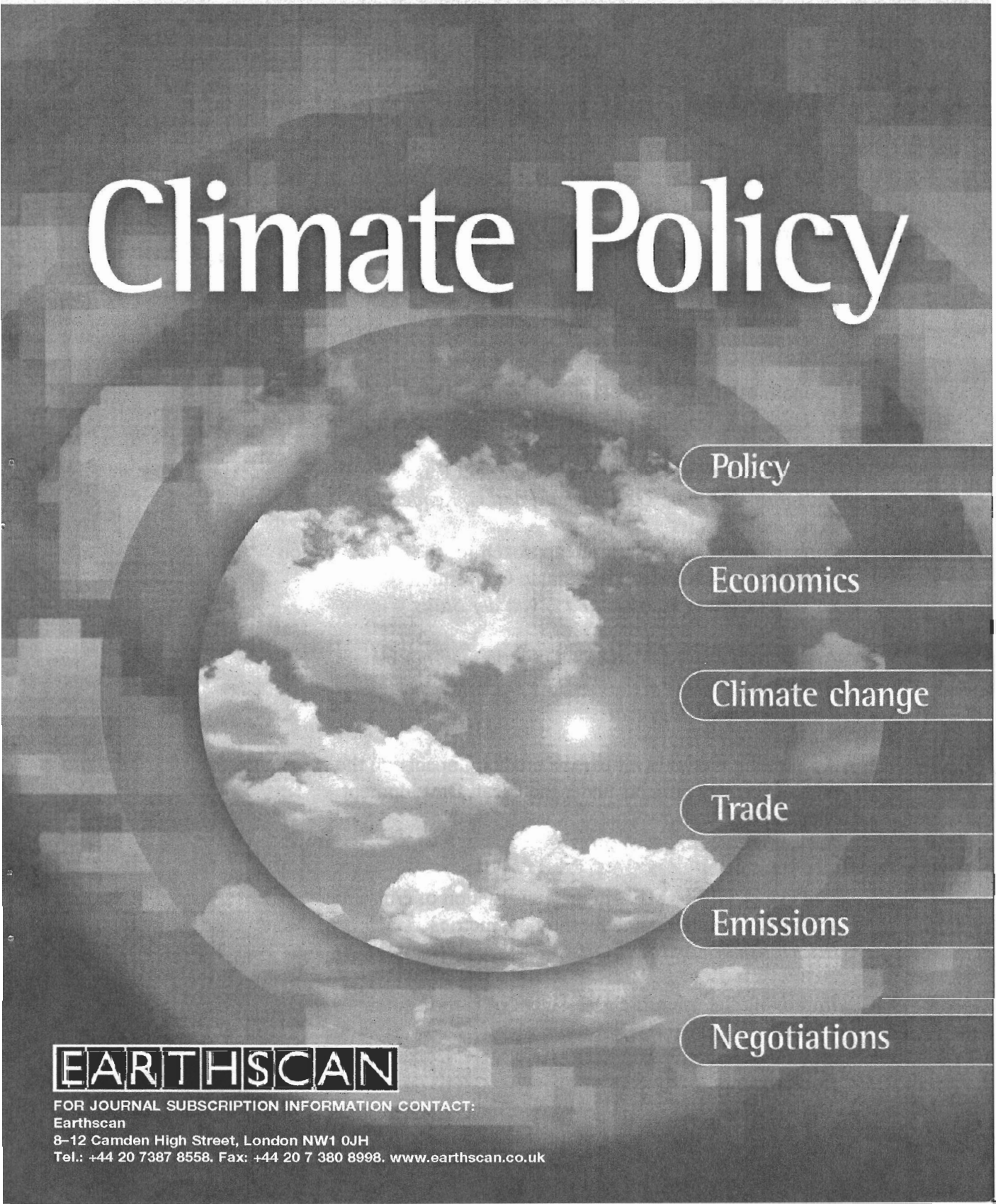
REPRINTED FROM VOLUME 4 • ISSUE 2 2004 ISSN: 1469-3062

Climate Policy



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VOLUME 4 • ISSUE 2 2004

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Climate Policy 4 (2004) 177–192

RESEARCH ARTICLE

Additionality reconsidered: lax criteria may not benefit developing countries

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Received 22 August 2003; received in revised form 18 December 2003; accepted 9 September 2004

Abstract

International negotiation on the additionality issue of the CDM (Clean Development Mechanism) seems to be proceeding without sufficient information or understanding. Especially apparent is a lack of recognition that the non-additional CERs (certified emission reductions) generated by relaxing the additionality criteria may lead to economic losses for developing countries. This article quantitatively reconfirms the effects of non-additional CERs on the international community, while clarifying that the generation of non-additional CERs in excess of a certain number will eventually lead to negative consequences for developing countries, even if these countries were able to acquire all the non-additional CERs. Furthermore, the Discussion section demonstrates that future system design would significantly affect the benefits of developing countries as well as the overall environmental integrity of the Kyoto mechanisms.

Keywords: Kyoto Protocol; Clean Development Mechanism; Certified emission reductions; Additionality; Emission trading

1. Introduction

The Kyoto Protocol of 1997 requires a CDM (Clean Development Mechanism) project in order to attain the 'reductions in emissions that are additional to any that would occur in the absence of the certified project activity' (Article 12, para 5(c)). The 'additionality issue'[1] is the problem of how to interpret this text, and in many cases investigating what actual substance and mutual relationships exist among the four additionalities: environmental additionality, investment additionality, financial additionality, and project additionality.[2]

Environmental additionality often means reducing greenhouse gas (GHG) emissions through the implementation of a certain project relative to a proposed baseline scenario emission. At its sixth meeting (Bonn, 7–8 July 2003), the Methodologies Panel (MethPanel), an expert group directly reporting to the CDM Executive Board (EB), defined environmental additionality as follows:

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> If the proposed CDM project activity is not implemented, a less greenhouse gas friendly activity would have been initiated or be continued instead. A baseline method does not evaluate *a priori* whether the project activity could be the baseline scenario (UNFCCC, 2003a).

On the other hand, on top of environmental additionality, investment, financial, and project additionalities require that a carbon credit (in case of the CDM, a certified emission reduction or CER) must not be granted to a project which would likely have been implemented regardless of the climate change issue or CDM, even if GHG emissions are below those of other project activity options.

Investment additionality is based on the above understanding that the concerned project cannot be eligible to generate the CER if it has a high possibility of being realized by the project developers and investors even without a climate change issue (Greiner and Michaelowa, 2003; Pearson and Loong, 2003). In other words, private-sector investment, which aims to earn commercial profits (for example, industrial afforestation or projects of the same type as current overseas power generation projects), is a flow of funds and technologies implementable as long as the profitability exceeds a certain level for rational investors both in developed countries and in developing countries. Therefore, along with considering various barriers (institutional and technological), an investment project with a certain economic attractiveness must be conceived under a business-as-usual scenario, and even if the project reduces GHG emissions, such a reduction should be assessed as a non-additional reduction quantity. To test the existence of investment additionality, *a priori* evaluation of whether the project activity could be in the baseline scenario or not is required and financial-investment parameters such as internal rate of return (IRR) can be important decision-making indexes.

Financial additionality considers the fact that current Overseas Development Assistance (ODA) is a flow of funds and technologies from developed to developing countries to resolve the South–North issue.[3] Although existing ODA would involve some projects that could reduce GHG emissions, such projects would have been implemented regardless of the climate change issue or the CDM. For example, about 20% of Japan's ODA (yen loans) in the 1990s are for energy-related projects such as power generation. By diverting such energy-related projects to the CDM every year, Japan might achieve a reduction of about 3% of its 1990 GHG emissions, which were about 9 million t-C (Sugiyama *et al.*, 2001). In terms of a strict interpretation of financial additionality, such projects should be included under the business-as-usual scenario, and their diversion to CDM should not be allowed. It is possible to use quantitative baselines such as the ratio of ODA to GDP as the criteria for judging financial additionality (Asuka, 2000). At the moment, researchers and governments are proposing several options for using public funds for the CDM (Dutschke and Michaelowa, 2003). The OECD Development Aid Committee (DAC) has also been discussing the diversion of ODA issue since 2002. It has not yet been decided exactly how ODA money and public funds can be used for CDM projects.

Project additionality is a new term and it seems to have the potential to become an official term for additionality because the CDM EB made it clear at its ninth meeting (Bonn, 7–8 June 2003) that project participants shall refrain from providing glossaries or using key terminology not used in the COP documents and the CDM glossary (environmental/investment additionality). Project participants must therefore describe how to develop a baseline scenario and how their baseline methodology addresses the determination of project additionality (UNFCCC, 2003b).

Under circumstances in which additionality is not well defined, strategic behavior for adopting obscure criteria to imitate additional projects is possible, and these attempts may allow the over-generation of GHG reduction credit in excess of actual reduction. Although such problems have been suggested elsewhere, there have been few quantitative assessments of whether the changes in economic benefits

derived from over-generation of emission credits are positive for developing countries (Jotzo and Michaelowa, 2002; Roy *et al.*, 2002).[4] In particular, we are not aware of any theoretical study examining the effect of lax additionality criteria.

In this article, we use a simple model to indicate that there may be negative benefits to developing countries because of lax additionality criteria, and we consider conditions which would make the CDM project modality truly beneficial to the prevention of climate change. Section 2 reviews the problems arising from the generation of non-additional CERs. Section 3 describes the quantification of changes in benefits at the investor side (developed countries) and the host country side (developing countries) by the generation and distribution of non-additional CERs. Section 4 reviews past and recent discussions about additionality in more detail, and considers the design of appropriate CDM modality. Section 5 presents our conclusions.

2. Negative impact of lax additionality criteria

Non-additional CERs saleable at market price will be generated when additionality criteria are relaxed. On the other hand, this will lead to three problems: (1) increase in global GHG emissions, (2) decrease in the social surplus from the trading of additional CERs, and (3) crowding-out of additional CDM projects (Chomitz, 1998).

2.1. Global GHG emission increases

In the case of Joint Implementation (JI) between developed countries, trading carbon credits between an investor country and a host country will be climate-neutral, because of the cap on GHG emissions for developed countries as a whole. However, in the case of the CDM, over-generated CERs make the trade climate-non-neutral, and delay climate change mitigation measures, since a host country does not have any cap on its GHGs emissions. It is also possible that the CDM may not change the investment pattern substantially if the price of carbon credits is not very high. For example, Bernow *et al.* (2000) estimates, using various assumptions, that even at a CER price of US$100/t-C, about 94% of new investments for power generation projects in developing countries are identical to business-as-usual investment projects that would have been implemented regardless of the CDM regime.

2.2. Reduction in social surplus through the trading of additional CERs

Figure 1 shows the amount of CERs (Q) on the horizontal axis and the CER price (P) on the vertical axis. When restrictive criteria are applied to additionality, the intersection of the demand curve D (which shows the marginal cost of GHG emissions reduction for developed countries as CER demand countries) and the supply curve S (which reflects the marginal cost of GHG emissions reduction for developing countries as CER suppliers) indicates the establishment of the equilibrium price P_1 and the equilibrium quantity Q_1. When additionality criteria are relaxed and non-additional CERs are generated for the quantity OQ_n, the supply curve will shift to S_n, and the social surplus due to the trading of additional CERs will shrink from OAP_0 to Q_nBE. At the same time, the flow of funds from developed to developing countries for additional CER trading will decrease from OQ_1AP_1 to Q_nQ_2BC. The amount of non-additional CERs is OQ_n, which is equal to the increase in global GHG emissions. By rotating D on A, one can confirm that the size of OAP_0 compared to Q_nBE becomes larger as the slope of D becomes steeper. This means that the reduction of gain from the trading of additional CERs becomes larger when demand is less elastic.

Social gains from trading total CERs seem to increase by OQ_nBA, from OAP_0 to OQ_nBP_0. This gain comes at the cost of increased global GHG emissions. Here we assume environmental damage from increased emissions is far greater than the gain of OQ_nBA. The assumption means that the emission reduction amount required under the Kyoto Protocol/Marrakech Accords is at or below the optimum that is determined by abatement costs and avoided environmental damage.

2.3. Crowding-out of additional CDM projects with a higher marginal cost of reduction

The decline in the price of CERs due to the generation of non-additional CERs will affect the contents of CDM projects (see Figure 1). As mentioned by several researchers, non-additional CERs would drive away from the market such projects that would be implemented when appropriately priced CERs are available (Chomitz, 1998; Greiner and Michaelowa, 2003). The number of additional projects crowded out of the market is equal to Q_2G in Figure 1. Therefore, it is quite possible that only business-as-usual energy development projects or technology diffusion projects within developing countries would be established as CDM projects, while technology transfer from developed countries (one of the original objectives of the CDM) would become difficult due to its relatively higher marginal cost.[5]

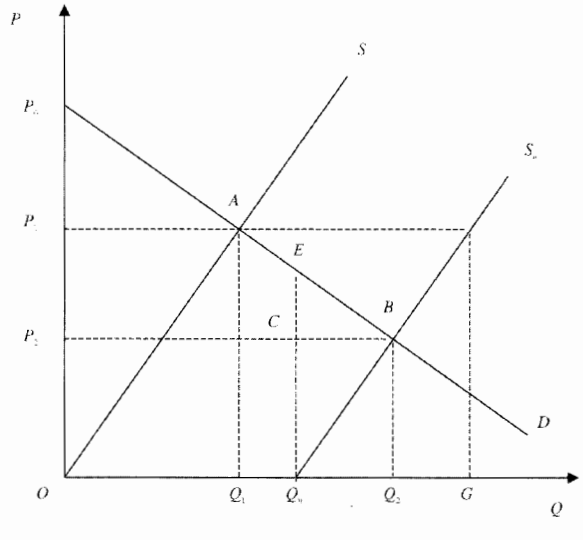

Figure 1. Effects of non-additional CERs, showing the CER price P, amount of CERs Q, the demand curve D, and the supply curve (S, S_n). See text for further explanations (from Chomitz, 1998, p. 3)

Regardless of those problems, at first glance, gains from trading total CERs seem to be increased by OQ_nBA. However, as previously mentioned, these gains come at the sacrifice of increased global GHG emissions that might cause damage to both present and future generations.

Aside from the environmental damage, developed countries will gain at least the area P_1P_2BA. In other words, developed countries will always gain from the generation of non-additional CERs if they do not care about the environmental damage. In contrast, developing countries may suffer losses depending on the degree of additionality criteria relaxation (the size of non-additional CERs). The size of these benefits will be further discussed quantitatively in the next section.

3. Benefits of non-additional CER : to whom and how much?

This section provides a quantitative analysis on the size of the economic benefits, which CDM suppliers (developing countries) and demand countries (developed countries) will earn by generating non-additional

CERs with relaxed additionality criteria. Thus, it compares the profits of developing countries under two scenarios (strict additionality vs. relaxed additionality). The analysis does not consider the possible external costs arising from climate change. In other words, further discussion in this article does not include environmental damage from non-additional CER generation and assumes that both developed and developing countries are concerned only with financial gain or loss from carbon credit transactions.

3.1. Size of benefits earned by developing countries and developed countries

First, let us denote the CER demand curve of developed countries as D, the supply curve of developing countries as S, and the supply curve in the case of non-additional CER generation due to the relaxation of additionality criteria as S_n (see Appendix for a more detailed derivation). Those countries behave under a given market price. Set these functions as follows (see also Figure 1):

$$D: \ P = b - aQ \tag{1}$$

$$S: \ P = cQ \tag{2}$$

$$S_n: \ P = cQ - d \tag{3}$$

where P is the price and Q is the amount of additional or non-additional CERs, and $a > 0$, $b > 0$, $c > 0$, and $d > 0$ are unknown parameters. The size of non-additional CERs is OQ_n. When the intersection A between D and S is (Q_1, P_1), and the intersection B between D and S_n is (Q_2, P_2), we obtain

$$OQ_1 = \frac{b}{a+c}$$

$$OQ_2 = \frac{b+d}{a+c}$$

$$OP_1 = \frac{bc}{a+c}$$

$$OP_2 = \frac{bc-ad}{a+c}$$

$$OQ_n = \frac{d}{c}.$$

The minimum amount of benefits newly earned by a developed country on CER trade due to non-additional CER generation will be (area P_1P_2BA in Figure 1):

$$\frac{1}{2}\frac{ad(2b+d)}{(a+c)^2}$$

which is always positive. In other words, developed countries will always find relaxation of additionality profitable, because they can gain from lowered spending for purchasing CER.

On the other hand, Z, the maximum amount of benefits newly earned by a developing country for CER trades due to the generation of non-additional CER (when a developing country earns all of the

rectangle OQ_2BP_2 in Figure 1)[6], will be:

$$Z = area\ OQ_nBP_2 - area\ OAP_1 \quad (4)$$

Equation (4) can be arranged as a quadratic function of d that is concave upward with an apex of:

$$\left(\frac{bc}{2a + \frac{a^2}{c}}, \frac{1}{2(a+c)^2} \cdot \frac{b^2c^2}{2a + \frac{a^2}{c}} \right)$$

Figure 2 shows the relation between the benefits for developing countries and relaxed additionality.[7] Initially, the benefits of developing countries increase with the size of non-additional CERs. However, it will decrease beyond a certain point and becomes zero when

$$d = 0 \text{ or } d = \frac{2bc}{2a + \frac{a^2}{c}}.$$

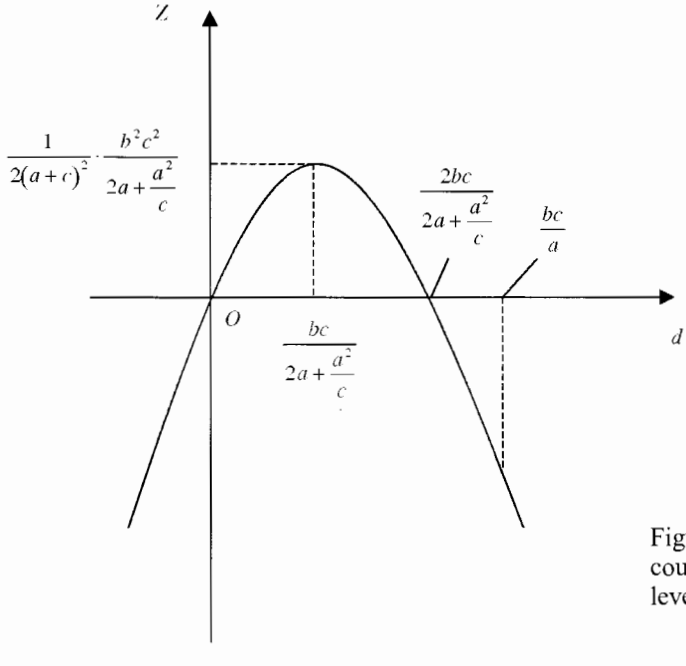

Figure 2. Relationship between developing country benefits and additionality criteria level. See text for explanations

Beyond this point where Z is zero, Z becomes negative, which means that the generation of non-additional CERs will eventually bring losses to such countries even when they earn all non-additional CERs. In terms of maximizing economic benefits for developing countries, the optimum quantity of non-additional CER generation (that is, the extent of criteria relaxation that will bring the maximum benefit for them) will be:

$$d = \frac{bc}{2a + \frac{a^2}{c}}$$

This will always be at the left of

$$d = \frac{bc}{a}$$

at which the price of CER becomes zero. However, the optimum relaxation level would not be realized without careful alliance of developing countries and their dominance over the determination of the additionality criteria.

Recall that Z becomes zero when

$$d = 0 \text{ or } d = \frac{2bc}{2a + \frac{a^2}{c}}$$

Thus we have a smaller region of positive benefit when b and c are smaller, and when a is larger. This means that the developing country cannot expect much benefit from relaxed additionality when demand for CERs is small and less price-elastic, and when the developing country's marginal cost of reducing GHGs is small. On the other hand, when demand for CER is large and more price-elastic, and the developing country's marginal cost of reducing GHGs is large, the developing country can expect much benefit. Although the behavior of these key assumptions is an empirical question, it seems that the former assumptions might represent more accurately the current situation.

As mentioned previously, this discussion does not quantitatively consider environmental damage cost from the relaxation of additionality criteria. Moreover, we assumed that the host country acquires all benefits from the sale of CERs. This will only be the case when all non-additional CERs are generated from unilateral CDM projects. So far, in most cases, Annex B investors have obtained the bulk of CERs. Therefore, if the project is non-additional, it is possible that the host country might only gain the small share it retains as CER tax.

It is also important to note that this analysis is for developing countries as a whole, not necessarily for each non-Annex B country. If the shares of non-additional projects in the CDM vary among countries, then some developing countries might be worse off even if the group as a whole gains.

3.2. Further consideration of the price of CERs

As the previous section indicated, the generation of non-additional CERs does not necessarily bring benefits to a CDM project host country. However, to the extent that the price of CERs is positive, some entities will gain market entry by creating their own non-additional CERs. If there were sufficient business-as-usual projects (potentially non-additional projects) and many entrants into the market with relaxed additionality criteria that could provide non-additional CERs at zero marginal cost, then CER prices would eventually decline to a level infinitely approaching zero, which would result in a negative Z value.

This will be the case when many non-additional CERs are generated from many business-as-usual energy-related and afforestation projects in developing countries, especially in the countries which have both high demand for the electricity and an attractive market for Foreign Direct Investment (FDI), significantly dropping CER prices, and bringing about a situation in which 'bad money' (non-additional

CERs) will drive out 'good money' (additional CERs). Then the credibility of the Kyoto Mechanism as well as the profits of developing countries will collapse, and the reduction targets of the Kyoto Protocol may become meaningless.

On the other hand, if developing countries can exercise price-control power, then it will be possible for them to act as a monopoly by squeezing the CER market supply, thereby raising prices. In that case, the CER supply would be located at the intersection between the supply curve (marginal cost curve) and the marginal revenue curve given by the differentiation of total revenue curve. That point will give maximum benefits. Jotzo and Tanujaya (2001) argue that benefits for developing countries and economies in transition (Russian Federation and Eastern European countries) will be augmented when they adopt cartel-like behavior, reaching a price several times higher than without cartelization. Such a strategy will raise CER prices, thereby unfavorably affecting developed countries in the form of reduced consumer surpluses.

Such a maneuver, however, would cause many problems. First, it would not be easy to limit the credit supply through cooperation among developing countries, while monitoring the exact amount of CER generation that can maximize the benefits of developing countries, and preventing free rides. Second, developed countries might strongly oppose strategic action by the developing countries, and resort to some kind of retaliatory measures. Third, it is difficult for each government to control all of the profit-oriented business behavior of their domestic private entities. Last, but not least, Russian strategic options may include more attractive choices such as ratification of the Kyoto Protocol and carbon credit price hikes around the end of the first commitment period, after preventing the entry of developing countries into the market by signaling a mass release of lower-priced carbon credits (limit pricing).[8] In summary, it would not be easy for developing countries to carry out such cartel-like actions.

4. Implication for designing CDM modality

On the additionality issue, it is desirable to conduct rational consensus building over time, based on qualitative and quantitative assessment of the advantages and disadvantages of each option. Past negotiations, however, have shown that both developed and developing countries appeared to rely on insufficient discernment and understanding. This section reviews the history of negotiations while focusing on the discussion of investment additionality, and considers the appropriate design of CDM modality for the future.

4.1. Outline of discussions on investment additionality

For the activities implemented jointly (AIJ) introduced at COP-1 in 1995 as a scheme without CER issuance, the Berlin Mandate defined additionality in this way:

> activities implemented jointly should bring about real, measurable and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities (FCCC/CP1995/ADD.1, Decision 5/CP1, para 1(d)).

The USA, which had proposed AIJ at COP-1 and successfully converted it to CDM at COP-3, has taken the position, conforming to the above text, that there shall be no mere re-capping of business-as-usual projects to AIJ projects (US Department of Energy, 1999).[9]

Owing to this background, the Kyoto Protocol of 1997 included the text, 'reductions in emissions that are additional to any that would occur in the absence of the certified project activity.' (Art. 12, para 5(c)). Furthermore, the Marrakech Accord of 2000 at COP-7 gave this definition:

> A CDM project is additional if anthropogenic emissions of GHGs by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (Draft decision /CMP1 (Art.12), Annex, para 43).

These texts have been subject to various interpretations, and among the various carbon credit trading schemes that emerged after the Kyoto Conference, several cases do not require strict investment additionality. On the other hand, examples such as the Climate Trust, which is a project-based carbon credit trading scheme implemented by the State of Oregon in the USA, oblige a project developer to prove that the project would not be implemented if there were no revenue from carbon credit sales, thereby practically requesting certification for the presence of investment additionality (Rosenzweig *et al.*, 2001).[10]

The Marrakech Accord included the text that defines three options, namely option 48(a), option 48(b), and option 48(c), for the baseline approach, in addition to the aforementioned text on additionality. According to the modalities and procedures of the CDM in the text, project participants should select the baseline approach that is most relevant for the proposed project. The baseline approach adopted so far for most of the investment-related CDM project activities is option 48(b),

> emission from a technology that represents an economically attractive course of action, taking into account barriers to investment (Decision /CMP.1, para 48(b)).

Accordingly, the baseline scenario is determined as the scenario that represents the economically most attractive option. Option 48(b) must be interpreted and made operational in view of the project circumstances. Since it assumes that economically rational behavior determines the most likely future baseline scenario, it seems appropriate to understand that operationalization of this approach would be done in the form of an investment or financial analysis.

If such a stipulation is applied correctly as a principal criterion for the project-specific baseline scenario setting, there will be no CERs issued to any projects with the highest profitability. However even in this case, 'the project with less profitability than a proposed baseline project but higher potential to attract investment funds under competitive conditions' will generate CERs. In other words, this approach without a separated additionality test involves the possibility that the proposed CDM project is equal to the baseline scenario and non-additional CERs will be generated by approving the CDM project activity that might be a commercially viable, business-as-usual project in reality.

After the Marrakech Accord, the subject of discussion on additionality shifted to the wording of the Project Design Document (PDD), which can be called a plan or detailed description of a CDM project candidate. On 3 July 2002, MethPanel submitted the first draft of PDD format, which contained the expression 'provide affirmation that the project activity does not occur in the absence of the CDM' (item A4.4). In response to this text, several industrial NGOs, operational entity candidates, the Government of Japan, the EU, and others submitted to the UNFCCC Secretariat the public comments claiming that this expression in item A4.4 is neither necessary nor appropriate. Those comments were antagonistic to the idea that can be implied from the text that 'in CDM, it is necessary that the project developer must prove the presence of investment additionality in its PDD.'

Probably in consideration of such public comments, the second draft PDD (version 1.0) submitted by the UNFCCC Secretariat on 29 August 2002, let the following text remain:

> Brief explanation of how the anthropogenic emissions of GHGs by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence

> of the proposed project activity, taking into account national and/or sectoral policies and circumstances (item A.4.4.).

Since these texts still leave room for various interpretations, it was expected that each project developer or operational entity would adopt own interpretation.

At its fifth meeting (Bonn, 21–23 May 2003), the MethPanel presented its first recommendations for new methodologies. The recommendations by the MethPanel on baseline and monitoring methodologies were based on a review of 14 proposed new methodologies. The panel approved only one baseline methodology. Five baseline methodologies were marked as B, indicating that they could be approved provided that required changes were made by the project participants. The other eight baseline methodologies ended up in the C category (not approved). It appears that 10 out of 14 methodologies were not approved, or 'not approved, unless' because they inadequately dealt with the additionality issue (JIQ, 2003; Jotzo, 2003; Ellis, 2003).

At its sixth meeting (Bonn, 7–8 July 2003), the MethPanel considered two interpretations for additionality: (a) The methodology must show *a priori* that it would not, or very likely would not, have occurred in the absence of the CDM. (b) The methodology merely needs to focus on additionality for GHG emission reductions.

The MethPanel at the meeting made it clear in the report to the CDM EB that it considers only the first interpretation to be correct (UNFCCC, 2003a). Since it seems that the first interpretation embodies the concept of investment additionality and the second embraces the concept of environmental additionality, it is quite clear that they recognize the importance of investment additionality; however, they created the new word 'project additionality,' which seems to be virtually identical to the investment additionality in a broader sense because almost no project can be realized without the investment decision-making that accompanies the financial analysis as well as the risk/barrier evaluation.

The CDM EB at the tenth meeting (Bonn, 28–29 July 2003) endorsed the following procedures to assess additionality for a proposed CDM project activity (UNFCCC, 2003c):[11]

- A flow-chart or series of questions that lead to a narrowing of potential baseline options; and/or
- A qualitative or quantitative assessment of different potential options and an indication of why the non-project option is more likely; and/or
- A qualitative or quantitative assessment of one or more barriers facing the proposed project activity (such as those laid out for small-scale CDM projects); and/or
- An indication that the project type is not common practice (e.g., occurs in less than [$<x\%$] of similar cases) in the proposed area of implementation, and not required by a Party's legislation/regulation.

At its eighth meeting (Bonn, 3–5 November 2003), as per the CDM EB's request, the MethPanel considered the PDD and agreed on recommendations for revisions which contain passages such as:

> Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (i.e. explanation of how and why this project is additional and therefore not the baseline scenario) (B.4 in UNFCCC, 2003d).[12]

Since it seems obvious that the MethPanel and the CDM EB highly respects the *spirit* of the investment additionality and the project developer should follow the decision made by the CDM EB,[13] the remaining issues to be overcome are: (1) clear separation of the additionality test from the baseline scenario determination among proposed scenario options, (2) clear specification as well as standardization of the

additionality test to make it more objective,[14] (3) transparent treatment of the financial data which may, for some projects, only be made available to the operational entities.

4.2. Implications for defining additionality and designing future modality

Unless the articles on additionality are deleted from the Kyoto Protocol, the need to require strict observation of additionality criteria will remain. On the other hand, it is understandable that people with greater economic incentives to generate excessive CERs such as: (1) operational entities/brokers/consultants wanting to earn greater fees quickly by increasing the number of CDM projects; (2) buyers of CERs who want to minimize the cost; and (3) developers of CDM wanting to earn quick revenues from selling CERs and from ordinary commercial return on investment, are not likely to stop criticizing the significance of both additionality and using financial-investment parameters for the additionality test.[15]

Typically found among such criticisms is the argument that 'Parameters to test the existence of investment additionality, such as internal rate of return (IRR) and the pay back years for the project are too complex and too prone to gaming to be workable.' (World Business Council for Sustainable Development, 2000). However, this argument deliberately ignores the fact that these very indexes of investment have been used as the most important tool for investment decision-making on project financing practiced worldwide.[16] The subjectivity argument cannot be convincing because even if there is no objective unique threshold there should be a range into which most of the subjective figures for rational investors fall (Greiner and Michaelowa, 2003). For example, it is quite a common practice among bankers that if the loan life coverage ratio (LLCR)[17] of the proposed investment project is below 1, they do not consider the project worth a loan. In terms of equity capital, it is also rational that the stockholders refrain from an investment project whose internal rate of return on equity (IRROE) is below the equity cash flow of the company, because the investment may cause the devaluation of corporate value.

Another oft-repeated argument is that 'because of lower CER prices, projects without commercial viability will not be implemented even as CDM projects. Therefore, asking for the strict observance of investment additionality is useless.' This argument misunderstands the definition of investment additionality. Investment additionality is a criterion to consider whether project investment will take place without the presence of the climate change issue and CDM. Therefore, in the first place it is wrong to introduce a review of criteria appropriateness for CER prices, as they will only exist under the premise of CDM, whose first priority is tackling climate change. Moreover, as already suggested in this article, lenient criteria for additionality constitute a major factor pulling down CER prices, so once investment additionality is no longer respected and investment additionality tests are no longer requested, then many non-additional CERs will be generated, further reducing CER prices.

Another argument is that 'even if financial-investment parameters such as IRR are high, various barriers (institutional/technological) may prevent the actual implementation of projects. Therefore the use of financial-investment parameters is misleading and based on a somewhat flawed hypothesis that all 'economic' projects will be implemented.' (World Business Council for Sustainable Development, 2000). Undoubtedly, the implementation potential of a project will require comprehensive judgment for each specific situation and its ancillary issues in a dynamic and differentiated competitive environment. However, with the definition of barriers inclined to be arbitrary as well as subjective, such arguments alone shall hardly provide a strong reason for rejecting the use of financial-investment parameters to prove both additionality and non-additionality. Moreover, in many cases, barriers and risks have been incorporated into those quantitative parameters for decisions on project financing, so financial-investment parameters still continue to be a decisive factor in making rational investment judgments.

Finally, there is an argument that 'scenario analysis with stringent baseline-setting using conservative parameters and assumptions can substitute for the investment additionality test.' This argument is also unconvincing because: (1) scenario analysis is merely a comparison among the proposed investment options, (2) it undermines the point of the investment additionality test, which plays an important role in keeping a baseline project from becoming a CDM project, and (3) the baseline does not test additionality if baseline parameters do not take economic decision-making into account. In other words, the role of investment additionality test is to avoid over-crediting from a mistaken baseline setting.

As far as one of the authors is aware, some operational entity candidates, who are involved in the 'JI/CDM project candidates' about to take place, ask JI and CDM developers to submit figures on projects such as cash flow without CERs, and request some kind of quantitative verification to prove that the IRR is lower than what investors would expect from a similar investment environment. Thus, among operational entity candidates, some organizations are actually requesting investment additionality testing. Such operational entity candidates seem to share the understanding that: (1) it is necessary to have a proof of investment additionality, and (2) financial-investment parameters can be used as the most objective and persuasive criteria to test and to prove the existence of investment additionality.

Although some may still argue that the explanation and identification of barriers to implement CDM projects is enough for verification of additionality, we strongly believe it is necessary to show project developers quantitatively to some extent, by using objective financial-investment parameters, that most rational investors would not invest their money to a proposed CDM project without revenue from CERs sales in order to demonstrate project additionality and to pass the additionality test. It is also important that operational entities should respect the importance of additionality and make a decision for validation by considering the financial-investment parameters of projects.

In the near future, we expect that 'CER rating agencies,' organized by private entities or environmental NGOs to evaluate both the quality of the credits and the activities of the operational entities, will play a very important role in improving the additionality assessment of these operational entities and ensuring a sound development of the carbon credit market.[18]

5. Conclusion

On the additionality issue, it is necessary to approach consensus-building rationally, based on qualitative and quantitative assessment of the advantages and disadvantages of each option. As discussed in this article, it can be said that one of the greatest concerns on the CDM is the amount of the non-additional CERs generated relative to additional CERs. However, both developed and developing countries seem to have been operating under an inadequate understanding of the consequences, i.e., who is the winner and who is the loser from the long-term perspective.

This article theoretically examined the effect of relaxed criteria for additionality on the benefits that developing countries receive. In addition to the damage to environmental integrity and market development, we found that relaxed additionality can reduce the developing countries' benefits and we demonstrated the conditions for such situations. Since financial benefit for developing countries from the CER transactions seem to be essential not only to realize the objective of the CDM but also to expect the *meaningful* participation of developing countries in the future post-Kyoto framework based on the mutual trust, it seems very important to understand what economic consequences arise from relaxing additionality both for developed countries and for developing countries.

Repetto (2001) also pointed out the problem with the generation of non-additional carbon credits having project-based carbon offset mechanisms, and argued that agreement on the practical tools for

climate change mitigation, such as the abolition of unnecessary subsidies, would work better than the quantitative targets of the Kyoto Protocol. Although the authors have some sympathy toward such arguments, the CDM is already under way as a solid scheme based on the Kyoto Protocol. Therefore, the immediate task is working out how the international community builds CDM modality that fully incorporates environmental integrity, with enough understanding of the issues identified. The fate of the Kyoto Protocol will certainly depend on the success of such system design efforts.

Acknowledgments

The authors acknowledge helpful comments from three anonymous referees. All remaining errors are the sole responsibility of the authors.

Appendix: Mathematical derivation of Equations (1) to (5)

Let us denote D as the CER demand curve of developed countries, S as the supply curve of developing countries, and S_n as the supply curve in the case of non-additional CER generation due to the relaxation of additionality criteria. Those countries behave under a given market price. Set these functions as follows (see also Figure 1):

$$D: \quad P = b - aQ \tag{1}$$

$$S: \quad P = cQ \tag{2}$$

$$S_n: \quad P = cQ - d \tag{3}$$

where P is the price and Q is the amount of additional or non-additional CERs, and $a > 0$, $b > 0$, $c > 0$, and $d > 0$ are unknown parameters. The size of non-additional CERs is OQ_n. When the intersection A between D and S is (Q_1, P_1), and the intersection B between D and S_n is (Q_2, P_2), we obtain

$$OQ_1 = \frac{b}{a+c} \qquad OP_2 = \frac{bc-ad}{a+c}$$

$$OQ_2 = \frac{b+d}{a+c} \qquad OQ_n = \frac{d}{c}$$

$$OP_1 = \frac{bc}{a+c}$$

The minimum amount of benefits newly earned by a developed country on CER trade due to non-additional CER generation will be :

$$area P_0BP_2 - area P_0AP_1 = area P_1ABP_2 = (OQ_1 + OQ_2)(OP_1 - OP_2)\cdot\frac{1}{2}$$

$$= \left(\frac{b}{a+c} + \frac{b+d}{a+c}\right)\left(\frac{bc}{a+c} - \frac{bc-ad}{a+c}\right)\cdot\frac{1}{2} = \left(\frac{ad(2b+d)}{(a+c)^2}\right)\cdot\frac{1}{2}$$

which is always positive. In other words, developed countries will always find relaxation of additionality profitable, because they can gain from saved spending for purchasing CER.

On the other hand, Z, the maximum amount of benefits newly earned by a developing country for CER trades due to the generation of non-additional CER (when a developing country earns all of the rectangle OQ_2BP_2 in Figure 1), will be:

$$
\begin{aligned}
Z &= \text{area}OQ_nBP_2 - \text{area}OAP_1 \\
&= OQ_1 \cdot OP_1 \cdot \frac{1}{2} + (OQ_2 + OQ_n) \cdot OP_2 \cdot \frac{1}{2} \\
&= \frac{b}{a+c} \cdot \frac{bc}{a+c} \cdot \frac{1}{2} + \left(\frac{b+d}{a+c} + \frac{d}{c} \right) \cdot \frac{bc-ad}{a+c} \cdot \frac{1}{2} \\
&= \frac{1}{2} \left(\frac{abd - \frac{1}{c}a^2d^2 + bcd - ad^2 + bcd - abd - ad^2}{(a+c)^2} \right) \\
&= \frac{1}{2} \left(\frac{-\left(2a + \frac{a^2}{c}\right)d^2 + 2bcd}{(a+c)^2} \right)
\end{aligned}
\tag{4}
$$

By square completion, Equation (4) can be rearranged as:

$$
Z = \frac{1}{2} \left(\frac{-\left(2a + \frac{a^2}{c}\right)d^2 + 2bcd}{(a+c)^2} \right) = \frac{1}{2(a+c)^2} \left(-\left(2a + \frac{a^2}{c}\right) \left(d - \frac{bc}{2a + \frac{a^2}{c}} \right)^2 + \frac{b^2c^2}{2a + \frac{a^2}{c}} \right) \tag{5}
$$

Thus, as shown in Figure 2, it will be a quadratic function of d that is concave upward with an apex of:

$$
\left(\frac{bc}{2a + \frac{a^2}{c}}, \frac{1}{2(a+c)^2} \cdot \frac{b^2c^2}{2a + \frac{a^2}{c}} \right)
$$

Notes

1 Regarding additionality in general, refer to Chomitz (1998), Philibert (1999), Baumert (1999), Bode and Michaelowa (2003), and PROBASE (2003). Ellis (2003) describes recent development on this issue. The concept of incremental cost by the Global Environmental Facility of the World Bank is also helpful for understanding the basic idea of additionality as well as how to quantify it. On the incremental cost analysis, refer to GEF (1996).

2 Although the CDM Executive Board at its ninth meeting (Bonn, 7–8 June 2003) made it clear that neither 'environmental additionality' nor 'investment additionality' should be used, this article uses those terms in order to follow and to clarify the

process and meanings of the discussion on additionality.

3 Another expression and an almost synonymous concept is called ODA additionality, due to ODA involvement. There are many cases in which financial additionality has been misused as investment additionality. For further reading on financial additionality, refer to Asuka (2000), and Dutschke and Michaelowa (2003).

4 Jotzo and Michaelowa (2002) empirically estimated the CDM market under the Marrakech Accords. Our article can be seen as a theoretical attempt to generalize their 'no-regrets potential' scenario. Roy *et al.* (2002) examined the effect of various baseline standards on the evaluation of projects for electricity generation in India.

5 Factors in CER price declines may also include the presence of Russia's excessive emission allowance (*hot air*), and the lack of demand due to uncertainties about the enforcement of the Kyoto Protocol.

6 This assumes that the host country appropriates all benefits from the sale of CERs. This will only be the case in unilateral CDM projects.

7 Strictly speaking, the amount of relaxed additionality is not d but d/c. However, the results hereafter are mostly unchanged by using d.

8 The long lead-time to realizing CDM projects is a comparative disadvantage for the carbon credits from Russia. See Asuka and Morioka (2001) for various options available to Russia.

9 'Projects accepted into the US Initiative on the Joint Implementation (USIJI) Program demonstrate that it was developed or realized because of the USIJI Program' (US Department of Energy, 1999).

10 'The Climate Trust, for example, adopts a stringent financial form of additionality, requiring demonstration that the project would not occur in the absence of revenues generated by the sale of offsets.' (Rosenzweig *et al.*, 2002, p .6) The US State of Oregon has set caps on greenhouse gas emissions from power companies since 1997.

11 These four procedures seem to be uncomparable and insufficient as additionality tests. See Michaelowa and Jung (2003).

12 As of 7 December, these revisions would be made available for public comments from 17 November to 15 December 2003. The MethPanel considered the public comments at its ninth meeting and is expected to prepare a final recommendation on revisions for consideration by the Board at its thirteenth meeting.

13 For example, additionality for projects submitted to the Dutch CERUPT program was initially determined only by determining a baseline scenario that represents the most likely future situation (either via scenario analysis or investment analysis). However, following non-acceptance of the first submission and guidance from the CDM EB, the CERUPT methodology now also includes a generic flow chart used to assess a project activity's additionality. See Ellis (2003) and VROM (2003).

14 Although standardization is needed for the additionality test, it would have certain limits due to the project specificity and the technical difficulty.

15 The criticisms often confuse the importance of additionality and the feasibility of the additionality test.

16 Manipulation of the numbers for the investment analysis is always accompanied to some degree by the risk of being found out and punished by the market.

17 An Index that has the present value of the cash flow for debt service at the time of disbursement as the numerator and the total debt amount as the denominator. It is logically impossible to expect the payment for debt service from the cash flow generated by the project itself if this Index is below 1. In many cases, the bankers who offer loan money demand that the Index be higher than 1.3.

18 'The Gold Standard' by the Worldwide Fund for Nature (WWF) can be considered an example of this kind of institution. See WWF (2002) for more details.

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