Certified Emission Reductions Weights for Improved CDM Projects

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Abstract

As currently designed and implemented, the Clean Development Mechanism (CDM) under the Kyoto Protocol is a market mechanism that creates "offset" credits, named CERs. These credits are issued to Annex I Parties that invest in projects both reducing emissions and contributing to sustainable development in developing countries. This paper explores how CERs weights could be used as a way to reform and improve this mechanism. On the one hand, weights strictly lower than one, or discount factors, would improve the environmental effectiveness of the CDM, enhancing global GHG mitigation while addressing the additionality concern. On the other hand, weights higher than one, or multiplication factors, could increase the competitiveness of project types and/or host countries currently underrepresented in the CDM pipeline. This paper concentrates on stimulating investment from developed nations to less developed countries and aims at reducing the disparity between the three main CDM host countries (Brazil, India and China) and less developed nations. Based on statistical data published by the UNFCCC, our analysis then considers different policies, estimates their impacts, and shows how a sensible mix of discounting and multiplication could lead to a more equitable geographical distribution of CDM projects and possibly create atmospheric benefits.

Keywords: CDM projects, CERs, discounting, atmospheric benefits, BRIC countries

1. Introduction

The Clean Development Mechanism (CDM) is one of the three market-based mechanisms introduced by the Kyoto Protocol in order to help countries with commitments meet their target in a cost effective way. Defined in Article 12 of the Protocol, the CDM allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol to implement sustainable development projects that reduce emissions in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, which can be counted towards meeting Kyoto targets. Operational since the beginning of 2006, the mechanism has already registered more than 2,000 projects and is anticipated to produce CERs amounting to more than 2.9 billion tonnes of CO_2-equivalent in the first commitment period of the Kyoto Protocol, 2008–2012 (UNFCCC). Thus the CDM seems quite successful at giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets. However, it can be criticized with respect to its environmental integrity, as it is an offset mechanism rather than a real emission reduction instrument. Other criticisms relate to its ability to promote sustainable development, and the current projects portfolio also raises equity concerns. Indeed, its contribution to the sustainable development of host countries so far has been limited, and the geographical distribution of CDM project activities and CERs among developing nations appears highly inequitable.

In this paper, we argue that CERs discounting and multiplication, or CERs weights, could alleviate these weaknesses. Section 2 introduces the concept of weights and briefly summarises the existing research on that topic; Section 3 details the implementation modalities of such schemes; Section 4 advocates the discounting of CERs as a way to improve CDM's environmental effectiveness; Section 5 then considers the uneven distribution of CDM project activities, and explains how a sensible mix of discounting and multiplication could handle this problem; Section 6 aims at implementing the concept of

CERs weight and discusses its potential impacts in terms of emission reductions and regional distribution of projects.

2. The concept of weights and scope of analysis

Currently, the implementation of CDM project activities by Annex I Parties is “rewarded” by the issuance of CERs, each of these units being equal to one metric ton of carbon dioxide equivalent (CO_2-eq)[i]. In this sense, the CDM is a pure “offset mechanism”, where one ton of emission reduction achieved through a CDM project activity in a developing country enables the industrialised investor country to increase its emissions by one ton. The idea of discounting consists in a reduction of the number of CERs issued through the use of a discount factor. Although the amount of emission reductions achieved through the project activity would stay the same, fewer CERs would be issued or used. This means that a reduction of one ton of CO_2-eq. emissions would no longer be equivalent to one CER. For instance, a project activity generating 100 CERs, if discounted by 10%, would only allocate 90 CERs to the investor Party. The opposite approach, i.e. the multiplication of CERs, may be proposed as well, as a way to reward preferable projects with more credits than the actual emissions reduction achieved. But multiplication in fact encompasses discounting, with the latter applying a multiplication factor strictly inferior to 1. As of now, the term “weight” shall be used as a surrogate both for multiplication and discounting.

Discounting is not a novel concept: it has already been applied with success for example under Title I of the U.S. Clean Air Act Amendments (CAAA) to promote emissions reductions by power plants rather than purchasing emissions offsets (Environmental Defense, 2007, Schatz, 2008). But more recently, several authors have proposed the application of this concept to the CDM as a way to reform this mechanism for a post-2012 climate regime while addressing some of its shortcomings (Chung, 2007b, Michaelowa, 2008, 2009, Schneider, 2009).

For Chung (2007b) and Schneider (2009), the leading idea is to discount CERs to let CDM projects result in net global Greenhouse Gases (GHG) emission reductions, i.e. to move the CDM beyond offsetting. Michaelowa also supports CER discounting for other reasons: to avoid CER import caps (Michaelowa, 2009), or to promote the integration of advanced developing countries into a cap-and-trade system (Michaelowa, 2008). In this perspective, he proposes to link the discount factor to the level of development of the host country. This approach is used in a further discussion paper to assess the impact of CER discounting on the competitiveness of different CDM host countries (Castro & Michaelowa 2009a). Their analysis considers two discounting schemes based on some development index, and shows their respective impact on the CDM abatement cost curves of some selected regions and countries. They notably conclude that discounting on its own would only marginally contribute to enhance the competitiveness of Least Developed Countries (LDCs) within the CDM market.

Building on this (somewhat disappointing) result, and with the objective of creating net atmospheric benefits and /or altering the geographical distribution of CDM projects and CERs, we considered taking the proposal one step further by mixing discounting with CER multiplication. This idea, even though it has been often mentioned in the literature, has only been studied so far by Bakker et al. (2009), as one way to introduce differentiation in the CDM, either between project types or between Parties. They analyse the impact of this option on the supply of carbon credits for host countries and technologies using marginal abatement cost (MAC) curves.

The present paper focuses on the high disparity between the three major CDM host countries in terms of projects and CERs, namely Brazil, India and China, and the LDCs, barely hosting 1% of the current CDM projects. In order to foster investment in LDCs, we propose to multiply CERs for projects implemented in these countries, and to compensate for these additional credits by discounting CERs in Brazil, India and China. Our analysis does not consider MAC, but rather tries to quantify the potential impacts of differing weights based on statistical data of the current CDM portfolio. To that end, we use an estimate of expected annual CERs from currently registered projects in order to assess, other things being equal, the feasibility of our proposal.

3. Options for implementation

Basically, a CERs discounting scheme could be introduced either on the supply side or on the demand side. Supply side discounting means that only a given percentage of the calculated emission reductions leads to issuance of CERs, while a demand side discounting implies that only a given percentage of the issued CERs can be used by the buyers for compliance purposes, the remainder being permanently set aside (transferred to a cancellation account for example). The supply side approach would require an agreement at the UNFCCC (United Nations Framework Convention on Climate Change) level but then, it would be technically easier to implement: if all Parties agree and support the concept, the Executive Board of the CDM would simply issue less CERs to the CDM registry and the discounting would apply equally to the whole CDM market. By contrast, discounting on the demand side potentially allows for different CERs users to choose different discount rates, thereby creating a distortion between markets; this would complicate the linking of various emissions trading schemes and could even distort CERs prices (Schneider 2009). The demand-side discounting is part of the American Clean Energy and Security Act of 2009, also known as the Waxman-

Markey Bill, that passed the US House of Representatives, and of several subsequent bills discussed in the Senate[ii]. This study mainly concentrates on the supply side approach.

Setting proper discount rate(s) is unlikely to be an easy task, as many economic and political factors have to be considered. Moreover, discount rates may need to be periodically reviewed to reflect changes in market conditions, such as abatement costs or economic viability of different technologies, but also to adjust to the need for enhanced mitigation contributions and to the capability of countries to contribute to this global effort. However, a discounted CDM must still create incentives for Annex I Parties to develop emissions reduction projects in developing countries; hence, a careful balance must be struck between the need for flexibility and investor certainty (Schneider 2009). Therefore, it would be essential to clearly determine when the discounting scheme should be applied, which projects should be covered and how often the discount rates should be reviewed[iii].

Finally, as stressed in Section 2, discounting could be mixed with multiplication of CERs. In this case, the scheme would plan to reward favoured projects with extra CERs (weights > 1, i.e. multiplication factors), while fewer CERs would penalize less favoured projects (weights < 1, i.e. discount factors). In consequence, an additional challenge would be to make sure that the aggregate quantity of CERs issued does not exceed total emission reductions achieved by the project activities. The determination of the different weights and their periodic review might therefore complicate their implementation.

As the appropriate weight(s) and the specific features of any weighting scheme would mainly depend on the rationale for introducing CERs discounting and/or multiplication, the next two sections discuss the benefits and drawbacks of this approach. Section 4 analyses the environmental effectiveness of the CDM, and thus calls for discounting only while Section 5 considers the uneven distribution of CDM project activities, a problem that would best be handled through a sensible mix of discounting and multiplication.

4. Environmental effectiveness

A first set of arguments relates to the environmental effectiveness of the CDM. The first and main rationale for introducing discount factors to CERs is to *move the CDM beyond offsetting*, thus enhancing global climate change mitigation beyond the commitments of the Annex I countries (Chung 2007b, Environmental Defense 2007a, Schatz 2008, Schneider 2009). Indeed, if a given percentage of the credits generated by a CDM project activity was permanently set aside instead of used to offset emissions, the CDM could achieve net atmospheric benefits, thereby providing enhanced global GHG abatement. The urgent need to reduce emissions below an acceptable and sustainable level unquestionably argues in favour of such an up-scaling of the CDM. In this perspective, Schneider (2009) showed the relevance of a "CDM with atmospheric benefits" as a potential building block in a future climate regime. Environmental Defense (2007a) also proposed a "value-added CDM" as an essential element of a post-2012 framework seriously contributing to the ultimate objective of the UNFCCC while delivering sustainable development benefits more broadly to non Annex I Parties. Besides, with the aim of applying market mechanisms in generating net global emission reductions from developing countries, Chung (2007b) proposed the introduction of a "CER discounting scheme" to unilateral CDM projects[iv] as a way for developing countries to contribute to global mitigation efforts without having to resort to binding targets. Then, during consultations under the UNFCCC on a post-2012 climate regime, it was suggested to grant developing countries credits for "nationally appropriate mitigation actions" (NAMAs) and to further discount these credits in order to generate net global reductions (Chung 2008).

Furthermore, a discounting of CERs could enhance the environmental effectiveness of the CDM by *addressing the "additionality" concern* (Bakker *et al.* 2009, Michaelowa 2008, Schatz 2008, Schneider 2009). The UNFCCC requires CDM project activities to generate additional emission reductions that would not have happened otherwise; a proper demonstration of additionality is thus key to ensuring the environmental integrity of the CDM. If a project activity is not additional but nevertheless registered as a CDM project, the issuance of CERs results in an increase in global GHG emissions (Schneider 2007). Unfortunately, the current system can be abused as approaches to prove additionality are inherently subjective and widely uncertain. The fact that projects receive CERs for emission reductions below a "business as usual" emissions baseline creates an incentive for Parties to exaggerate their baseline in order to maximise their CERs gains (Schatz 2008). Several observers indeed found that the additionality of a significant number of projects seems unlikely or questionable (Michaelowa and Purohit 2007, Schneider 2007, Wara and Victor 2008).

The idea of discounting to safeguard overall additionality of the CDM originates from Greenpeace (2000). From this perspective, CERs discounting should be introduced to address, on an aggregated level, the fact that a certain amount of "free riding" projects will always be part of the CDM, whatever the rules for assessing additionality. In other words, the discounting of CERs should compensate for emission reductions claimed from projects that would be implemented anyhow but nevertheless qualify under the CDM (Schneider 2009). However, this approach has several disadvantages. First, the use of discounting to safeguard environmental integrity would require an estimate of the average share of non-additional registered projects, so that this fraction could be applied as a discount factor. This task requires an independent judgement and it is obviously difficult, time-consuming and uncertain. Moreover, such a discount factor should be adjusted over time, as the fraction of "free riding" projects will vary[v]; this would obviously deter investors, who need certainty for their investments. A second drawback is that this approach only addresses the additionality concern at an aggregated level. Without any differentiation between projects that are more or less likely to be additional, the discounting of CERs might penalize all project developers; it is therefore unable to provide an incentive to develop more truly additional projects. As Schneider (2009) stated, "this means that discounting cannot replace the testing of additionality but only compensate for the problem that additonality testing will never be perfect".

Finally, the introduction of CERs discounting could also be proposed in pursuance of the principle that "the use of the mechanisms shall be supplemental to domestic action and that domestic action shall thus constitute a significant element of the effort made by each Party included in Annex I to meet its quantified emission limitation and reduction commitments" (UNFCCC 2005). Currently, the use of CERs within regional emissions trading schemes is already limited, but because of the uncertain environmental effectiveness of the CDM, some policymakers (the EU Commission and the European Parliament notably) are now asking for more stringent caps of CERs imports. However, Michaelowa (2009) argues that such a policy is likely to be inefficient and would not effectively address the current shortcomings of the CDM[vi]. Moreover, the discounting approach could result in a lower volatility of allowance prices, because the use of the CDM would work in a similar way as a price cap (Schneider, 2007). A discounting of CERs could thus be seen as an *alternative or supplement to these CERs import caps.*

The above-mentioned advantages of course could only be obtained through CERs discounting, i.e. a reduction of the number of CERs issued, since multiplication factors would have the opposite effects and would thus threaten the CDM's environmental effectiveness even more.

5. Distribution of CDM project activities

The second set of arguments in favour of CERs weights relates to the uneven distribution of CDM project activities. Indeed, concerns have been raised with regard to the unequally distributed CDM project portfolio, both across project types and across potential host countries. Looking at the CDM pipeline of late 2009, it appears that some sectors are particularly successful, while others, such as the transport, building and forestry sectors, are virtually absent. Besides, more than 75% of the total CERs issued so far come from HFCs, PFCs and NO_2 reduction projects. As far as the geographical distribution is concerned, a few regions and countries are clearly dominant. More than 75% of the CDM project activities (delivering more than 80% of the total CERs expected until 2012) concern the Asia and Pacific region, while Africa hardly hosts 2.5% of the projects currently in the CDM pipeline. The most popular countries are rather advanced developing countries, and more precisely, the non-Annex I BRIC countries, namely China, India and Brazil, accounting for 75% of all project activities and 78% of expected CERs. On the other hand, the Least Developed Countries (LDCs) barely host 1% of the CDM projects currently in the pipeline (UNEP/Risoe 2009). The discounting of CERs may help addressing these shortcomings of the current CDM if the discount factor is differentiated according to either the type of project or the developing host country, and further improvements may be gained if multiplication as well as discount factors are applied to CERs.

A *variation of discount factors between project types* has been proposed by Chung (2007) and Schatz (2008) and it has been considered by Bakker *et al.* (2009) as well as under the Ad-hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP)[vii]. The idea here is thus to favour or disfavour some types of projects in order to alter the mix of project activities under the overall CDM portfolio. If a smaller discount rate were applied to the favoured project types, these would indeed become more economically attractive to developers, which could increase their market share. Different criteria have been proposed to determine which types to favour. First, one could decide to penalize project types that are associated with high windfall profits. Indeed, the mitigation costs for some GHG (industrial gases such as NO_2 and HFC-23 in particular) are very low compared to the related CER revenues. High discount factors would reduce the huge economic rents of the project developers (or, in case of taxes on CERs, of host country governments) and help lower the market share of these projects. For instance, Schatz (2008) proposes discount rates that closely reflect the marginal abatement cost for each GHG and the associated abatement processes, while still providing incentives for foreign investors to implement these projects[viii]. Alternatively, one could argue that projects with large benefits for sustainable development should be favoured, as enhancing the contribution of CDM projects to sustainable development in host countries is often highlighted as a key objective for a reform of the CDM. One could also decide to favour projects that use innovative technologies, which are likely to have positive spillover effects (Schneider 2009). Applying lower discount rates to these desirable types of projects would improve their competitiveness and thus encourage their implementation. An alternative option could be to multiply CERs from those project activities, while, at the same time discounting CERs from less favoured project types in order to maintain the equality between the emission reductions achieved and the CERs issued.

Although these options for differentiating between project types seem promising, they involve some difficulties and weaknesses. First, as some project activities would be preferred over others, a differentiation between project types would create a market distortion, thus reducing the cost-effectiveness of the CDM (Schneider 2009). Second, it is likely that differentiated discount rates would only slightly improve the sectoral distribution of CDM projects. Even if the underrepresented sectors would have an advantage compared to the current situation, other sectors would probably remain more attractive (Bakker *et al.* 2009). Finally, and most importantly, agreeing on which project activity types to favour will turn out to be particularly challenging. Although promoting projects that bring many sustainability benefits or other positive externalities seems straightforward, the evaluation and the weighting of the different elements will be highly problematic. The reason is that the host country itself has the prerogative to determine whether a project contributes to its sustainable development. As sustainability is an inherently subjective concept, different countries will have different priorities and may thus have different preferences regarding the project types to favour. Therefore, it will certainly be hard to compromise on suitable differentiated weights at the UNFCCC level.

Several authors like Chung (2007), Meng (2007), Michaelowa (2008, 2009), Schatz (2008), and Schneider (2008, 2009) have also proposed a *variation of discount factors between host countries* and this option has been further analysed by Bakker *et al.* (2009) and Castro and Michaelowa (2009a). The main rationale for suggesting a differentiation between host countries is the principle of "common but differentiated responsibilities" emphasized by the UNFCCC. Among the group of developing countries, high disparities exist between emerging economic power, such as China, India or Brazil, and significantly poorer nations, such as LDCs. Therefore, high discount rates could be applied to CERs coming from more advanced developing countries[ix], since they have higher responsibility and capability to mitigate GHG emissions, while poorer nations could be entitled to a preferential treatment, i.e. lower discount rates, no discount, or even multiplication factors.

This approach could be interesting for several reasons. Foremost, a country-based discounting could induce a more equitable regional distribution of the CDM project activities. Indeed, the CDM is basically an investment instrument, and the fact is that foreign investment flows are driven to countries offering a favourable environment, characterized by several conditions (economic and political stability, appropriate infrastructures, strong and efficient institutions, etc.). As investing nations are searching for the highest revenues with the lowest uncertainty, it is not surprising that Brazil, India and China are more popular than Least Developed Countries (LDCs) and Sub-Saharian African (SSA) countries. As mentioned in Castro and Michaelowa (2009b), in order to foster investment in LDCs, the first need is to reduce barriers and improve the capacity of the potential host countries. But investors are unlikely to turn away from Brazil, India and China unless they are provided with financial incentive to develop ambitious projects in LDCs. The financial incentive proposed in this paper is thus to apply various weights to CERs depending on the host country chosen by investing Parties.

In practice, discounting CERs will lower the competitiveness of individual host countries, raising emissions abatement costs and reducing abatement potentials. Thus lower or no discount rates for projects in LDCs and African countries might create an economic incentive to develop more projects in these currently underrepresented regions. However, focusing their analysis on the host countries' potential for specific abatement technologies and their abatement costs, Castro and Michaelowa (2009a) show that this approach on its own would not provide sufficient financial incentives to achieve its goal, since it would only marginally improve the competitiveness of LDCs within the CDM market. Yet, if financial, technical and institutional barriers in these countries could be overcome, a much larger potential would become feasible.

As a consequence, if CERs from those countries would be multiplied while those from China, India and Brazil would be heavily discounted, a higher supply of CERs would emanate from poor countries and the profitability of projects in these countries would also increase. Such a country-based weighting scheme could then steer investments towards LDCs and African countries and hence, potentially improve the CDM's contribution to sustainable development, since there is evidence that those CDM projects are more likely to be associated with sustainable benefits for the host region.

But, once again, applying multiplication factors may endanger the environmental integrity of the CDM. Therefore, when using multiplication, one should make sure that the additional CERs this may create are compensated for by CERs discounting for other countries, so that the total CERs issued do not exceed the total emission reductions achieved through CDM project activities.

6. Feasibility and practical implementation

The purpose of this section is to implement the ideas detailed in Sections 4 and 5 concerning CER weights, i.e. discounting and multiplication, and atmospheric benefits, as well as to estimate the impacts these policies may have, both on the host countries and the credited countries. As inferred from the two preceding sections, we will propose to discount the CERs gained in Brazil, India and China, and to multiply those from CDM projects implemented in LDCs.

To assess the feasibility of this proposal, we proceed in two steps. We first estimate the amount of CERs that would be lost by Annex I investing Parties if discount factors were applied to CERs. Based on UNFCCC statistical datas, we thus quantify the expected atmospheric benefits of different discounting policy options. Secondly, we consider a further differentiation between host Parties, and show how the cancelled CERs from advanced developing countries could be redistributed to Parties investing in LDCs via multiplication factors.

The first step is thus to estimate the quantity of CERs related to CDM projects. The UNFCCC website keeps track of each and every project in the pipeline, and publishes for each of them the “estimated emission reductions in metric tonnes of CO2-eq. per annum”. As of December 14 2009, adding them all up amounts to a global emissions reduction and potential credits of 352,142,365 tons of CO_2 equivalent per annum. However, this number includes each and every project but some have been withdrawn or rejected, some are under review, some are in the process of registration, some are under corrections further to a first review, … All these projects have been subtracted from the analysis and the computed CERs for projects formally registered by the CDM Executive Board are therefore 339,828,361 tons.

There are drawbacks to this annual number as the analysis presented here is just a snapshot at one point in time. Obviously, once a new project is accepted, the number will change. Obviously, some projects have started a few years ago and others a few months ago. Also, even though this annual calculation might seem misleading since not all projects have the same CER production every year, this is in conformity with the UNFCCC calculation method. So this number should be viewed as a best estimate of yearly expected CERs for registered projects in December 2009 and will be compared with disaggregated data along the same line of computation, for consistency of analysis.

In the earlier Sections as well as in the literature, it is often claimed that non-Annex I BRIC countries, that is, Brazil, India and China, are by far the most important hosts of CDM projects. As a matter of fact, Table I illustrates the annual estimated CERs earned by Annex I countries in these three nations and shows their importance in CDM projects.

Table I: Annual CERs earned in Brazil, India and China for registered CDM projects

The computation is similar to what was done for global CERs. Each CDM project taking place either in Brazil, India or China is singled out, no matter what the investing country is. Then, only those projects that are fully registered and for which the Annex I nations are precisely identified are taken into account. For Brazil, it means that 83% of the

CERs in the pipeline are considered. For China, nearly all of them are accounted for (99% of them) while only 61% of CERs expected in India are confirmed and considered in the analysis. Furthermore, unilateral projects are excluded because this analysis focuses on projects financed by Annex I countries as it concentrates on stimulating investment from developed nations to less developed countries. Finally, when more than one country is investing in an accepted CDM project in one of the three non Annex I BRIC countries, we use the hypothesis that each investing nation shares an equal part of the CERs. Then, for minimizing the error risk of overevaluating small countries' shares in a project, we aggregate the numbers into three regional groups: Canada, Japan and "Europe+", that is, the EU-15 group of nations whose Kyoto target was set at 8% emission reduction based on 1990 levels by 2012 as well as Norway and Switzerland. For illustration purposes, the China Fluoro HFC23 abatement project, registered in 2007, is done in cooperation between Japan, Switzerland and the UK and provides 4,248,092 metric tons of CO_2 equivalent per annum; for simplicity it is assumed that each of the three OECD countries benefit from one third of the CERs and then the numbers are aggregated in the final group of three players. The same computations are done for all registered CDM projects in India, Brazil and China.

Overall, with annual quantities of respectively 19, 27 and 221 million CERs, Brazil, India and China account for 5.6%, 8% and 65% of all CERs gained by developed nations in CDM projects. In other words, China alone provides about two thirds of all CERs and, taken together, the three nations account for more than three quarter (78.6%) of all CERs. This does not mean that the proportion of CDM projects implemented in these countries is similar – as some projects provide more CERs and others provide less (in fact, this proportion is a little bit smaller, as stated in Section 5) but the vast majority of CDM projects and CERs is obviously obtained in these countries.

Table I also shows that, not surprisingly, “Europe+” is the major user of CDM projects, followed by Japan and Canada. Once “Europe+” is disaggregated, the most active country in all three host countries is the United Kingdom. It is followed by Switzerland, the Netherlands and Germany who also take part in may CDM projects. Should CERs be discounted, these four European countries as well as Japan would be the ones bearing the largest burden among developed nations.

Table II: Reductions in certified emissions credits (Million tons of CO_2-eq.), or atmospheric benefits

Section 4 details the rationale for discounting CERs to enhance the CDM’s environmental effectiveness. Suppose first that only a certain percentage of the calculated emission reductions are used as CERs for all projects and in all host countries and suppose three different weights for CERs 50%, 70% and 90% (that is 50%, 30% and 10% discount)[x]. As shown in Table II, taking into account registered projects only, this first policy option means that 170 million, 102 million and 34 million CER would be slashed every year. This option does not impair the idea of market mechanism searching for lowest cost alternatives, it should be politically acceptable to developing nations since the rents of CER suppliers may not necessarily diminish under a CDM with atmospheric benefits due to discounting (Schneider, 2009), but it would obviously increase the marginal cost of CERs delivery for industrialised countries.

A second policy option proposed in Section 5 is to differentiate between non Annex I BRIC countries and least developed nations. For illustration purposes, as sown in Table II, applying a lower weight, that is using one of the three discount rates, for projects undertaken in Brazil, India and China would lower the global crediting of emission reductions by – and thereby create atmospheric benefits of – 27 to 134 million CERs every year for a discount rate included between 10% and 50%.

Finally, as China and India are the two largest polluters among non Annex I nations and as they attract most of the CDM projects, the third policy analysis applies a lower weight (i.e. higher discount rate) to credited emission reductions in those two nations only. Table II shows that this option somewhat lowers atmospheric benefits, compared to the two previous alternatives.

If the first policy option would equally impact each investing country in relative terms, the other two options would essentially be disfavourable to "Europe+" – and above all the United Kingdom – and Japan. As a matter of fact, for the second policy, "Europe+" would lose some 22 to 108 million CERs annually with a discount factor of 10 to 50%. And its loss would be reduced by a small amount if CDM projects in Brazil are not discounted; i.e. 20 to 100 million CERs for the same discount factors as above. This is not trivial as CO_2 equivalent emissions in these 17[xi] "European+" countries were equal to 3,394 million tons in 2006 (UN Statistics webpage, 2006 being the last year for which data are available); a weight of 0.5 on Brazil, India and China CDM projects would be equivalent to 3.2% of these global European emissions. Similarly, the application of policy 2 in Japan whose CER supply would be lowered by 4 to 22 million tons every year with a discount factor of 10 to 50% (weight of 0.5 to 0.9) would represent up to 1.7% of its global emissions. Canada would bear a smaller burden as, under policy 2, a weight of 0.5 on its CERs gained would impact its emissions by 0.6% (3.5 million tons compared to emissions valued at 560 million tons).

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One drawback of the CDM, detailed in Section 5, concerns the uneven geographical distribution of project activities. As mentioned before, Castro and Michaelowa (2009a) suggested that using different discount rates for different countries may be a tool to enhance investment in underrepresented nations, as done in policies 2 and 3 for example. However, they concluded that the incentive is likely to be marginal. In another discussion paper (Castro and Michaelowa, 2009b), the same authors estimate projected CERs in 2020, show small improvements for less developed countries under a scenario with preferential access and suggest to couple preferential access with, among others, reduced access costs and financial incentives for CDM projects with added values.

Another option to tackle that issue would be to abandon (partially or globally) the idea of atmospheric benefits and to "invest" the non distributed CERs, obtained when weights are smaller than 1, in some nations by multiplying CERs (weight strictly higher than 1) in less favoured nations. This is what is done in this paper. Said differently, the new policy option may be to discount CDM projects in advanced developing nations where most projects take place, that is Brazil, China and India, *and,* as a corollary, to multiply CERs for projects hosted in (part of) the other non Annex I countries, while making sure, as said earlier (Section 3) that the sum of extra CERs granted does not exceed the sum of CERs discounted. If both sums are equal, there are no atmospheric benefits anymore but the incentives to invest in poorer nations are likely to be much more important. Alternatively, if the discounted CERs remain above the multiplied ones, atmospheric benefits remain, even though at lower levels than in Table II.

For illustration purposes, as CDM projects in all other developing countries bring about 73[xii] million tons of CERs every year, and, as shown in Table II, as a weight of 0.7 (30% discount) in Brazil, India and China would reduce certified emissions by 80 million tons, it would then be possible to multiply all CERs gained from projects in LDCs by 2 (weight=2) and still end up with a small atmospheric benefit of 7 million tons per year. This is likely to significantly increase the incentive of Annex I countries to invest in poor nations.

Obviously, such a policy can be refined and targeted to specific nations and multiplication factors could be differentiated as well. For example, one may think of discounting projects in India and China alone, the two biggest polluters in absolute value in non Annex I countries, to give a higher weight x ($x>1$) for projects elsewhere in Asia, a weight y ($y>x$) in Latin America and the highest one z ($z>y$) for projects in Africa. Thanks to the fact that India and China represent more than 70% of all CERs, this type of policy option seems feasible.

Though we are aware of the difficulties that would be linked to the implementation of such a policy (especially the determination and periodical review of the weights), we believe that such a CER weighting scheme could be applied as a complement to the different measures considered under the Nairobi Framework and to other initiatives aiming at promoting the CDM in LDCs and SSA countries. Concerning the applicability, or the political acceptance, of that sort of policy, we believe that there is room for political agreement. Recently, many voices have claimed that India and China should restrain their emissions and there has been a latent dispute between (some) North and South nations on that matter. Accepting to lower the weight on CDM projects in these two nations could be seen by developed countries as a positive and strong step. Moreover, by increasing incentives to invest in poor nations, the geographical distribution of CDM projects would probably improve and this might enable a faster dissemination of technology transfers and/or this might enhance projects favouring sustainable development in poorer regions.

7. Conclusion and caveats

By applying weights to CERs, this paper seeks to improve environmental effectiveness and geographical distribution of CDM projects. The first objective can be met with a discounting procedure (weights < 1). It enables to move the CDM beyond a pure offset mechanism, creating atmospheric benefits and addressing the additionality concern. The second objective requires a mix of discount and multiplication factors (i.e. weights < 1 and weights > 1). Varying weights between host countries should contribute to a better geographical distribution since projects hosted in LDCs could be granted with a multiplication factor while CERs issued from projects held in the more advanced countries of China, India and possibly Brazil could be discounted. Both objectives (environmental effectiveness and geographical representation) could then be combined by requiring that additional credits earned with weights higher than 1 do not exceed those gained from imposing weights smaller than 1, thus making sure that this policy mix always brings about atmospheric benefits.

With these objectives in mind, we computed the quantity of CERs formally registered by the CDM Executive Board. We then estimated yearly CERs earned in the three most important host countries in terms of CDM projects: China, India and Brazil, in descending order of importance. We finally took all registered projects into account and aggregated the investor countries in three groups: "Europe+", Japan and Canada.

The analysis shows that the three host countries of China, India and Brazil account for more than three quarters of all CERs and that "Europe+" is the main investor (with the UK, Germany, Switzerland and the Netherlands being the most active players in terms of the number of CDM projects). Applying a weight strictly smaller to 1 to projects hosted in the three non-Annex I BRIC countries of the analysis or in India and China alone would therefore greatly impact "Europe+" and would mechanically create non trivial atmospheric benefits. For example, a weight of 0.5 on projects in the three host countries would bring about yearly atmospheric benefits of 134 million tons of CO_2-eq. These benefits, or part of them, could then be redistributed to investing nations, for lowering their discount burden in more advanced countries, by applying multiplication factors (weights > 1) to projects taking place in less favoured nations. For example, a weight of 0.7 applied for projects in Brazil, India and

China could enable a doubling of CERs to be gained by investing countries in LDC and still maintain atmospheric benefits.

There are obviously caveats in the analysis, as, among others, there are no dynamics involved, abatement costs are not taken into account, aggregation of CERs are based on available data and are very crudely computed. Also, estimated CERs are based on December 2009 data and are not forecasted after 2012, even though discounting only becomes relevant at that time, because our purpose is to act as if the computation date of December 2009 is the starting point of the analysis of December 2012 in order to estimate, with current data, if there is a potential for improving the geographic distribution of CDM projects when incorporating weights for projects undertaken by Annex 1 countries in Brazil, India and China … Notwithstanding these caveats, we believe that this analysis, even though it is simple and based on historical data, is illustrative of the applicability of a CER weighting scheme option, which can improve the environmental integrity and the geographical distribution of CDM projects, thus enabling the CDM to achieve more effectively its twin objective of stimulating both emission reductions and sustainable development.

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Tables

	BRAZIL	INDIA	CHINA	TOTAL
EU	15,960,397	25,140,233	175,032,803	216,133,432
Canada	92,698	1,964	6,867,724	6,962,385
Japan	2,889,287	1,892,535	39,165,300	43,947,122
Total	18,942,381	27,034,732	221,065,827	267,042,940

Table I: Annual CERs earned in Brazil, India and China for registered CDM projects (Million tons of CO_2-eq.)

	Weight=0.5	Weight=0.7	Weight=0.9
Policy 1	170	102	34
Policy 2	134	80	27
Policy 3	124	74	25

Table II: Reductions in certified emissions credits (Million tons of CO_2-eq.), or atmospheric benefits

[i] These are calculated using global warming potentials defined by decision 2/CP.3 or as subsequently revised in accordance with Article 5 (UNFCCC, 2005).

[ii] This was pointed to us by an anonymous referee and we are grateful to him/her for that.

[iii] In particular, it should be decided whether discount rates should be reviewed automatically based on previously agreed criteria or only at the end of each commitment period, whether projects registered before the introduction of the scheme are covered or exempted, and whether discounting should become effective immediately or only at the renewal of a crediting period.

[iv] "Unilateral CDM" projects refer to those CDM project activities that do not have an Annex I Party letter of approval at the time of registration of the project.

[v] Michaelowa (2008) proposed an example of additionality-based discounting with a time-adjusted discount rate, set according to the percentage of the non-additional CERs in total projected CERs until the end of the end of the commitment period. The share of non-additonal projects would be determined at the end of every calendar year, by an independent review team, and the discount factor would be applied to all CERs issued during the following year.

[vi] Michaelowa (2009) explains that an EU closed to CERs imports would essentially separate the CDM market into « EU accepted » and « non EU accepted » CERs, leading to a boom and bust cycle. Moreover, global CDM efficiency would be reduced as no projects with low abatement costs would be mobilized in developing countries.

[vii] See UNFCCC, 2008a, option M, p.8, and UNFCCC, 2008b, option 14, pp. 24-25.

[viii] According to Schatz (2008), in order to reflect the real world costs, uncertainties, and equitable concerns, the factors that should be considered when setting the discount rate include, among others, the project type and size, the host country, transaction costs, uncertainty from CER realisation risks, effectiveness at promoting sustainable development, and flexibility.

[ix] In particular, Michaleowa (2008) proposed an approach where the discount factor were linked to the level of development of the host country (the development index being defined as a combination of per capita income and per capita emissions thresholds).

[x] These weights are used as examples to analyze their impact, like in Bakker et al. (2009) – weights of 75% for advanced countries – and in Schneider (2009) – weights between 50% and 70% - and are not linked to any particular proposed policy option. Other weights, like those based on a development index (Michaelowa, 2009), may also be used. This is not done here because emissions are not discounted for all three countries together (Brazil, India, China) in the three discounting mechanisms proposed by Michaelowa (2009).

[xi] In fact, 16 countries participate in accepted CDM projects hosted by Brazil, India and China ; that is all of EU-15 countries but Greece, plus Norway and Switzerland.

[xii] Total value of registered projects in tons (339,828,361) minus CDM hosted by BRIC countries (267,042,940).