Improving Cost-effectiveness and Facilitating Participation of Developing Countries in International Emissions Trading

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Abstract

This paper discusses ways in which the next climate agreement – a renegotiated Kyoto Protocol or a second-period agreement – can be made more cost-effective. The discussion focuses on the design of international emissions trading to facilitate early participation by developing countries. Four aspects are highlighted: the design of compensation rules, the need to regulate the use of the CDM, the effect of allowing borrowing and the implications of a Commitment Period Reserve.

Introduction

Cost-effectiveness is a crucial requirement for meaningful agreements on international climate change policy. This is also borne out in the wording of the Framework Convention of Climate Change and, in particular, the Kyoto Protocol (KP), see UNFCCC (1992) and UN (1997). However, the KP – as it stands after COP7 in Marrakesh – is not cost-effective, although it may eventually turn out to be the only politically feasible, 'most cost-effective', first step in international climate change policy. The successor to the COP7 version of the KP may be a renegotiated protocol, if the COP7 version fails to be ratified by enough countries to enter into force, or it may be the treaty to be designed for a second commitment period.

Four dimensions in which cost-effectiveness may be improved in a treaty that succeeds the KP are discussed here. They all relate to international emissions trading (IET) which is likely to be the most significant instrument for attaining cost-effective reductions in aggregate greenhouse gas (GHG) emissions.

It is important for a climate treaty to be able to attract as many developing countries to IET as possible and achieve this as soon as possible. This would have to occur at essentially no cost to them. Only with developing countries onboard can the world community get full access to their low-cost options for emission reductions. A first aspect to be discussed here is related to identifying a cost-effective approach to attain that goal (Section 1). Another aspect concerns the role of the Clean Development Mechanism (CDM) in this context (Section 2). A third issue is to evaluate the consequences for cost-effectiveness of introducing a Commitment Period Reserve to

limit 'overselling' (Section 3). A final one deals with the increase in flexibility that would follow from allowing not only banking but also borrowing of Assigned Amount Units (AAUs) (Section 4). While the first two issues refer directly to developing countries, the last two will be particularly relevant for them once they get involved in IET, since (a) these countries then typically would be sellers of AAUs, and (b) some room for borrowing may be important especially for risk-averse developing countries.

The main conclusions can be briefly stated as follows.

(1) It is likely that there exist more cost-effective ways to attract non-Annex I countries to IET than simply to 'offer' them large enough AAs, as is the approach taken in the KP with respect economies in transition. One such alternative involves replacing part of an AA allocation by financial transfers.

(2) The CDM is an imperfect flexibility mechanism that would disappear for developing countries that join IET/JI. But it is also an instrument that makes it costlier to have such countries join IET. Applying stringent rules for 'certifying' emission reductions would reduce these costs, in addition to reducing the particular kind of 'hot air' that the acceptance of sanguine (standardized) project baselines would tend to create. The choice here may be seen as one of giving up possible short-term CDM benefits for long-term cost-effectiveness in climate change policy.

(3) To reduce the risk that sales of AAUs exceed what a Party is entitled to sell the Party is required to hold a Commitment Period Reserve. Its direct effect on cost-effectiveness may be limited but, as is true for all rules directed against 'overselling', it implies a heterogeneous treatment of the origins of

overemissions – which is the real offense here – by punishing more those who overemit *and* sell AAUs, which are the poorer trader countries, than those who overemit and fail to purchase enough AAUs.

(4) The strong opposition from many Parties to allowing borrowing in IET does not seem to have taken into account that realistic sanctions against Parties in non-compliance would amount to just that. However, the particular sanctions agreed on will hardly represent the most cost-effective conditions for borrowing.

1. Attracting More Countries to International Emissions Trading - A Win-Win Option

The cost-effectiveness of the Kyoto Protocol or any similar form of international climate change policy would be enhanced by attracting as many new countries as possible to IET and achieving these additions as soon as possible (see e.g. Zhang, 2001). Adding more participants in IET would make their low-cost abatement options available for international emission reductions. In addition, it would reduce the scope for 'carbon (or GHG) leakage', *i.e.,* for movements of GHG emitting production to countries that are not committed to emission constraints.[2] Both the new and the pre-existing trader countries stand to gain from the increased cost-effectiveness of increasing the number of participants in IET. [3]

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[2] Adding more participants in IET is likely to affect ordinary trade and hence, the countries' terms of trade. In this section, we abstract from effects on GHG leakage and terms of trade.

[3] The pre-existing trader countries are here and below regarded as a group. Individually these countries differ; pre-existing would-be sellers would lose from AAU prices falling as a result of new countries

It is obvious, but still important to note that if the set of participating countries is not expanded at the earliest possible occasion, part of the potential gains in cost-effectiveness is lost forever. Most if not all the low-cost emission reductions that are made available by the participation of additional countries in a conceivable first commitment period will, of course, have to be made during that period.

Another potential cost-effectiveness reason why non-Annex I countries should join IET as early as possible concerns the fear that dominant trader countries might try to distort trade to their advantage. Increasing the number of (large) trader countries would tend to reduce such risks. Furthermore, additional traders and larger transaction volumes would make it more likely that an efficient AAU exchange is introduced to replace a system of bilateral trading where market power risks and transaction costs are higher and market transparency lower (Bohm, 2000).

In principle, the gain in cost-effectiveness from adding countries to IET could be used either to achieve an aggregated cap on emissions at a lower cost or to reduce this cap, given the aggregate compliance cost of the original KP, or some combination thereof. However, new participants can be expected to be unwilling to join an agreement that is certain to let pre-existing (rich) signatories get away with a reduction in their commitment costs. Therefore, a more interesting target for a cost-effective policy agreement might be one of minimizing aggregate emissions given that (a) total costs, all borne by the pre-existing signatories, are kept at the level implied by, say, the KP, and (b) the additional countries are apportioned AAs that keep them fully, but barely, compensated. This target, which is assumed here, would identify the maximum

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joining IET. Therefore, it is presupposed that measures (such as higher AAs in the next commitment period) are taken to redistribute the group's net gains so that no countries would lose.

potential reduction in climate change risks for the case where all Parties were kept compensated (net of their perceived benefits from the resulting reduction of the risks for global warming).

Different ways to keep new IET Parties fully compensated

Compensation to attract poor countries to participate in IET is typically taken to be in terms of sufficiently large AAs, as was the case in the KP for economies in transition. However, the cost-effectiveness of other forms of compensation needs to be evaluated. We take a step in that direction here, assuming that developing countries are typically more risk averse than developed countries.

Bohm and Carlén (2000) show that compensating a developing country partly in terms of a financial transfer from pre-existing Annex-B Parties is more cost-effective than a compensation in terms of assigned amounts only. More specifically, the two options were compared for a case where a basic AA volume to the prospective developing trader country is given and – initially – equal to that where the country's expected value of revenue from future sales of AAUs *minus* abatement costs is zero. This is an AA at which a risk-neutral Party would be barely compensated. To attain the reservation AA of a risk-averse party, additional compensation is required, either in terms of extra AAUs (= X units) or as a financial transfer (= $M).[4] For simplicity,

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[4] See Wiener (1999) for a discussion of a similar set of options. The primary reason why he ends up in favor of an AA-only approach is due to "the difference in compensation currencies" …where the financial transfer "would involve cash flows from donor government to recepient government, while /the alternative compensation payment in terms of extra AAUs/ would involve the investment by industrialized emitters in the transfer of low-emissions technologies to firms in host countries in return for some of the /AAUs/ freed up by the attendant emissions reduction" (p. 766). In the approach

the new trader country is assumed to obtain the additional compensation only after having been found to be in compliance at the end of the (first) commitment period. This could mean that the sales revenue up to that point is kept in escrow until that date and that (the present value of) the financial transfer is deposited by the collective of pre-existing Annex-B countries prior to the start of the commitment period (see further below). Keeping all sales revenue in escrow until the Parties concerned are found to be in compliance is a safeguard against overselling that is compatible with seller liability, the *ceteris paribus* most efficient form of liability.

The cost-effectiveness of the M option emerges from the fact that the compensation in terms of X, the value of which is uncertain, is worth less to the more risk-averse new trader country than to less risk-averse pre-existing Annex-B Parties. More specifically, the gain in cost-effectiveness – or the gain from using the increase in cost-effectiveness to reduce aggregate AAs – is obtained as follows:

- The outcome of a minimum X for the new Party to join IET is compared to that of a minimum M, both options evaluated at the expected new equilibrium,

- The group of pre-existing Annex-B Parties are kept at the same total cost level as implied by the case the new Party would not join IET. This allows reducing their aggregate AAs to balance the gain they otherwise would have made from lower AAU prices,

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discussed below, the 'extra AAU' option (X) is not assumed to take that form. The government in the new trader country obtains either a financial transfer or extra AAUs as a result of an international agreement and may, if it so wishes, devolve IET to firms. The pre-existing trader countries' governments agree to a specific set of AAs or a set of larger AAs plus a financial commitment and may or may not devolve IET to legal entities. In other words, in the present analysis it is altogether a negotiation issue between governments and whether IET takes place between legal entities or governments or a combination of both is of no concern here.

- Keeping the new trader Party as well as the pre-existing group of Annex-B Parties indifferent, the M option will imply lower aggregate emissions than the X option.[5]

As shown in Bohm and Carlén (2000), the most cost-effective financial transfer (M) is larger, and hence the AA part (the 'basic' AA) smaller, than so far assumed. This contributes to making the aggregate emissions even lower. Intuitively, this follows from the fact that, instead of being allocated a large AA and exporting a substantial part of it to the pre-existing Annex-B Parties, the new trader country would be paid a large financial transfer for agreeing to a much smaller AA. Thus, the implication of the M approach resembles a long-term contract for a large part of the new trader's emission abatement and amounts to an efficient shifting of risks to the party with the lowest costs of risk bearing.[6]

There are aspects of the compensation issue that may speak against the realism of using any significant amount of financial transfers. As suggested above, the M transfer must be made credible to the new trader country before it starts operating as an AAU trader. Thus, it was suggested that the financial transfer be deposited prior to the commitment period, hence made certain to be available for being paid out at the end of the commitment period, or some other solution to the same effect. If the pre-existing Annex-B countries, for political reasons, cannot agree to secure the feasibility

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[5] An experiment that let 32 PhD students in Economics face a decision similar to that which is here taken to confront governments of developing countries are reported in Bohm and Carlén (2000). The results show that risk-averse subjects behaved essentially in accordance with the prediction suggested here. The hypothesis of equal X and M asks under the two mechanisms was rejected in favor of lower compensation asks under M at p-values below 1 percent.

[6] Substituting the basic AA + M for the AA-only approach also reduces the risk that the AA allocation includes 'hot air', i.e., exceeds the business-as-usual level of emissions. Such allocations have raised political demands to place binding constraints on IET, which would reduce the cost-effectivenss of the policy (see further Section 3).

of the financial transfer, they have in fact revealed that they do not consider the increase in cost-effectiveness worthwhile.

To conclude, there is a need to investigate the cost-effectiveness of various designs for compensating developing countries to join IET as compared to that of just finding the minimum AA volumes required.[7] An increase in cost-effectiveness in this respect would facilitate having the developing countries join IET and hence, a further reduction in global GHG emissions.

2. CDM – the imperfect flexibility mechanism

When a non-Annex I Party joins IET, its involvement in the CDM is discontinued and it becomes eligible for joint implementation (JI) instead. Whatever the CDM can achieve in terms of project-related benefits to the Party the same could now be obtained from JI, e.g., technology transfers, assuming the benefits are calculated in the same way. However, replacing the CDM by JI fundamentally reduces the role of the baseline problem (see further below) since there would no longer be any incentives in common for investor and host countries/firms to exaggerate the emission reductions attained by the project. The host country has no reason to help making the emission reduction units (ERUs) of JI as large as possible, in contrast to what is true for the CDM's certified emission reductions (CERs). Rather, giving away ERUs will be costly to the host country since it requires either increased domestic abatement or

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[7] Other options include commitments by the pre-existing Annex-B Parties to stabilize AAU prices for the X component. Or new countries may be allowed to make early, preliminary commitments to join IET (with an AA less than their BAU emission levels) and be allowed to opt out later, at a cost. See Bohm and Carlén (2000) for a discussion and an experimental test of the latter approach.

selling fewer AAUs. Thus, the environmental effectiveness of the ERUs tends to exceed that of the CERs. However, if the host country finds that the way the CERs are calculated gives it more benefits than those provided by joining IET and JI, the country may prefer to stay with the CDM.

Take the case of a new Party that joins IET, while satisfied that it will be kept fully compensated over some minimum number of periods. Its costs of leaving the CDM for JI are those just mentioned – the possibility that the CERs and hence, the CER sales to the investor, are overvalued. Its primary benefits of joining IET consist of having more emission reductions available for AAU sales than those arising from feasible, large CDM projects. The additional emission reductions include those that result from the introduction of domestic policies such as carbon taxes or carbon tariffs (e.g., reduced emission from transportation, heating and cooling).[8]

The reservation AA of a non-Annex I country is given by the AA at which the potential benefits of IET (and JI) are considered equal to those of the CDM. Thus, the higher the estimated benefits of the CDM, the higher the Party's reservation AA – hence the cost for compensating it to join IET – and possibly the longer its delay to enter into IET.

The benefits in terms of increased cost-effectiveness accruing to all pre-existing Parties from a new Party joining IET are two-fold. First, more low-cost abatement options will be made available. Second, the risk for inflated CERs will disappear. Below, we check possible ways to reduce the risks that the global community won't

be able to collect the increase in cost-effectiveness from having more countries join IET. Before doing so, however, we will take a look at the extent of the CDM baseline problems and the verifiability of emission reductions from CDM vs. IET.

Baseline problems and verifiability

IET is cap and trade while the CDM is baseline and offset trading. Fraud is possible in both cases, but the major difference between the two is the role of the fundamental uncertainty in estimating project baselines and the high likelihood of a systematic bias towards exaggerated emission reductions from the CDM.[9]

It is well known that investor and host parties have an interest in common to do what they can to convince the CDM executive board or its representative that their project has a high emission baseline (see e.g., Bohm, 1994, Wirl *et al.,*1998). This may, but need not, involve explicit planning to try to fool the authorities. The fundamental reason for the problem is that the baseline is unobservable.

An important illustration of this risk may be the following. The least costly CDM projects are those which are near to being profitable on their own, say, projects that might well be carried out in the near future, say, with expected funding from conventional international organizations. The prospects of CDM funding of such projects would be particularly valuable to the host firm/country. Given these prospects,

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[8] It is sometimes argued that domestic policies such as the introduction of a carbon tax could constitute an eligible CDM project. However, this is unlikely since there is no way to prohibit a sovereign host country from introducing other policies that offset the effects of the carbon tax.
[9] Note also that there are ways to *check* serious underreporting in a Party's national emissions inventory (e.g., by way of checking imports of fossil fuel), but no ways to *check* reasonably-looking but exaggerated baselines.

it is too much to expect that the firm/country would reveal a baseline suggesting that this or a similar project would soon have been carried out without any CDM funding. Specifically, the existence of the CDM institution may have a systematic effect on development plans, leaving out projects that directly or indirectly might qualify for the CDM, hence probably distorting the reported baseline.

Here, we will focus on a couple of other – less often highlighted – reasons for the risk that CDM projects would end up with exaggerated CERs.

(a) Given that firms involved in CDM projects are risk-averse, their reported emission baseline estimates would exceed their expected value of these emissions, which is the relevant estimate for the CDM authorities. Thus, even without any attempt by the contract parties to distort their estimates of the true emissions distribution, their reported estimates would tend to imply an overstatement of the baseline emissions.

(b) Monitoring GHG emissions under IET is not designed to observe all that, strictly speaking, is relevant to include. For example, it will not take into account that emission reductions caused by policy actions in an Annex B country may give rise to more emissions in non-Annex I countries. As a result of such actions, carbon-emitting activities may move to such countries. Or, more generally, these countries may now increase their exports of the commodities concerned to countries that used to buy them from producers in the Annex B country, hence increasing GHG emissions outside Annex B.

In this respect, the case of CDM is far worse. While correct national inventories cover all changes in emissions in the country, even unbiased estimates of the host firm's emission reductions of a CDM project would not take into account what changes in emissions the project may give rise to elsewhere in the domestic economy.[10] In an economy with available capacity, economic activity and hence emissions elsewhere may increase. The CDM project may raise input prices that would crowd out other activities but also increase aggregate output of intermediary inputs and the transports connected to that increase. Similarly, if the project implies an increase in the output of the host firm, equilibrium output prices may be reduced and give rise to increased activities and emissions elsewhere. Or such price changes may eliminate an emissions-reducing project similar to the CDM project that otherwise would have occurred. As a result, nation-wide emission reductions due to a CDM project may be smaller than the reported project-wide estimates.

To be sure, the nation-wide GHG emission reductions of a CDM project could be larger than the project-wide ones. If so, it is likely that the CDM parties would do what they can to call such indications to the attention of the CDM authorities. This is not likely for CDM projects where the nation-wide reductions are smaller than the project-wide ones. Thus, the risk for an overestimate of the baseline emissions of CDM projects would be further enhanced.

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[10] This creates some perverse incentives for large firms or conglomerates. Say, a CDM energy-transformation project would involve considerable construction activities with large emissions from construction and transportation equipment. If these activities normally would be handled by the conglomerate's construction department, it may now pay the firm to first sell off this department.

<u>Improving the prospects of IET/JI being more attractive to developing countries than the CDM</u>

Given that the CERs are more likely than the ERUs and the AAUs to result in an exaggeration of the emission reductions, the question arises what can be done with respect to the fact that the CDM reduces the prospects of non-Annex I Parties joining IET. To be more certain that reported CERs are not overblown, the CDM authorities could be instructed to be conservative in their evaluation of the CDM projects' emission reductions. As a result, joining IET would be more attractive. [11]

Another option to facilitate involvement of non-Annex I Parties in IET is to put an end to CDM operations, e.g., in the commitment period after 2012, the first conceivable date if the KP is not renegotiated. An early elimination of CDM would be certain to meet strong opposition from Parties that now have a vested interest in keeping it or count on its short-term contributions to reduce global GHG emissions. However, if no date is set for a cessation of the CDM, it will continue to delay the enlargement of IET. The remaining option to speed up as much as possible the increase in cost-effectiveness that follows from this enlargement would be to attract non-Annex I countries to IET by offering them a higher level of compensation – e.g., extra AAUs or financial transfers.

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[11] It has been argued that experience from CDM operations would make DC Parties more acquainted with the emissions trading idea and hence help making such Parties more interested in joining full-

3. The Commitment Period Reserve's Implications for International Emissions Trading

There has been considerable concern over the risk that the KP would allow sales of AAUs that do not represent any real emission reductions. To begin with, this concern was related to the fact that some Annex-B countries had received AAs that are likely to exceed their BAU emissions in the first commitment period. This would allow them to sell AAUs that do not reflect actual emission reductions, so-called hot air. Soon after Kyoto, explicit rules for limiting hot-air sales were proposed by the EU, in spite of the fact that, like other (binding) trade constraints, such rules would clearly reduce cost-effectiveness. These ideas were eventually shelved at COP7. Instead, rules have now been introduced to limit another form of 'overselling', that when Parties sell more AAUs than they are expected to have available for sales while remaining in compliance. These rules require that each Annex I Party shall maintain in its national registry a Commitment Period Reserve (CPR) that should not drop below 90% of the Party's AA or 100% of five times its most recently reviewed inventory, whichever is lower. [12]

The effects of the CPR can be illustrated by a case where a Party wants to sell a large volume of AAUs at some point before or during (in particular, the early part of) the commitment period. Even if the Party is confident that its emissions will end up below 90% of its AA, e.g. because of measures already taken or near completion, it

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fledged international emissions trading. This is hardly credible given that the IET itself is straightforward and verifiable in a way that the CDM is not.

[12] For an in-depth analysis of the percentages selected, with respect the liquidity of the markets for emissions trading, the effectiveness in limiting non-compliance due to overselling and constrained sales of surplus AAUs, see Haites and Missfeldt, 2001. For additional comments on the CPR, see IEA, 2001.

may still not be able to sell, under this part of the CPR rule, all that it wants to sell. With respect to the second part of the rule and due to a likely lag in the reviews of its inventories, the Party would not be able to sell even a known surplus of emission reductions when actual emissions, say, in the last year of the commitment period, are lower than the most recently reviewed inventory of emissions, say, two years earlier.

'Overselling' in the sense that the CPR requirement is violated is a real problem only to the extent that it amounts to overemissions. Except for such 'last-minute' sales that unavoidably result in emissions in excess of the seller's AAU holdings, selling does not prohibit a Party from taking actions later to be sure to end up in compliance. Thus, by itself, selling cannot imply any (increased risk for) overemissions, no more than suspicions that, at any point, a non-seller Party is buying 'too little'. This means that sales, which are ruled out by the CPR but which the seller Party would like to carry out, represent a loss of cost-effectiveness.

The purpose of the CPR is obviously to avoid having *seller* Parties emit more than they are allowed, presupposing that such countries cannot be effectively or sufficiently controlled by sanctions against overemissions. However, it must be noted that equally strong incentives to overemit exist also for *buyer* countries. This follows from the fact that the incentives and their strength must be gauged at the Parties' optimal in-compliance level of emissions for Parties. In Fig. 1, this level is located at point E where the marginal abatement cost (MAC) equals the AAU price (p). Sellers are defined by an AA level to the right of point E, e.g., AA_{max}, and buyers by an AA level to the left of E, e.g., AA_{min}. There are two forms of overemitting, (*i*) too little emission abatement and (*ii*) selling too much or buying too little. (*i*) Regardless of

whether it is a seller or a buyer that considers abstaining from a given amount ΔA of abatement from point E, gross savings would be the same, of course, and equal the abatement costs of ΔA. *(ii)* Similarly, the gross gains of a seller that sells AAUs beyond point E are the same as those of a buyer that does not buy enough to cover emissions up to point E, in both cases p times the excessive sales or deficient purchase.

The often heard statement that a Party, given the chance to sell AAUs at a profit, will have a particularly strong incentive to overemit ('oversell') is therefore not correct. What is correct, although hardly relevant, is that the introduction of IET increases incentives to overemit for those who will emerge as sellers – from zero for those who have hot-air allocations – but reduce them for those who will emerge as buyers.[13]
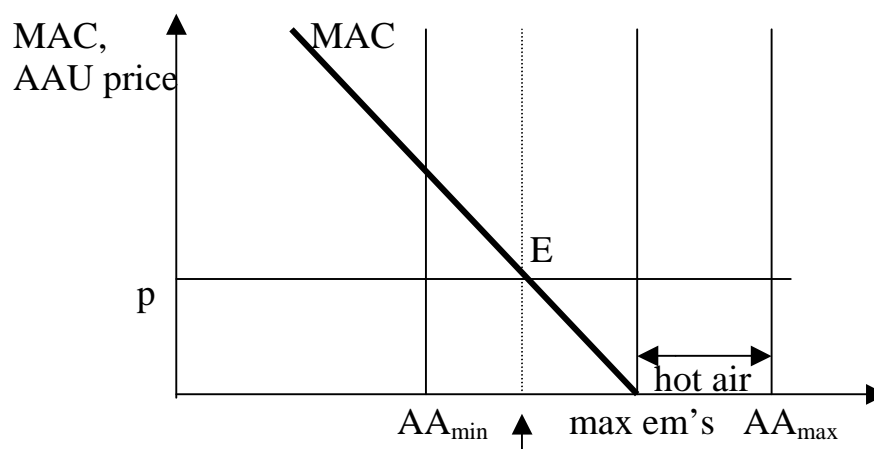

Fig. 1 Optimal in-compliance level of emissions

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[13] Whether or not this is taken to mean that IET will increase the risk for overemissions is essentially a question of how sensitive the different groups of countries are to such incentives. However, this perspective is relevant only for those who wish to consider abolishing IET as a step towards a better climate change policy.

Sanctions against noncompliance is what regulates non-seller Parties that emit more than the AAUs they have at their disposal. The introduction of the CPR means that such sanctions are not considered to be a deterrent enough with respect to overemissions by seller Parties. In other words, overemitting is regulated twice for seller Parties but only once for other Parties that violate the same rules and face the same incentives to do so. A parallel second deterrent for non-seller countries to overemit could be to require that they buy a reserve of AAUs to reduce the risk that they eventually have bought too little. But such a 'fair' set of rules would, of course, further reduce cost-effectiveness.

To sum up, if effective, the CPR reduces cost-effectiveness. In addition, it has distributional effects. It hits seller countries, typically poorer countries, but not buyer countries, which are all wealthier countries.

4. Borrowing and cost-effectiveness

Banking is accepted in the KP and provides cost-reducing opportunities to transfer AAUs between periods for Parties that expect discounted AAU prices to be higher in the next period. But those with the opposite expectations do not have access to any similar kind of inter-period flexibility. In the negotiations leading up to the KP, there was strong opposition to the principle of permitting a Party to borrow AAUs from its AA in the next period.[14] The sentiments seem to have been that, given an agreement

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[14] In an IET system proposed by the US State Department (US DOS, 1997) prior to the COP3 meeting in Kyoto, both banking and borrowing were included. The US has large experience of some 25 years of emissions trading that, in some cases, have allowed borrowing.

on a modest cap of (Annex B) emissions in a first commitment period, it should not be allowed to let emissions increase by borrowing, regardless of whether aggregate borrowing would exceed or fall short of aggregate banking. Moreover, allowing Parties to borrow might tempt them to let emissions exceed their AAs to an extent that in a later period might force them to defect from the agreement.

However, the increase in cost-effectiveness that follows from allowing also borrowing would increase the Parties' willingness to accept more stringent AAs and hence speed up the process of reducing the aggregate emissions. The increased 'when' flexibility would also help attract, in particular risk-averse, developing countries to join IET. For example, if a developing country, towards the end of the period, unexpectedly finds it (a) needs to buy back some AAUs to remain in compliance and (b) faces high final AAU prices, it could now count on the borrowing option for protection against large losses.[15]

Earlier studies analyzing the social efficiency of borrowing seem to be limited to the case where marginal environmental damages are known and where a system of banking and borrowing are introduced at the same time. Leiby and Rubin (2000) address the case of stock pollutants, i.e., where the environmental effects are caused by the accumulated stock of pollutants, such as carbon in the atmosphere. They show that full intertemporal trading is socially efficient, where the banking/borrowing interest rate is equal to the ratio of the current marginal stock damages to the discounted future value of marginal stock damages less the decay rate of emissions in

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[15] The California Cap and Trade system, RECLAIM NO_x, in which intertemporal trading is prohibited, may be a good illustration of such risks of exceptional price hikes. There, NO_x prices which stayed on a fairly constant level for a number of years rose sixty-fold at the end of year 2000 (based on information from Denny Ellerman).

the atmosphere. However, in the case of climate change policy, little is known about any relevant global (or national) marginal damage function. The agreed sum of AAs and its distribution over countries – and, eventually, over time – will likely represent political compromises that, at least for the time being, do not reflect any global, or Annex B, damage estimate. Moreover, in the KP, the banking rate of interest is set at zero and the borrowing rate, so to speak, at a rate that precludes any borrowing.

Not quite. Sanctions against a Party in noncompliance, as agreed on at COP6bis, imply that the Party will have its AA for the next period reduced by 1.3 times the AAUs lacking at the end of the preceding period. (Note that the AA allocations for the second period will have to be determined prior to the start of the first period.) This implies that borrowing *de facto* can take place, at an annual rate of interest of about five percent – or 30 percent per commitment period of five years. Thus, the Party may choose to borrow by choosing not to buy enough AAUs.

Now, the sanctions agreed on have two additional components, none of which seems to be fully specified as yet. One is that an *action plan* that is deemed to take the Party back to compliance will have to be determined. Thus, the Party in noncompliance will likely have to commit to a plan of abatement actions that may differ from its preferred option to return to compliance. To provide an incentive for the Party to follow that plan, there is a second additional sanction component in that *the Party's eligibility to sell AAUs is suspended*, presumably until the Party is found to be 'faithfully' following its action plan. This amounts to an additional cost for (future) sellers in noncompliance, hurting in particular those Parties for whom selling AAUs is an important source of revenue. By contrast, buyers in noncompliance will not be

punished by this rule. A 'compensating' rule can hardly be introduced that would prohibit a Party from buying AAUs since this is what they failed to do to a sufficient extent in the preceding period.

This means that the total costs of being in noncompliance will not be known at the time a Party completes its AAU tranactions in the first commitment period. In this sense, the consequences of borrowing by being in noncompliance differs from regular borrowing at a given rate of interest. These consequences are particularly unfavorable to seller Parties, which are the poorer ones, and unattractive to the developing countries that have not yet joined international emissions trading. Given whatever rules are selected to combat noncompliance, a step in the direction of increased cost-effectiveness would be to introduce a right to borrow AAUs up to some limit at a rate of interest at, or below, that of the noncompliance rate, but without any additional conditions.[16]

Thus, the initial opposition to borrowing obviously did not realize that sanctions against Parties in noncompliance eventually would come to require some conditions for repayment of the exceeding amount of emissions and that this would imply a form of borrowing, although under unknown conditions. However, as indicated here, more cost-effective systems for borrowing are possible to design, a simple version being one that precedes the state of noncompliance at known conditions. This will increase the 'when' flexibility of IET, hence making it more attractive for new countries to join and, in principle, reducing the reservation AAs for all Parties. In contrast to the

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[16] For a recent overview of issues related to noncompliance, see Hargrave *et al.* (2000).

implications of the existing noncompliance rules, such regular borrowing in kind

would not discriminate between seller and buyer Parties.

References

Bohm, P., 1994. On the Feasibility of Joint Implementation of Carbon Emissions Reductions, in *"Climate Change: Policy Instruments and their Implications"*, Proceedings of the Tsukuba Workshop of IPCC Working Group III (ed. A. Amano), Center for Global Environmental Research, Environment Agency of Japan, Tsukuba, Japan

Bohm, P., 2000. International Greenhouse Gas Emission Trading – with special reference to the Kyoto Protocol, in: *Efficiency and Equity of Climate Change Policy*, ed. C.Carraro, Kluwer, Dordrecht

Bohm, P. and B. Carlén, 2000. Cost-effective Approaches to Attracting Low-income Countries to International Emissions Trading: Theory and Experiments, in: B. Carlén: *Studies in Climate Change Policy: Theory and Experiments, Department of Economics*, PhD dissertation, Department of Economics, Stockholm University

Haites, E. and F. Missfeldt, 2001. Analysis of the Commitment Period Reserve at National and Global Levels, working paper

Hargrave, T., S. Kerr, N. Helme and T. Denne, 2000. Treaty Compliance as Background for an Effective Trading Program, in: *Global Emissions Trading: Key Issues for Industrialized Countries* (ed. S. Kerr), Elgar, Cheltenham, pp. 43-82

Nentjes, A. and E. Woerdman, 2000. The EU Proposal on Supplementarity in International Climate Change Negotiations: Assessment and Alternative, memorandum, Department of Economics, University of Groningen

International Energy Agency (IEA), 2001. *International Emissions Trading: From Concept to Reality*, OECD, Paris

Leiby, P. and J. Rubin, 2001. Intertemporal Permit Trading for the Control of Greenhouse Gas Emissions, *Environmental and Resource Economics*,

Rose, A. and B. Stevens, 2000. A dynamic analysis of the efficiency and equity of tradeable greenhouse gas emission permits, in: *Efficiency and Equity of Climate Change Policy* (ed. C. Carraro), Kluwer, Dordrecht, 247-71

UN, 1997. Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations, Kyoto

UNFCC, Framework Convention of Climate Change, United Nations 1992

Wiener, J.B., 1999. Global Environmental Regulation: Instrument Choice in Legal Context, *The Yale Law Journal*, 108, 4, January

Wirl, F., C. Huber and I.O. Walker, 1998. Joint Implementation: Strategic Reactions and Possible Remedies, *Environmental and Resource Economics*, 12, 2, September

Zhang, Z.X., 2001. Meeting the Kyoto Targets: The Importance of Developiing Country Participation, Working Paper 30.2001, Feem, Milano