USING EMISSIONS TRADING TO REGULATE GLOBAL GREENHOUSE GAS EMISSIONS

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Summary

The inclusion of emissions trading in the Kyoto Protocol reflects an important decision to address climate change issues through flexible market mechanisms. In this article, we address a number of policy issues that must be considered in designing and implementing an international greenhouse gas (GHG) emissions trading scheme. These include emissions trading models, the allocation of emissions permits and competitiveness concerns, banking and borrowing, the liability rules for non-

compliance, and bubbles. The following conclusions emerge from the discussion. First, we think that although emissions trading could take place either on an intergovernmental basis or on an inter-source basis, sub-national legal entities are the best entities to trade emissions permits. Allocating permits to individual emissions sources will facilitate private participation in emissions trading. Moreover, we argue that individual governments should be left free to devise their own ways of allocating assigned amounts. Second, we point out that although national emissions trading systems could be modeled as *upstream* or *downstream* or *hybrid* systems, the distinguishing features of broad coverage and administrative simplicity would make an *upstream* system the more attractive approach. Moreover, national emissions trading systems should incorporate the maximum degree of flexibility in banking. Third, in order for an international GHG emissions trading scheme to function properly, we think that the liability rules are essential to its success. In general, a seller-beware liability works well in a strong enforcement environment. In the Kyoto Protocol, however, it may not always work. By contrast, a buyer-beware liability could be an effective deterrent to non-compliance, but the costs of imposing it are expected to be very high. To strike a middle ground, we suggest a combination of preventive measures with strong but feasible end-of-period punishments to ensure compliance with the Kyoto emissions commitments.

1. Introduction

In December 1997, 158 countries reached an historic agreement in Kyoto on limiting greenhouse gas (GHG) emissions. While the United Nations Framework Convention on Climate Change (UNFCCC) signed at the Earth Summit in June 1992 committed Annex I countries (i.e. the Organisation for Economic Co-operation and Development (OECD) countries and countries with economies in transition; these countries have committed themselves to GHG emissions targets) to "aim" to stabilize emissions of carbon dioxide (CO_2) and other GHGs at their 1990 levels by 2000, the Kyoto Protocol goes further. It sets legally binding emissions targets and timetables for these countries. Together, Annex I countries must reduce their emissions of six GHGs by 5.2% below 1990 levels over the commitment period 2008–2012, with the European Union (E.U.), the United States, and Japan required to reduce their emissions of such gases by 8%, 7%, and 6% respectively. The protocol will become effective once it is ratified by at least 55 parties whose CO_2 emissions represent at least 55% of the total from Annex I parties in the year 1990.

Reflecting the underlying principle in Article 3.3 of the UNFCCC, which states "policies and measures to deal with climate change should be cost effective so as to ensure global benefits at the lowest possible cost," the Kyoto Protocol incorporates a variety of provisions for cooperative implementation mechanisms (see Box 1). It is generally acknowledged that the inclusion of cooperative implementation mechanisms in the protocol reflects an important decision to address climate change issues through flexible market mechanisms. Article 6 authorizes the transfer or acquisition of "emission reduction units" (ERUs) from joint implementation (J.I.) projects among Annex I parties. Article 12 establishes what is called the clean development mechanism (CDM). Through the mechanism, Annex I countries will be able to obtain the "certified emission reductions" (CERs) from jointly implemented projects with non-Annex I

countries (i.e. developing countries), and count them towards meeting their commitments under the Kyoto Protocol. Pushed by the U.S., the Kyoto Protocol also accepts the concept of emissions trading in principle, under which one Annex B (an annex to the Kyoto Protocol that lists the quantified emission limitation or reduction commitment per party) country or its sub-national entities (e.g. companies, nongovernmental organizations) would be allowed to purchase the rights to emit GHG from other Annex B countries or their regulated entities that are able to cut GHG emissions below their assigned amounts or their targets. Although Annex B to the Kyoto Protocol and Annex I to the UNFCCC are now slightly different numerically, this change from Annex I into Annex B potentially allows a developing country to engage in emissions trading if it voluntarily adopts an emissions target and is inscribed in Annex B. (By the end of 1999, only Argentina and Kazakstan of the Group of 77 and China had declared they would undertake a voluntary commitment to abate their GHG emissions.) Because the emissions trading proposal was adopted at the very end of the Kyoto negotiations, designing "the relevant principles, modalities, rules and guidelines" governing emissions trading has been deferred to subsequent conferences. One year later, after two weeks of intense debate at the fourth Conference of the Parties (COP) to the UNFCCC held in Buenos Aires in November 1998, delegates adopted the Buenos Aires Plan of Action, an ambitious two-year work program intended to make the Kyoto Protocol operative. According to the plan, decisions on rules governing cooperative implementation mechanisms, including emissions trading, were to be made in the year 2000 at the latest.

Article 4.1

Any Parties included in Annex I that have reached an agreement to fulfil their commitments under Article 3 jointly shall be deemed to have met those commitments provided that their total combined aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A do not exceed their assigned amounts calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B and in accordance with the provisions of Article 3. The respective emission level allocated to each of the Parties to the agreement shall be set out in that agreement.

Article 6.1

For the purpose of meeting its commitments under Article 3, any Party included in Annex I may transfer to, or acquire from, any other such Party emission reduction units resulting from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of greenhouse gases in any sector of the economy . . .

Article 12.2

The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3.

Article 17

The Conference of the Parties shall define the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading. The Parties included in Annex B may participate in emissions trading for the purpose of fulfilling their commitments under Article 3. Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under that Article.

Box 1. Mechanisms of cooperative implementation under the Kyoto Protocol (*Source*: *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (FCCC/CP/1997/L.7/Add.1) (Bonn: United Nations, 1997))

With the work program in place, attention has since focused on how an international GHG emissions trading scheme would work. The market-based emissions trading approach, pioneered in the U.S. sulfur dioxide (SO_2) allowance trading program, can achieve significant cost reductions in cutting GHG emissions while also allowing flexibility for reaching compliance only if it is structured effectively. This has motivated us to address a number of policy issues that, although far from comprehensive, must be considered in designing and implementing such a trading scheme. Taking environmental effectiveness, economic efficiency, equity, and political acceptability as the guiding principles of designing and implementing an emissions trading scheme, we discuss emissions trading models, the allocation of emissions permits and competitiveness concerns, banking and borrowing, the liability rules for non-compliance, and bubbles. These design and implementation issues are only partially on the climate negotiators' agenda but are very important because they are essential to the success of emissions trading. It seems unlikely that an international GHG emissions trading scheme will commence until these issues are seriously addressed. Although our focus is on emissions trading, we discuss its relationship with the CDM, J.I., and bubbles wherever necessary. By providing some new insights, this article aims to contribute to the design and implementation of an international emissions trading scheme.

First, however, we would like to emphasize that this discussion is based on, but is not limited to, the Kyoto Protocol. One obvious reason is that, as part of the overall climate policy debate, all the rules governing emissions trading still need to be established. So, we think that a broad discussion as presented in the article could provide more useful inputs to the ongoing process of moving to decisions on rules governing emissions trading. Therefore, our discussion is analytical in nature, although it intends as far as possible to enrich its policy relevance by considering some political aspects.

2. Emissions Trading Models

In principle, an emissions trading scheme could include all the GHGs under Annex A to the Kyoto Protocol. The comprehensive approach would provide maximum opportunity for trading to find those sources where the costs of abating GHGs are lowest, thus maximizing the cost savings. In practice, a workable emissions trading scheme requires that emissions of whatever pollutant is to be included have to be measured with

reasonable accuracy. This requirement implicitly precludes including all gases in the initial trading scheme. However, limiting trading to a subset of gases is not likely to be effective unless the protocol is further amended to partition the assigned amounts into two categories—tradable and non-tradable gases—with separate goals being assigned for each. Without a separation of categories, it seems to lack a legal basis to reject legitimate claims from those countries that use the flexibility inherent in the equivalence process to substitute freely among the gases, because Article 5.3 of the protocol has authorized that the global warming potentials be used to translate non-CO_2 GHGs into carbon equivalent units in determining each Annex I party's compliance with its assigned amounts.

2.1. Intergovernmental Emissions Trading Versus Inter-Source Trading

Once the coverage issue is set, emissions trading could take place on either an intergovernmental basis or an inter-source basis. Under intergovernmental trading, governments elect not to allocate the assigned amounts to sub-national entities, and retain the sole right to trade. Thus, intergovernmental emissions trading is on a government-to-government basis. The legal basis for such trading has been provided by Article 17, which unambiguously states that the parties in Annex B to the Kyoto Protocol are eligible for emissions trading. It should be pointed out that intergovernmental emissions trading differs from J.I. as specified in Article 6 of the Kyoto Protocol, for at least two reasons. First, intergovernmental emissions trading separates the issue of the financing from the source of generating allowances. By contrast, the initial ERUs to be transferred and acquired are always tied to specific J.I. projects, although ERUs could be incorporated into an international emissions trading scheme and afterwards be traded on the international market. Second, under normal conditions, no specific approval is needed to make the transactions under intergovernmental emissions trading, whereas any J.I. projects need the approval of both the host and investor Annex I countries. Moreover, intergovernmental emissions trading differs from the bubble approach as specified in Article 4 of the Kyoto Protocol. A bubble must be declared when the ratification is deposited. Once the terms of agreement have been registered with the UNFCCC secretariat, the commitments agreed on cannot be revisited during the commitment period. Therefore, the bubble approach could predetermine how much of a party's assigned amount can be transferred and acquired within the voluntarily formed group prior to the beginning of the commitment period, whereas intergovernmental emissions trading could take place at any time during the commitment period.

Under inter-source trading, governments elect to allocate the assigned amounts to individual sub-national entities, and authorize them to trade on the international emissions permits market. The great advantage over the first model is that it limits governments to setting the rules rather than undertaking emissions trading themselves, and leaves individual companies the freedom to choose how to comply with their limits. By incorporating sub-national entities into an international emissions trading scheme, the companies that actually have control over emissions would be able to profit directly from emissions reduction activities, thus providing them with strong incentives to exploit cost-effective abatement opportunities. This would potentially increase the total amount of transactions in the international scheme, meaning greater capital flows to

selling participants and greater cost reductions for buying participants. By increasing the number of trades, it would also improve market liquidity and reduce the potential for abuse of market power that might occur under intergovernmental trading if one country or bloc holds a significant proportion of the total number of permits. Moreover, in comparison with national governments, individual companies are in the best position to posses information about their emissions reduction options and the corresponding marginal cost and thus to determine their efficient emissions level. Although we argue here that sub-national legal entities are the best entities to trade emissions permits, it is important to bear in mind that there are some potential drawbacks of including private companies in the trading scheme. One is increased administrative complexity; another is that because inter-source trading would affect the assigned amounts of the parties, the parties might feel they have lost control over the level of their assigned amounts and thus their ability to meet their Kyoto obligations.

2.2. The Structure of National Emissions Trading Systems

If emissions trading among sub-national entities is authorized, the next issue is how these governments allocate the assigned amounts within their countries. The allocation of permits depends on the structure of national emissions trading systems. Such systems could be modeled as *upstream* or *downstream* or *hybrid* systems. An *upstream* trading system would target fossil fuel producers and importers as regulated entities, thereby reducing the number of permit holders to oil refineries and importers, natural gas pipelines, natural gas processing plants, coal mines, and processing plants. For example, if such a system were implemented in the U.S., the total number of permit holders would be restricted to about 1900, as shown in Table 1. Even with such a relatively small number of regulated sources, market power would not be an issue. In the above upstream system for the U.S., the largest firm has only a 5.6% market allowance share. Firms having less than 1% share each would hold the lion's share of allowances.

Industry	Point of regulation	Number of regulated entities
Oil	Refinery	175
Oil	Refined product importers	200
Natural gas	Pipeline	150
Natural gas liquids	Processing plant	725
Coal	Preparation plant	550
Coal	Mine	100*
Total		1900

* Of the approximately 2100 mines in the U.S., probably less than 100 would actually be required to hold permits. This is because mines would be required to hold permits only for coal not sent to preparation plants. This occurs at a relatively small number of mines, principally located in the west.

Table 1. Number of regulated entities in an upstream trading system in the U.S. (*Source*: T. Hargrave, *U.S. Carbon Emissions Trading: Description of an Upstream Approach* (Washington, D.C.: Center for Clear Air Policy, 1998))

Implemented effectively, an upstream system would capture virtually all fossil fuel use and carbon emissions in a national economy. Firms would raise fuel prices to offset the additional cost. In an upstream system relatively few firms have to be monitored for compliance, thus it is easier to administer. Moreover, the institutions for levying excises on fossil fuels that exist in most industrialized countries can be used to enforce the scheme. However, one of the drawbacks of an upstream system is that it provides no incentive for energy end users to develop disposal technologies, which is deemed critical in seeking long-term solutions to climate change. (Large-scale technologies for disposing of carbon are not yet economically available. This is why we currently regulate CO_2 emissions by limiting the use of fossil fuels, because there is a one-for-one relation between the carbon content of fossil fuels and the CO_2 emitted.)

In contrast, a *downstream* trading system would be applied at the point of emissions. A large number of diverse energy users are therefore included. This would offer greater competition and stimulate more robust trading, thus leading to increased innovation. However, such a system would be more difficult to administer, especially for emissions from the transport sector and other small sources. On the other hand, it would avoid the potential problem that some energy users do not respond to the price signal, which might occur in an upstream system because of market imperfections such as high transaction costs, high discount rates, and imperfect information, although the extent of responsiveness depends on the degree of competition and on whether price increases are actually passed on to consumers.

To keep a downstream trading system manageable, regulated sources could be limited to utilities and large industrial sources. Governments could then address uncapped sources through other regulatory means such as carbon taxes. In so doing, however, governments need to establish additional programs. This would be administratively burdensome because it would require the establishment of additional programs as well as a trading system; there would also be political difficulties in introducing carbon taxes in some countries. Moreover, the actual achievements in reductions of CO_2 emissions by a proposed carbon tax remain uncertain because of imperfect knowledge of the price elasticities of demand and supply for fossil fuels, especially for the large price increases caused by carbon taxes for major emissions cutbacks. This would put governments at risk of non-compliance with the emissions commitments. Furthermore, restricting trading to a subset of domestic emissions sources would pose serious efficiency and leakage problems. Alternatively, national trading systems could be modeled as *hybrid* systems. A hybrid system is similar to a downstream trading system in the sense that regulated sources at the levels of energy users are also limited to utilities and large industrial sources. On the other hand, like an upstream trading system, a hybrid system would require fuel distributors to hold permits for small fuel users and to pass on their permit costs in a mark-up on the fuel price. Small fuel users would thus be exempt from the necessity (and transaction costs) of holding permits. This would avoid the establishment of a large and costly reporting system for small users. Yet the rise in fuel price would motivate them to reduce fuel consumption or to switch from high-carbon fuels, such as coal, to low-carbon fuels, such as natural gas.

Finally, it should be pointed out that fossil fuels sold on the domestic markets are supplied by importers as well as by domestic producers. The provisions in the World

Trade Organization (WTO) do not allow unequal treatment of like products, be it domestic or foreign. In other words, imported products should be accorded no less favorable treatment than domestically produced products. So, no matter what national trading systems are adopted, domestic producers and importers of like products should be treated equally in obtaining emissions permits. Moreover, regardless of whether individual countries choose to empower inter-source trading, the ultimate responsibility for fulfilling the Kyoto Protocol commitments would remain with the national government as a party to the protocol.

3. The Initial Allocation of Permits and Competitiveness Concerns

The Kyoto Protocol has set caps on aggregate GHG emissions for Annex B countries. If emissions trading among sub-national entities is authorized, the next issue is how Annex B governments allocate the assigned amounts to sub-national entities within their countries. This decision is the first step towards trading among emissions sources as well as trading among countries. This raises concerns about competitiveness in the initial allocation of permits. This section examines whether there is a need to harmonize allocation of permits.

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Biographical Sketch

ZhongXiang Zhang is a senior economist with the East-West Center, Honolulu, USA; an adjunct professor of economics at both the Chinese Academy of Social Sciences, Beijing, PRC, and Peking University, Beijing, PRC; and an affiliate professor of economics at the University of Hawaii at Manoa. The author of numerous articles in a wide variety of international outlets in the fields of energy and environmental economics, trade and the environment, public finance, and macroeconomic modelling, Professor Zhang has also authored *The Economics of Energy Policy in China: Implications for Global Climate Change* (Edward Elgar, 1998) and co-authored *International Rules for Greenhouse Gas Emissions Trading* (United Nations, 1999). Currently, he is serving on the editorial boards of seven international journals (*Climate Policy*; *Energy Policy*; *Energy and Environment*; *Environmental Management and Policy*; *Environmental Science and Policy*; *International Environmental Agreements*; and *Mitigation and Adaptation Strategies for Global Change*) and one Chinese journal. He has served as an expert/consultant to many national and international organizations, including UNCTAD, UNDP, UNEP, OECD, ADB, IPCC, CEC, and WRI. He has been included in Marquis *Who's Who in Science and Engineering* and *Who's Who in the World*. He received a B.S. and an M.S. in energy engineering and systems analysis from Tianjin University (the oldest Chinese university), and a Ph.D. in economics from Wageningen University, The Netherlands. Professor Zhang's previous affiliations include visiting fellow, Pennsylvania State University at University Park and Stanford University; senior fellow, Faculty of Economics and Faculty of Law, University of Groningen, The Netherlands; research fellow, Department of Economics, Wageningen University, The Netherlands; research fellow, Policy Studies Department, Netherlands Energy Research Foundation; and researcher, Energy Research Institute, State Development and Reform Commission, Beijing, PRC.