions. And they use the global average emission per capita as a second trigger that will require countries to reduce that per capita emission over time in order to allow global concentrations to stabilise at some level. By using global models this approach can be evaluated using many different assumptions for the per capita income and concentration stabilisation level.

Berk et al. [21] use a similar, but even more flexible approach. They use a trigger for participation in emission

limitation or reduction that can be chosen from a wide variety of indicators (such as per capita emissions, per capita income, per capita temperature increase) and a separate indicator that determines the share the country will take in the global emission limitation or reduction effort (to be chosen from an array of possibilities such as per capita emissions, current emissions, cumulative emissions, per capita temperature increase, etc.). Figure 10 shows the case of not using a participation threshold: all countries have to participate immediately in the global emission limitation and reduction efforts. Even if the contribution from developing countries to that effort is very limited because they are not contributing much to the problem, it is hard to conceive that such an immediate participation by developing countries would be politically feasible. Figures 11 and 12 show some other cases. The case where participation is triggered by reaching the world average per capita emission is an interesting one. Developing countries can in principle postpone that moment by taking voluntary domestic action, while developed countries could lower world average per capita emission levels through their own reduction efforts, thereby forcing developing countries to participate earlier (“increasing participation by others through reducing your own emissions”).

11.2. Outcome-based studies

The IPCC Second Assessment Report [5] summarises the main schools of thought on outcome-based distribution of efforts.

First, it mentions proposals that basically “circumvent” the allocation stage. One way to do that is by direct payment of all incremental costs of emission limitation and reduction measures in non-Annex-I countries by Annex-II countries, which is in fact the way the Financial Mechanism of the UNFCCC, as implemented through the Global Environment Facility, works. Other mechanisms are possible that divide the total costs of a certain global emission limitation or reduction effort according to certain equity criteria (using some sort of fund). One such mechanism could be raising carbon taxes and redistributing the revenues on the basis of equity considerations. The problem with these proposals is that they require such a degree of collective decision making and such a trust in global (or regional) financial mechanisms that it is unlikely they get sufficient political support.

Second, it points to systems of tradable quota, where initial allocations are determining the financial outcome for countries after trading has taken place. Given the early stage of the debate about emissions trading at that time the assessment is not very detailed. An interesting element covered in the IPCC report is the notion that emission quota could be leased rather than sold in order to avoid the establishment of “emission property rights”. That is a useful idea that could possibly address the fear of developing countries that formal agreement with a system of tradable emission quota would de facto deprive them from getting

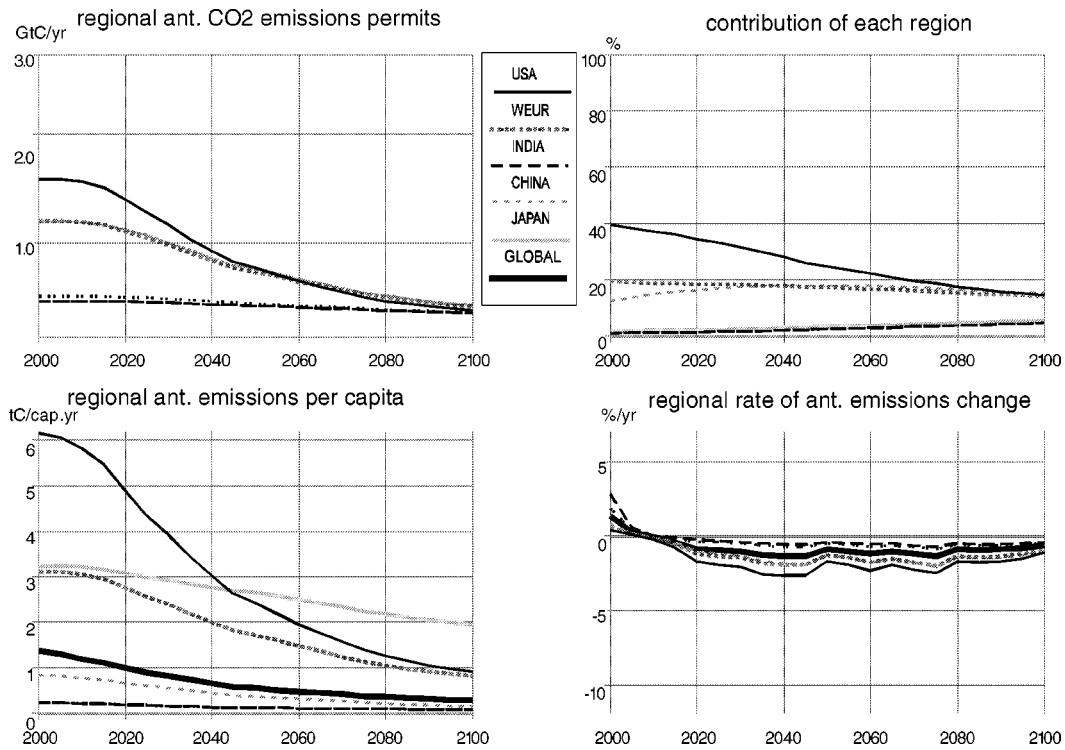


Figure 10. Allocation of CO₂ emission quota for USA, Western Europe (WEUR), Japan (JAP), India region (IND) and China region (CHI) under the following assumptions: (1) no threshold for participation in the global effort (i.e., all countries participate in limitation and reduction); (2) share of limitation and reduction effort based on absolute contribution to global temperature increase; (3) IPCC emission profile for stabilising CO₂ concentrations at 450 ppmv by 2100. Top left panel shows absolute emissions, bottom left panel emissions per capita. Percentage contribution to the global effort is shown in top right panel and the annual rate of change of available emission quota in the bottom right panel [21].

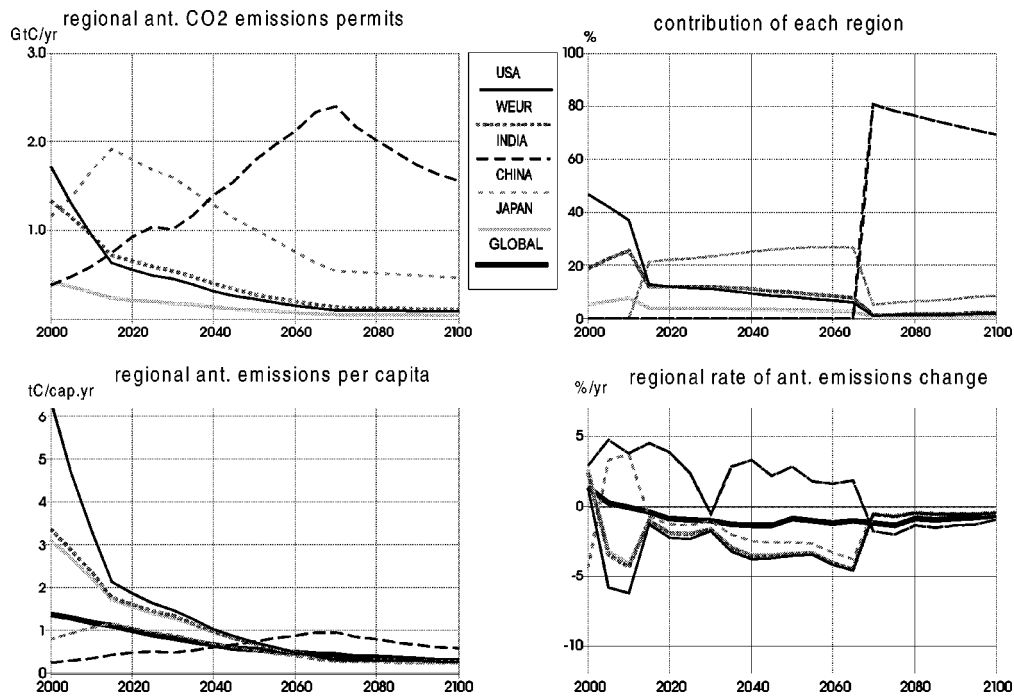


Figure 11. Allocation of CO₂ emission quota for USA, Western Europe (WEUR), Japan (JAP), India region (IND) and China region (CHI) under the following assumptions: (1) participation threshold of 1.0 ton of per capita CO₂ emissions; (2) share of limitation and reduction effort based on per capita contribution to temperature increase; (3) IPCC emission profile for stabilising CO₂ concentrations at 450 ppmv by 2100. Top right panel shows start of participation by China region around 2010 and India region around 2065. Bottom left panel shows lower ultimate emission quota per capita for industrialised regions than for developing regions due to historic emissions of industrialised world. Bottom right panel shows high rates of emission quota reduction for industrialised regions in early period [21].

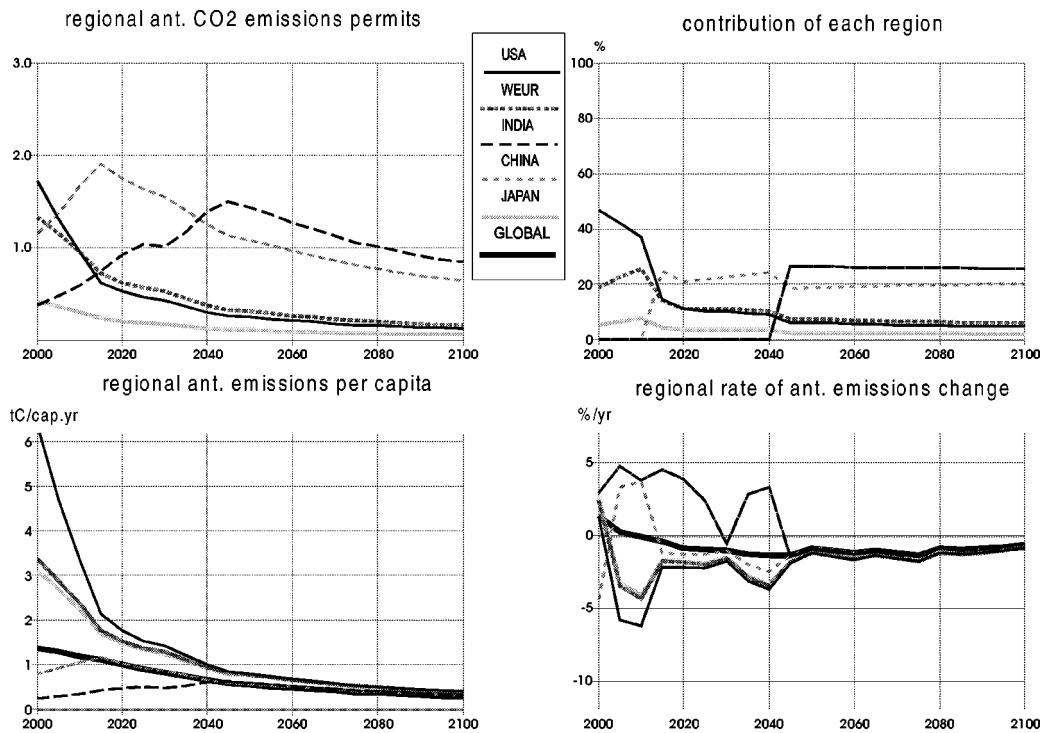


Figure 12. Allocation of CO₂ emission quota for USA, Western Europe (WEUR), Japan (JAP), India region (IND) and China region (CHI) under the following assumptions: (1) participation threshold of world average per capita CO₂ emissions; (2) share of limitation and reduction effort based on per capita CO₂ emissions; (3) IPCC emission profile for stabilising CO₂ concentrations at 450 ppmv by 2100. Top right panel shows start of participation in global effort by China region around 2010 and India region around 2040. Bottom left panel shows that for CO₂ per capita emission as the criterion for sharing the effort all emission quota per capita become equal in the long term. High rates of quota reduction for industrialised regions still apply in the early stages [21].

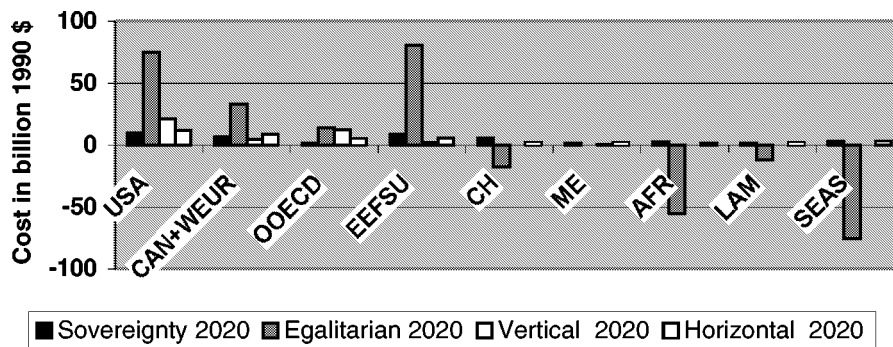


Figure 13. Total abatement costs for some Annex-I and non Annex-I regions (USA, Canada + Western Europe, other OECD, Eastern Europe + Former Soviet Union, China, Middle-East, Africa, Latin America and South-East Asia) for four different permit allocation rules under a global trading scheme and global emission reduction regime (1990 levels by 2000, -20% of 1990 by 2010 and fixation thereafter) (based on data from Rose et al. [9]).

equal rights in the future because the developed countries could consider their current emissions as rights that cannot be taken away. It can also protect against the selling of future rights forever out of short-term interests.

Third, it discusses several aspects of what constitutes fair distribution of costs and what types of costs are considered (abatement costs, total net costs of climate change and its abatement or total economic losses/benefits) without giving a clear picture of the options and their equity implications.

More recent literature is focussing mostly on a system of tradable emission quota as the basis for proposals to share the global efforts and compares the costs to countries or

regions depending on the allocation regime. Rose et al. [9] give a good overview of several studies. They present a comprehensive analysis of the outcomes of various permit allocation rules in terms of total abatement costs (after trading), assuming a global trading system and looking at the years 2005, 2020 and 2035, using a nonlinear programming model. They assume a 20% reduction of global emissions compared to 1990 by 2010 and a fixation of that level until 2050.

Figure 13 summarises some of their results for 2020 using four different permit allocation rules. It is clear that sovereignty based allocations (equal reduction percentages)

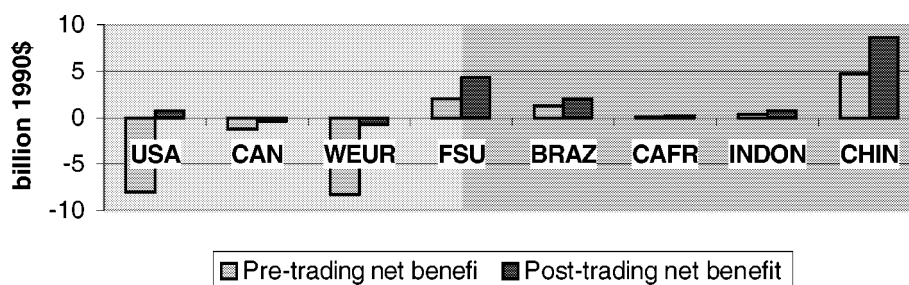


Figure 14. Net benefits (abatement costs minus avoided climate change damages) for Kyoto protocol emission quota (developing countries no restriction); without and with global trading (data from Rose [7]).

mean costs for all regions, while egalitarian allocations (equal per capita based on projected population growth) lead to high costs in Annex-I regions and high benefits (from traded quota) in non-Annex-I regions (except the Middle East), the total global costs being the same in the two cases. Those cases represent the extremes in the range of cost distributions. Other rules give outcomes that are closer to the sovereignty case.

The vertical allocation rule for instance (cost inversely proportional to GDP/cap) leads to much lower costs for Annex-I regions than for the egalitarian case and to more or less zero cost/benefits to developing countries (except for the Middle East), again at the same global costs. This would be close to a “no harm to poor countries” principle. Another rule is the so-called horizontal distribution (equal percentage GDP loss) that is leading to somewhat higher cost for Annex-I regions than in the sovereignty case, but also to some costs for non-Annex-I regions, albeit lower than in the sovereignty case. This equal percentage of GDP loss rule has also been advocated by Australia during the negotiations on the Kyoto protocol [36].

Rose [7] and Roson and Bosello [15] analyse the net outcomes (abatement costs minus benefits from avoided climate change damage) from the Kyoto protocol allocation. Rose approximates the Kyoto protocol arrangements with a system of global emissions trading in which non-Annex-I countries receive emission quota equal to their baselines (equivalent to not having any emission limitation or reduction obligations and having an operational CDM, JI and emission trading system). He calls this the “no harm to developing countries” rule, as proposed by Edmonds [37]. The results of this analysis are summarised in figure 14. All countries benefit from trading, in fact with the assumptions in this study only Canada and Western Europe face small net costs, while all others have net benefits after trading. Of course, the net cost approach means quantifying climate change damages, which is a risky and uncertain exercise given the difficulty of monetarising climate change impacts. The model results should therefore be interpreted cautiously. An overview of studies and proposals and how they relate to specific equity criteria is included in table 1.

12. Conclusions

International equity issues are central to the UNFCCC and its Kyoto protocol and will play a major role in the implementation and further evolution of these agreements. Most literature is focussing on equity aspects of mitigation questions. However, equity plays also an important role in dealing with climate change impacts and adaptation issues and the decision-making process and the participation in this process

The Kyoto protocol itself, both in terms of the differentiation in Annex-I emission quota as well as in the implications of the articles on sinks, on minimising impacts on developing countries and on the CDM, JI and emission trading mechanisms, is an experiment in dealing with international equity. At the level of the European Union there is also some experience with equitable distribution of mitigation efforts. The current debate about the future evolution of the global regime of emission limitation and reduction centres very much around equity questions.

Theoretical equity criteria are useful to inform the debate, but are themselves unlikely to provide concrete solutions. A major reason is that equity criteria are highly subjective and value laden. For practical solutions equity has also to be balanced with considerations of efficiency (eco-efficiency and cost-efficiency) as well as with political feasibility. This means that out of the many different proposals for dealing with equitable sharing of the future efforts to control greenhouse gas emissions, mixed allocation, outcome and process approaches might have the best potential. They are explicitly making room for subjective choices of (a mix of) equity principles and allow evaluation of the consequences of such choices in a dialogue with policy makers. They also are using transition mechanisms to deal with political feasibility.

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