



Munich Personal RePEc Archive

Towards a successful international greenhouse gas emissions trading

Zhang, ZhongXiang

University of Groningen, The Netherlands

July 1998

Online at <https://mpra.ub.uni-muenchen.de/13023/>

MPRA Paper No. 13023, posted 27 Jan 2009 10:17 UTC

July 1998

Towards a Successful International Greenhouse Gas Emissions Trading

ZhongXiang Zhang

Faculty of Law and Faculty of Economics

University of Groningen

P.O. Box 716

9700 AS Groningen

The Netherlands

Tel: +31 50 3636882

Fax: +31 50 3637101

Email: Z.X.Zhang@Rechten.RUG.NL

Abstract - The inclusion of emissions trading in the Kyoto Protocol reflects an important decision to address climate change issues through flexible market mechanisms. In this paper, we have addressed a number of policy issues that must be considered in designing and implementing an international greenhouse gas (GHG) emissions trading scheme. These include how much of a Party's assigned amounts of GHG emissions can be traded internationally; emissions trading models; competitiveness concern in the allocation of emissions permits; banking and borrowing; accountability; emissions trading system enlargement; and bubbles. Although our focus has been exclusively on emissions trading, we have discussed its relationship with the clean development mechanism, joint implementation and bubbles wherever necessary. By providing some new insights, the paper aims to contribute to the design and operationlization of an international emissions trading scheme.

Keywords: Bubbles, carbon tax, clean development mechanism, emissions trading, greenhouse gases, international competitiveness, joint implementation, Kyoto Protocol.

JEL Classification: Q25, Q28, Q48

1. Introduction

In Kyoto in December 1997, 160 countries reached a historical agreement on limiting greenhouse gas emissions. In comparison with the United Nations Framework Convention on Climate Change (UNFCCC) at the Earth Summit in June 1992 that only committed Annex I countries to “aim” to stabilize emissions of carbon dioxide (CO₂) and other greenhouse gases at their 1990 levels by 2000, the so-called Kyoto Protocol sets legally binding emissions targets and timetables for these countries. Together, they must reduce their emissions of six greenhouse gases by at least 5% below 1990 levels over the commitment period 2008-2012, with the European Union, US and Japan required to reduce their emissions of such gases by 8%, 7% and 6% respectively (UNFCCC, 1997). This Protocol will become effective once it is ratified by at least 55 parties representing at least 55% of the total CO₂ emissions of Annex I Parties in the year 1990.

As a reflection of the underlying principles 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 has incorporated 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 (JI) projects among Annex I Parties while Article 12 establishes the so-called “clean development mechanism” (CDM) through which Annex I countries can obtain the “certified emission reductions” (CERs) from JI projects with non-Annex I countries. Pushed by the US, the Kyoto Protocol also accepts the concept of emissions trading in principle under which one Annex B country will be allowed to purchase the rights to emit greenhouse gases (GHG) from other Annex B countries that are able to cut GHG emissions below their assigned amounts (i.e. their targets). Although Annex B to the Kyoto Protocol and Annex I to the UNFCCC are now identical in nature, 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. 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. No doubt, such design of a workable emissions trading scheme is essential to the success of emissions trading. The market-based emissions trading approach, pioneered in the US Acid Rain Program (cf. Ellerman *et al.*, 1997), can achieve significant cost reductions in cutting GHG emissions while also allowing flexibility for reaching compliance only if it is structured effectively.

Box 1: Mechanisms of Cooperative Implementation under the Kyoto Protocol

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.”

Source: UNFCCC (1997).

In this paper, we address a number of policy issues that, although far from comprehensive, must be considered in designing and implementing an international GHG emissions trading scheme.² These include how much of a Party’s assigned amounts of GHG emissions can be traded internationally; emissions trading models; competitiveness concern in the allocation of emissions permits; banking and borrowing; accountability; emissions trading system enlargement; and bubbles. Although our focus is exclusively on emissions trading, we discuss its relationship with the CDM, JI and bubbles wherever necessary. By providing some new insights, the paper aims to contribute to the design and operationlization of an international emissions trading scheme.

2. How Much Can Be Traded Internationally?

How much of a Party's assigned amounts of greenhouse gas emissions can be traded internationally is a very important issue in the current international debate on emissions trading. In accordance with Article 17 of the Kyoto Protocol that specifies that emissions trading "be supplemental to domestic actions", some countries have called for imposing a percentage limitation on the use of international emissions trading to meet one Annex I Party's Kyoto commitments (cf. United Kingdom, 1998).

Restricting trades interferes with the operation of an inter-source trading market. If Annex B governments elect to allocate the assigned amounts to individual sub-national legal entities and authorize them to trade on the international emissions permits market, no country would know up-front what a percentage of its obligations would have been fulfilled via emissions trading unless all transactions require to be pre-approved by the government or the endorsed agency. In the latter case, no legal entity is guaranteed up-front whether its transactions fall below the national threshold, although the government is sure that its allowed percentage limitation on the use of emissions trading is met. Clearly, this rule would raise transaction costs and inhibit trades, which would limit the effectiveness of emissions trading. Moreover, because the fundamental integrity of the Kyoto Protocol relies on the accountability of a Party for ultimately matching its actual GHG emissions with its assigned amounts, this approach to compliance explicitly suggests that no one means of meeting the emissions commitments is superior to, or more valid than, any others, provided that actual reductions in GHG emissions occur (Environmental Defense Fund, 1998).

It is important to bear in mind that incorporating the provision for trading to be supplemental to domestic actions was to prevent the trading in the "hot air" and to provide the incentive for technical innovation.³ Imposing a general restriction to solve a limited concern runs the risk of throwing out the baby with the bath water. A ceiling on trading on the fixed, arbitrary and once-for-all basis proposes a permanent solution to a transition problem. Moreover, setting a ceiling makes it even more difficult to set stringent emissions targets for the subsequent commitment periods beyond 2012. It is the lack of the post-2012 targets that restricts the choice of the compliance mechanisms and tools and that creates some divergence of views in assigning liability.

Instead of imposing a percentage limitation on the use of emissions trading, one possible resolution to the "hot air" concern would be to require the Parties to demonstrate adequate domestic actions according to

a set of criteria against which such actions can be measured. Such criteria should be defined by the Conference of the Parties. Unlike a ceiling on trading, this option refers to process rather than to outcomes.

Another option involves imposing a transaction tax on trades involving “taxable” allowances, with the tax rate to be set by the Conference of the Parties (Zhang, 1998). Such a tax could be imposed only on the buyer side and could differ to reflect the direction of emissions trading flows, with zero or low rate for transactions within the advanced OECD countries themselves but high rate for transactions between them and countries with economies in transition. In order to prevent countries from attracting more trades by setting even lower transaction tax rate, the low rate should be uniformly imposed on trading within the OECD countries, and the high rate on those transactions with non-OECD countries. Moreover, the differentiated rate could become the uniform rate until the trading in the “hot air” would not be a big issue anymore.

Such a transaction tax should be internationally imposed but nationally administrated and collected by buyer countries. Buyer countries could use the proceeds from such a tax to strength their research, development and diffusion of low-cost climate friendly technologies, to subsidize transfer of such technologies to non-Annex I countries, or to buy and retire a portion of their allowed emissions permits from the market. They could also be used to retire the “hot air”.

Although imposing a transaction tax raises the cost of meeting their allowed emissions limits, it is much less trade-restrictive than imposing a percentage limitation on the use of emissions trading, because legal entities avoid the risk of being bumped over the national threshold. It alleviates to some extent the concern about the “hot air” trading, because legal entities in the advanced OECD countries face higher transaction tax rate when engaging in trading with their counterparts in other Annex I countries. It also provides the incentive to search for cleaner technologies, particularly when the proceeds from such tax are used as buyer countries’ R&D investments in climate friendly technologies and as their payments for buying and retiring a portion of their allowed emissions permits from the market.

Finally, it should be pointed out that a transaction tax differs from a carbon tax. A carbon tax is a mandatory tax for firms emitting carbon emissions. Therefore, it is expected that there are the great political difficulties of introducing such a tax in some countries. In contrast, a transaction tax leaves firms the freedom to determine how to meet their emissions limits. Firms that elect to meet their emissions limits only by taking domestic actions have no obligations to pay such a tax.

3. Emissions Trading Models

In terms of whether sub-national entities are eligible for trading, two types of emissions trading models can be distinguished: 1) Inter-governmental emissions trading; and 2) Inter-source trading.

In the first model, governments elect not to allocate the assigned amounts to sub-national entities, and retain the sole right to trade. As such, inter-governmental emissions trading takes place on a government-to-government basis. The legal basis for such trading has been provided by Article 17, which unambiguously states that the Parties included in Annex B to the Kyoto Protocol are eligible for emissions trading. It should be pointed out that inter-governmental emissions trading differs from joint implementation (JI) as specified in Article 6 of the Kyoto Protocol, at least for two reasons. First, inter-governmental emissions trading separates the issue of the financing from the source of generating allowances, whereas ERUs to be transferred and acquired are always tied with specific JI projects. Second, under normal conditions, no specific approval is needed to take the transactions in inter-governmental emissions trading, whereas any JI projects need the approval of both the host and investor Annex I countries. Moreover, inter-governmental emissions trading differs from the “bubble” approach as specified in Article 4 of the Kyoto Protocol because the latter pre-determines the transfers and acquisitions of assigned amounts within the voluntarily-formed group prior to the beginning of the commitment period.

In the second model, 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 the 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. The latter might occur in inter-governmental trading if one country or bloc holds a significant proportion of the total number of permits. Moreover, individual companies which have information on their technical options and costs can choose their efficient emissions level by comparing marginal costs and the international permit price, whereas, in the inter-governmental trading model, national governments can make errors in their decisions of how many permits to buy or sell because they possess only global and imprecise information about greenhouse gas emission reduction options and their marginal cost.⁴

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 modelled as either “*upstream*” or “*downstream*” or “*hybrid*” systems (Zhang, 1998). An “*upstream*” trading system would target fossil fuel producers and importers as regulated entities, so would reduce number of allowance holders to oil refineries and importers, gas pipelines, LNG plants, coal mines and processing plants (Hargrave, 1998). For example, if such a system would be implemented in the US, the total number of allowance 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 US, the largest firm has only a 5.6 percent market allowance share. Firms, with each having less than one percent share, would hold the lion’s share of allowances (Cramton and Kerr, 1998).

Table 1 Number of Regulated Entities in an Upstream Trading System in the US

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

* Although there are approximately 2100 mines in the US, the number of mines actually required to hold allowance probably would be less than 100. This is because mines would be required to hold allowances only for coal not sent to preparation plants. This occurs at a relatively small number of mines, principally located in the West.

Source: Hargrave (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 the number of firms that has to be monitored for compliance is relatively small, thus it is easier to administer. Moreover, existing institutions for levying excises on fossil fuels, which exist in most industrialized countries, can be used to enforce the scheme (Zhang and Nentjes, 1998). However, one of the drawbacks of an upstream system is that it provides no incentive for energy end-users to develop disposal technologies, the aspect that is deemed critical in searching the long-term solutions to solving climate change problems.

In contrast, a “*downstream*” trading system would be applied at the point of emissions. As such, a large number of diverse energy users are 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 concerning emissions from the transportation sector and other small sources. On the other hand, it would avoid 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 depends on the degree of competition and price elasticities whether price increases are actually passed on to the consumers (U.S. Office of the President, 1998).

To keep a downstream trading system at a manageable level, 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 doing so, however, the governments need to establish additional

programs. This would be administratively burdensome, let alone the political difficulties of introducing carbon taxes in some countries. Moreover, the actual achievements in reductions of CO₂ 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 (Cline, 1992). This would put the governments at risk of non-compliance with the emissions commitments.

Alternatively, national trading systems could be modelled as “*hybrid*” systems (Zhang and Nentjes, 1998). 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 allowances for small fuel users and to pass on their permit costs in a mark-up on the fuel price. As such, small fuel users are exempted from the necessity (and transaction costs) of holding allowances. Yet the rise in fuel price will motivate them to reduce fuel consumption or to switch from fuels with a high carbon content, such as coal, to fuels with a low carbon content such as natural gas.

No matter what national trading systems are adopted, importers and domestic producers of fossil fuels should be treated equally in obtaining emissions permits under the “like product” provisions in the World Trade Organization (WTO) (Zhang, 1998). Moreover, regardless of whether individual countries choose to empower private trading, the ultimate responsibility for fulfilling the Kyoto Protocol commitments would, however, remain with the national government as a Party to the Protocol.

4. Competitiveness Concern in the Allocation of Permits

The Kyoto Protocol has set the caps on aggregate GHG emissions for Annex I countries. 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 process itself represents the establishment and distribution of private property rights over emissions, and itself lies outside the mandate of the WTO (Vaughan, 1997). Given the great concern about international competitiveness, however, the allocation of permits does have the potential to bring parties into conflict with the WTO provisions. Some fear, for

example, that governments could allocate the permits in such a manner to favour domestic firms against foreign rivals. This will violate the WTO principle of non-discrimination. The allocation of permits could also be designed in such a manner to advantage certain sectors over others and further enhance their existing imperfect market competition. This makes the unequal treatment explicit, which can be much easier hidden from the general public if the conventional command-and-control regulations are used. This in turn will have a similar price distortion effect as a subsidy, and would be in conflict with the WTO rules that prohibit the use of export subsidies for such a purpose. All this clearly indicates that the manner in which countries allocate their assigned amounts should be compatible with these WTO principles and should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.⁵

However, it should be pointed out that although grandfathering is thought of as giving implicit subsidies to some sectors, grandfathering is less trade-distorted than the exemptions from carbon taxes. To understand their difference, it is important to bear in mind that grandfathering itself also implies an opportunity cost for firms receiving permits: what matters here is not how you get your permits, but what you can sell them for - that is what determines opportunity cost. Thus, relative prices of products will not be that distorted and switching of demands towards products of those firms whose permits are awarded gratis (the so-called substitution effect) not be induced by grandfathering. This makes grandfathering different from the exemptions from carbon taxes. In the latter case, there exist substitution effects. For example, the Commission of the European Communities (CEC) proposal for a mixed carbon and energy tax provides for exemptions for the six energy-intensive industries (i.e., iron and steel, non-ferrous metals, chemicals, cement, glass, and pulp and paper) from coverage of the CEC tax on grounds of competitiveness. This not only reduces the effectiveness of the CEC tax in achieving its objective of reducing CO₂ emissions, but also makes the industries which are exempt from paying the CEC tax to improve their competitive position in relation to those industries which are not. There will therefore be some switching of demand towards the products of these energy-intensive industries, which is precisely the reaction that such a tax should avoid (Zhang, 1997).

With the great concern that a government that grandfathers permits to a domestic firm could give it a competitive advantage over similar firm in another country where permits are not awarded gratis, some thought that there is the need for the harmonisation of allocation of permits. However, we think that individual governments should be left free to devise their own ways of allocating permits on the following grounds. First,

we think this is not necessarily the case, because even if a firm obtains emissions permits by auction, if necessary, its government still can protect its international competitiveness by means of recycling the revenues raised through auctioned permits to lower other pre-existing distortionary taxes, such as taxes on labour and capital.

Second, although auctioning at least part of the assigned amounts to sub-national legal entities alleviates to some extent the concern about international competitiveness, any attempts to produce an agreement on a common rate are likely to run into concerns about national sovereignty and thus would encounter significant political. Take the above CEC proposal for a carbon/energy tax as an example. National sovereignty considerations to some extent explain why the CEC proposal for a carbon/energy tax failed to gain the unanimous support of its member states, partly because some member states opposed an increase in the fiscal competence of the Community and thus opposed the introduction at a European level of a new tax on grounds of fiscal sovereignty (Bill, 1997). This failure is also because some member states are loath to restrict themselves to the common CEC-specified policy and measure design to stabilise CO₂ emission and way how to do it.

Third, given great differences in national circumstances, setting a uniform rule of allocation will restrict the rights of individual governments to select the option which is best suited to their own national circumstances. With second-best considerations, it is conceivable that some countries whose economies are heavily distorted would decide to auction permits, and that the revenues generated through auctioned permits can then be used to reduce pre-existing distortionary taxes, thus generating overall efficiency gains. Parry *et al.* (1997), for example, show that the costs of reducing US carbon emissions by 10% are four times more costly under a grandfathered carbon permits case than under an auctioned case. This disadvantage reflects the inability to make use of the revenue-recycling effect in the former case.

Fourth and importantly, leaving individual governments the freedom to devise their own ways of allocating assigned amounts to sub-national entities would ensure that any individual government maintains its right to determine the domestic policies and measures that would be taken to meet its Kyoto obligations. For example, a government that wants to use taxes or regulations for domestic emissions control could retain the sole right to trade. Alternatively, a government could allocate its assigned amounts to private entities to trade.

5. Banking and Borrowing

Banking offers a greater degree of intertemporal flexibility, thus lowering the cost of abating GHG emissions. There has been heavy use of banking in the US Acid Rain Program (cf. Ellerman *et al.*, 1997), which has led to early reductions and substantially lower overall costs of compliance.

In an international GHG emissions trading scheme, three types of banking can be distinguished. The first type of banking has been built into Article 12.10 of the Kyoto Protocol. It specifies that CERs obtained under the CDM during the period 2000-2008 can be banked for later use in meeting Annex I country's commitments during the first commitment period 2008-2012. This banking clause provides the incentive for private firms in Annex I countries to invest in emissions reductions in developing countries prior to the beginning of the first commitment period.

The second type is similar to the banking element built in the US Acid Rain Program. Once an emissions trading scheme, either domestic or international, is established among Annex B countries, permit holders are allowed to bank their unused permits to offset future emissions or to sell them to others. If property rights to permits during the commitment period are well defined, banking would encourage permit holders to go further with reducing emissions than their required emission limits in early years if it were more cost-effective for them to do so.

The third type of banking extends the second mechanism by including emissions reductions achieved within the jurisdiction of Annex I countries prior to the beginning of the first commitment period as well. In comparison with the first type of banking under the CDM, it also provides a similar incentive for private firms within Annex I countries to take early actions at home rather than shop around abroad. Currently, the type of banking has not been an option under the Kyoto provisions but warrants special attention. We propose that potential use of the option is contingent on the following two conditions. The first is conditional on ratification of the Kyoto Protocol (Kopp *et al.*, 1998). The option might only be authorized from the year in which the Protocol is ratified onwards. This would provide a strong incentive for Annex I countries to ratify the Protocol earlier than what otherwise would be the case. The second is conditioned on the stringency of overall assigned amounts of emissions. The countries that are supposed to sell the "hot air" should be not allowed to use the

option. Thus, it alleviates to some extent the concern about the “hot air” trading, because it provides the incentive for legal entities in the advanced OECD countries to take abatement actions at home. If authorized, the option will accelerate the process of implementing a domestic emissions trading scheme by dealing with all technical issues associated with it. However, triggering the green light for the option requires amendment to the Kyoto Protocol because the total emissions of one Annex I country during the commitment period will exceed its assigned amounts if pre-2008 emissions reductions banked are awarded to offset the post-2008 emissions targets. If such an amendment were made, the next question is that those countries that are eligible for pursuing the option have to negotiate internationally accepted national baselines for the pre-2008 period. As the negotiations leading up to the Kyoto targets have shown, this task will not be that easy.

An alternative option to allow the banking of Annex I country’s own early reductions is that any credits one Annex I country awards its sub-national legal entities for pre-2008 reductions are drawn from the assigned amounts of the country in question. On the one hand, this option would give these “first-movers” a competitive advantage over those not undertaking early actions (Environmental Defense Fund, 1998). On the other hand, since the credits awarded to early movers would be otherwise allocated to those entities not undertaking early actions, with limited supply of early credits, the option amounts to government encourage of uneconomic rent-seeking (Fischer *et al.*, 1998).

No matter what degree of flexibility is allowed in banking, governments should not confiscate banked permits even if the latest scientific evidence suggests that further emission reductions are necessary. A more acceptable approach would be to reduce the issue of new permits proportionally from the year for which the stricter emissions cap applies. This suggests that an emissions trading scheme would have to be designed from the outset to be flexible enough to facilitate any changes that might be required in the overall emission limits.

If an Annex I country starts with a very strict limit on GHG emissions, bottlenecks could be prevented by allowing the borrowing of a limited amount of future permits provided that a premium is paid. By taking into account the turnover of capital stock, the prospect for low-carbon or carbon-free backstop technologies, and time discounting, borrowing would allow total abatement costs to be minimised while keeping to an overall emissions budget. Therefore, as with banking, borrowing is another way to increase flexibility and lower the cost of abating GHG emissions (Richels *et al.*, 1996).

Although banking is relatively uncontroversial, borrowing is much more controversial (cf. Matsuo, 1997; Mullins and Baron, 1997; Zhang and Nentjes, 1998). Opponents fear that borrowing would make it more difficult to check whether emission sources are in compliance with their emission limits. If borrowing is allowed, firms facing bankruptcy have an incentive to borrow without being able to meet their future commitments. Borrowing could conceivably even discourage trading among individual emission sources, thus reducing market liquidity. Borrowing could also undermine the incentive to search for cleaner technologies. To some extent, the delayed response will mean additional committed warming.

In case the Conference of the Parties deems it desirable to allow some but not complete borrowing, some safeguards could be developed to allow borrowing in such a way that it does not undermine the environmental objectives. Such safeguards could include:

- limiting the contribution of borrowing to meeting an emission target;
- restricting borrowed permits to own use, rather than sale to others;
- restricting borrowing to special circumstances, such as insufficient availability of allowances on the international market;
- making borrowing of the allowance contingent on the stringency of overall emission limits (perhaps postponing its adoption until more stringent limits for the subsequent commitment periods are agreed). In any case, borrowing should not be allowed for the countries that are supposed to sell the “hot air”; and
- restricting how far into the future permits can be borrowed. For example, borrowing in the current period should not go beyond the subsequent commitment period.

6. The Rules for Accountability

The question of which Party - the buyer, the seller or both - is liable for non-compliance by the seller who over-sells its permits and then fails to comply with its commitments is one of the most important issues in designing a workable emissions trading scheme. Article 6 of the Kyoto Protocol allows Annex I countries to transfer to, or acquire from each other, ERUs resulting from JI abatement projects, but rules governing such

transfers and acquisitions as well as emissions trading have not been defined. No matter how emissions trading takes place on a government-to-government basis or on a fully-fledged emissions market, such rules are essential to the success of emissions trading.

In addressing essential design features underling the transfers and acquisitions of allowances, we begin with Article 6.4. Under the Article, if one Annex I country is found non-compliance with the relevant provisions of Article 8, any ERUs acquired by the buyer country can not be used to meet its commitments under Article 3 until the question of compliance by the seller country is resolved. Put another way, Article 6.4 specifies in vague terms that the buyer country is only at risk if the question is raised regarding the seller country' compliance with reporting provisions, but does not hint anything suggesting that such ERUs acquired by the buyer country would be invalidated. So some observers think that Article 6.4 implicitly means that trading ERUs rests on the so-called "seller beware" liability (Rolfe, 1998). Under a "seller beware" regime, any ERUs or allowances acquired by the buyer is valid regardless of whether the seller is in compliance with its commitments under the Protocol. Because buyers bear no risk under the "seller beware" liability, they are more likely to become active in the market. This would stimulate the development of a more robust trading market. This is essential to the successful function of emissions trading, particularly in the initial start-up stage when few potential buyers, if any, have any trading experiences.

"Seller beware" works well in domestic emissions trading scheme, such as the US Acid Rain Program whose built-in effective enforcement mechanisms make non-compliance very expensive and unattractive. However, an international "seller beware" trading scheme will be problematic, given the fact that enforcement at the international level often proves to be more difficult and less likely to be effective than at the national level because of the absence of an institution with the international jurisdiction to enforce policy. As such, the "seller beware" liability could lead to a regime of weak compliance because the lack of strong enforcement at the international level would provide few disincentive for buyers to acquire from sellers who take a lax attitude to compliance.

To remove the built-in flaws, one option is to use eligibility to trade as an enforcement mechanism. The approach assumes that trading is a privilege, not a right. Initially, trading is only allowed to those "eligible" parties whose domestic monitoring and enforcement systems have met certain "minimum quality" criteria (Zhang and Nentjes, 1998). By precluding those Annex B countries that do not meet the criteria from

engaging in emissions trading until such time as they bring their domestic monitoring and enforcement systems up to the threshold eligible for trading, the eligibility criteria would ensure that there is no significant risk to buyers. Therefore buyers are more likely to become active in the market. The more stringent are the criteria, the greater is the assurance that traded tons of emissions represent real reductions, and hence the less risk there is to buyers. From the environmental perspective, the more stringent criteria are preferred. On the other hand, this would lead to reduced scope of participation in the trading market than do the less stringent ones, thus undermining the effectiveness of emissions trading in lowering the cost of abating GHG emissions. Clearly, a compromise needs to be reached between the desirability of assigning the seller responsibility for the validity of acquired allowances and the “appropriate” eligibility threshold.

Another option to assign the responsibility for the validity of acquired allowances could rest on the so-called “buyer beware” liability. The principle stipulates that the buyer, be it a country or a firm, is liable for non-compliance by the sellers. In this case, the allowances acquired by the buyers become invalidated or are discounted if the sellers are found not in compliance with their commitments. This would provide the strong incentive for risk-averse buyers to ensure that any allowances acquired are valid.

If, at the end of the commitment period, it turns out that the seller has exceeded its assigned amounts, then the allowances acquired by the buyers could either be discounted in proportion to the degree of the seller’s overage or become invalidated on a “last-in, first out” (LIFO) basis. Operationalization of the LIFO system entails certain vintage of allowances so that the last allowances acquired could be identified. In so doing, the Parties that wished to trade are required to serialize their allowances at least by their country of origin and year of origin, with the transfers and acquisitions of allowances being mandated to start with lower numbers. In the event of non-compliance by the seller, the acquired allowances to be voided is on the basis of the last that has acquired would be the first to become voided. The process of taking back the seller’s overage continues until the seller is brought into compliance. The LIFO approach is preferred to the simple discounting approach because the former can distinguish buyers who acquire allowances from sellers when no implementation problems are on the horizon from those buyers who do so when serious implementation problems have arisen in the seller country (Goldberg *et al.*, 1998). It also corrects the serious drawback of discounting that is unable to decide who, all buyers or just the marginal buyer, is liable for non-compliance by the seller whose allowances are sold to several countries.

However, one drawback of including a “buyer beware” liability is that the allowances are not fungible, with each one representing a unit with reference to the country where it originated. This might complicate the transfer and acquisition process and could add substantial transaction costs. With modern information technology, however, a regime of the “buyer beware” liability is probably not as complicated as it sounds. Another major drawback of assigning a “buyer beware” liability is that it erodes the commodity nature of allowances by allowing them to be retroactively devalued, thus creating uncertainty over their value until the end of commitment period. This drawback becomes even more serious because in this Protocol there is only one very long commitment period. The long length means that compliance is not determined until the end of the commitment period because, in principle, both the seller and buyer responsibility regimes do not require any interim evaluation of implementation before the end of the commitment period. As a result, we know whether the seller is in compliance only at the end of the commitment period. At that time, it might be too late to bring the seller back into compliance, although a “true-up” period of several months at the end of the commitment period is allowed for the seller finding itself in non-compliance to acquire additional allowances to cover its excess tons of emissions.

To prevent that unwanted outcomes from an early date, it is desirable to assign the buyer-seller hybrid responsibility by introducing a process of evaluating Parties’ efforts towards implementation during the commitment period. This includes annual reporting of the progress of each Party in meeting its assigned amounts. If in a given year a Party’s actual emissions did not exceed by a certain margin its annualized assigned amounts, the seller’s tons acquired by the buyers would be valid. After the year when the seller is found to go beyond that tolerance margin, however, the buyers become liable for potential non-compliance by the seller. As such, the allowances acquired prior to that year would not be discounted, thus avoiding the imposition of retroactive liability for the buyer.

Article 12 provides that Annex I countries can acquire the certified credits obtained from joint implementation abatement projects with developing countries under the CDM. In view of this, some suggest that the transfers and acquisitions of allowances in an international emissions trading scheme could be envisioned along this line. Any extra allowances to be sold first have to be verified and certified prior to trading. In comparison with the pre-verification trading scheme, the post-verification one would increase certainty surrounding the validity of acquired allowances. In the mean time, however, it could significantly

reduce the volume of trades, particularly in the multi-year compliance system in which transfers and acquisitions of allowances are expected to take place when it is approaching the end of the commitment period. It is presumably assumed that the concern about the validity of acquired allowances prevails at the beginning of setting up an international emissions trading scheme. So the post-verification trading scheme, although not the first-best choice, could be considered in the first commitment period in case there are a large of countries sceptical about the accountability of a pre-verification trading scheme. Whether it continues or using other options to ensure certainty over the validity of acquired allowances could be reviewed at the end of that period. In any case, only certified credits from joint implementation projects with developing countries can be incorporated into an international emissions trading scheme.

7. Emissions Trading System Enlargement

Given the fact that the costs of abating GHG emissions differ significantly among countries and there are a great deal of low-cost abatement options in developing countries (cf. IPCC, 1996), it is generally acknowledged that broadening an international emissions trading scheme to include developing countries creates a source of obtaining low-cost abatement options, thus increasing potential of efficiency gains. This is one of the reasons why some OECD countries insist on bringing non-Annex I countries into an emissions trading scheme. On the other hand, Russia, the country widely regarded as the biggest seller of emissions permits among Annex I countries once emissions trading takes place, would not welcome the addition of non-Annex I countries, such as China and India, to the scheme because these new entrants would raise the supply of overall permits on the market and depress the prices of those permits held by Russia. Although these are just political speculations, they underline the importance to establish clear rules of procedure about admitting new entrants before emissions trading begins.

There are two avenues to establish such rules of procedure. One is based on voting to admit new entrants. So far any decisions made by the Conference of the Parties to the UNFCCC have been generally adopted by consensus. If admitting new entrants requires unanimous assent by all current Annex B countries eligible for emissions trading, this confers on Russia a *de facto* power of veto. Thus, if avenue to admit new

entrants rests on voting, a three-fourth majority vote of the current Annex B countries present and voting at the meeting could be adopted to prevent exploitation of market power.

The second avenue rests on automatic phase-in once one prospective country meets pre-determined criteria. In our view, the second is superior to the first avenue. Such criteria should include the conditions under which any new entrant could be incorporated into the emissions trading scheme. Once such criteria are set, they should remain stable in the short-run, although in the long-run adjustments in the criteria might be normal as greater information and experience is gained.

By the same token, broadening an emissions trading scheme to cover all greenhouse gases under Annex A to the Kyoto Protocol increases the cost savings. On the other hand, a workable emissions trading scheme requires that emissions of whatever a pollutant 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 be lack of a legal basis to reject the legitimate claim 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 are used to translate non-CO₂ greenhouse gases into carbon equivalent units in determining each Annex I Party's compliance with its assigned amounts.

8. Bubbles

In addition to Article 17, on the insistence of the EU, the Kyoto Protocol incorporates the “bubble” concept into the final text (Article 4). It allows a group of Annex I countries to jointly fulfil their commitments under Article 3, provided that their total combined aggregate GHG emissions do not exceed their assigned amounts. The “bubble” approach is often termed as “trading without rules” because it sets few restrictions on trading between Parties. This makes it a potentially attractive instrument. Given great differences in environmental monitoring and enforcement infrastructures among Annex I countries, if it turns out to be too difficult to agree

on the common rules and guidelines for a full-fledged emissions trading scheme, the “bubble” approach at least opens the possibility of trading emissions permits within the voluntarily-formed group. In addition to the current EU bubble, the US has reached a conceptual agreement with Australia, Canada, Japan, New Zealand, Russia and Ukraine to pursue an umbrella group to trade emissions permits (USDOS, 1998). However, the approach presents some drawbacks. First, it requires to set a cap on overall emissions for the group as a whole and to work out a specific cap for each member country within the group in an agreement, the terms of which must be notified to the UNFCCC Secretariat at the time of ratification of the Protocol. Once the agreement has been registered with the Secretariat, the commitments agreed on cannot be revisited during the commitment period in question.

Second, it narrows the scope of efficiency gains in comparison with inter-source trading, because it restricts where firms or countries comply with their caps and because it is likely to have frightening transaction costs.

Third, in the case of the current EU bubble, because the European Community (EC) itself as a Party to the Protocol, in addition to its member states, has the legitimate responsibility for reporting on the performance of the EU as a whole and ensuring its declared targets as a whole under the notified agreement are met, the potential advantages of offering double coverage of reporting obligations and double assurance for abatement obligations could be hindered by the need to have complete and early information from individual member states (OECD, 1998). In the event that the EC as a whole would fail to meet its own targets and if a non-compliance procedure would be established, the EC, together with those individual member states that have not achieved their own targets set out in the agreement, would thus be faced with sanctions under Article 4.6. In this case, who bears the responsibility of the EC itself? As such, some clarification for the clear division of responsibility in the terms of that agreement is needed in the case where a regional economic integration organization itself is a party to the Protocol.

Fourth, although originally conceived as a way of allowing the EC as a regional economic integration organization (REIO) to accommodate the internal burden sharing of the Kyoto commitments among its member states, the final wording under Article 4 is framed in general terms. This might create potential loopholes in meeting the Kyoto obligations. In the case of a REIO bubble, each REIO member and the organization itself are held accountable for the failure to achieve the required reductions for the REIO

member. Under the terms of the agreement notified to the UNFCCC Secretariat, the incentive for non-compliance is offset by the joint responsibility of both the individual members and the regional organization. In contrast, in the case of a non-REIO bubble, the absence of a formal regional organization with enforcement powers means that the seller countries are solely responsible for their own non-compliance. As discussed in Article 17 trading, these countries may have an incentive to fall short of compliance. To ensure the environmental integrity of the Kyoto Protocol, it is thus desirable to assign some form of joint responsibility for non-REIO bubbles too. However, the countries concerned within a non-REIO bubble should be left free to work out an arrangement to bring the whole group into compliance.⁶

9. Concluding Remarks

The Kyoto Protocol is the first international environmental agreement that sets legally binding GHG emissions targets and timetables for Annex I countries. Its Article 17 authorizes emissions trading between Annex B countries. If properly designed, emissions trading can effectively reduce their abatement costs while assisting Annex I countries in achieving their Kyoto obligations.

Aimed at contributing to the design and operationization of an international GHG emissions trading scheme, this paper has discussed how much of a Party's assigned amounts of GHG emissions can be traded internationally; emissions trading models; competitiveness concern in the allocation of emissions permits; banking and borrowing; accountability; emissions trading system enlargement; and bubbles. The following conclusions emerge from that discussion.

First, no ceiling on the use of international emissions trading should be imposed on countries eligible for emissions trading, on grounds of both economic efficiency and environmental effectiveness. We think that setting a ceiling on trading on the fixed, arbitrary and once-for-all basis proposes a permanent solution to a transition problem, interferes with the development of financial markets for allowances, and makes it even more difficult to set stringent emissions targets for the subsequent commitment periods beyond 2012.

Second, we propose to impose a transaction tax on trades involving "taxable" allowances as one possible resolution to the "hot air" concern that motivated the placement of supplemental norm in the Kyoto

Protocol. Such a tax differs from a carbon tax because firms that elect to meet their emissions limits only by taking domestic actions have no obligations to pay such a transaction tax. It could be imposed only on the buyer and could differ to reflect the direction of emissions trading flows. Another approach to addressing the supplemental norm requirement would be to require the Parties to demonstrate adequate domestic actions according to a set of criteria to be defined by the Conference of the Parties.

Third, companies are the best entities to trade emissions permits. Allocating permits to individual sub-national legal entities will facilitate private participation in emissions trading. Such an allocation depends on the structure of national emissions trading systems. Such systems could be modelled as either “*upstream*” or “*downstream*” or “*hybrid*” systems, depending on national circumstances.

Fourth, the allocation of permits has the potential to bring parties into conflict with the WTO provisions, raising concerns about international competitiveness. Although such concerns are not limited to trading where allowance allocation can make unequal treatment explicit, they can be much more easily hidden from the general public if conventional command-and-control regulations are used. Auctioning at least part of the assigned amounts to sub-national legal entities alleviates to some extent the concern about international competitiveness. However, any attempts to produce an agreement on a common rate are likely to run into concerns about national sovereignty and thus would encounter significant political. With this in mind, we argue that individual governments should be left free to devise their own ways of allocating assigned amounts. This would ensure that any individual governments maintain their right to determine the domestic policies and measures that would be taken to meet their Kyoto obligations.

Fifth, banking offers a greater degree of intertemporal flexibility, thus lowering the cost of abating GHG emissions. The Protocol allows CERs obtained under the CDM prior to the beginning of the first commitment period to be credited for later use, and seems to place no restrictions on the use of banking during the post-2008 commitment periods. However, banking of Annex I country’s own early reductions prior to the beginning of the first commitment period has not been an option under the Kyoto provisions. If authorized, this type of banking would provide a strong incentive for Annex I countries to ratify the Protocol earlier than what otherwise would be the case. It alleviates to some extent the concern about the “hot air” trading, because it provides the incentive for legal entities in the advanced OECD countries to take abatement actions at home. As with banking, borrowing is another way to increase flexibility and lower the cost of abatement. However,

borrowing is much more controversial. If allowed, a number of safeguards should be added to avoid possible abuses of the option.

Sixth, the rules for accountability are essential to the success of emissions trading. In general, a “seller beware” liability works well in a strong enforcement environment where the built-in effective enforcement mechanisms make non-compliance very expensive and unattractive. In the Kyoto Protocol, however, a “seller beware” liability may not always work because there is only one very long commitment period and, as of now, no additional commitment periods have been defined, and because enforcement at the international level has proved to be less likely to be effective than at the national level. This may create a need for some form of a “buyer beware” liability under which acquired allowances that are tainted could not be used to satisfy the buyer’s assigned amount requirements. This would provide the strong incentive for risk-averse buyers not to acquire allowances from sellers who appear to be headed towards non-compliance. If the Parties decide that “buyer beware” liability is needed to complement traditional compliance procedures, the “last in, first out” approach is preferred to the simple discounting approach in taking back the seller’s overage, because the former can distinguish buyers who acquire allowances from sellers when no implementation problems are on the horizon from those buyers who do so when serious implementation problems have arisen in the seller country. Furthermore, we argue that, in order to prevent non-compliance from an early date, it is desirable to assign the buyer-seller hybrid responsibility by introducing a process of evaluating Parties’ efforts towards implementation during the commitment period. If in a given year a Party’s actual emissions did not exceed by a certain margin its annualized assigned amounts, the seller’s tons acquired by the buyers would be valid. After the year when the seller is found to go beyond that tolerance margin, however, the buyers become liable for potential non-compliance by the seller. As such, the allowances acquired prior to that year would not be discounted, thus avoiding the imposition of retroactive liability for the buyer.

Seventh, the Protocol itself, the eligibility criteria and the measurement capability considerations initially preclude including all the countries and greenhouse gases in an international emissions trading scheme. However, broadening a coverage of such a scheme will induce more cost-effective abatement options and further increase the cost savings. Therefore, it is very important to establish clear rules of procedure to facilitate admitting new entrants and including gases that are not covered initially before emissions trading begins.

Finally, although originally conceived as a way of allowing a REIO to accommodate the internal burden sharing of the Kyoto commitments among its member states, the final wording of joint fulfilment under Article 4 is framed in general terms. If it turns out to be too difficult to agree on the common rules and guidelines for a full-fledged emissions trading scheme, the “bubble” approach at least opens the possibility of trading emissions permits within the voluntarily-formed group. Moreover, in order to ensure the environmental integrity of the Kyoto Protocol, just as a REIO bubble has built-in joint responsibility of both the individual members and the regional organization, it is desirable to assign some form of joint responsibility in the case of non-REIO bubbles, although the countries concerned within a non-REIO bubble are left free to work out an arrangement to bring the whole group into compliance.

Acknowledgements

This paper was part of the presentations at the UNCTAD Workshop on International Greenhouse Gas Emissions Trading, A Side-Event of the Eighth Sessions of the Subsidiary Bodies of the UNFCCC, 8 June 1998, Bonn; The World Congress of Environmental and Resource Economists, 25-27 June 1998, Venice; and The European Union Workshop on Domestic Tradeable Quotas, 1-2 July 1998, Brussels. I would like to thank the Netherlands Organization for Scientific Research for financial support, and participants in the above Workshops and Congress and Tom Tietenberg for useful discussions and comments on an earlier version of the paper. The usual caveat applies.

References

Bill, S. (1997), European Commission’s Experience in Designing Environmental Taxation for Energy Products, Presented at the European Union Advanced Study Course on Goals and Instruments for the Achievement of Global Warming Mitigation in Europe, 20-26 July, Berlin.

- Cline, W.R. (1992), *The Economics of Global Warming*, Institute of International Economics, Washington, DC.
- Cramton, P. and S. Kerr (1998), *Tradeable Carbon Allowance Auctions: How and Why to Auction*, University of Maryland at College Park.
- Ellerman, A.D., Schmalensee, R., Joskow, P.L., Montero, J.P. and E.M. Bailey (1997), *Emissions Trading under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance*, Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology.
- Environmental Defense Fund (1998), *Cooperative Mechanisms under the Kyoto Protocol*, New York.
- Fischer, C., Kerr, S. and M. Toman (1998), *Using Emissions Trading to Regulating Greenhouse Gas Emissions: An Overview of Policy Design and Implementation Issues*, Resources for the Future, Washington, DC.
- Goldberg, D.M., Porter, S., LaCasta, N. and E. Hillman (1998), *Responsibility for Non-compliance under the Kyoto Protocol's Mechanisms for Cooperative Implementation*, Center for International Environmental Law, Washington, DC.
- Hargrave, T. (1998), *US Carbon Emissions Trading: Description of an Upstream Approach*, Center for Clear Air Policy, Washington, DC.
- IPCC (1996), *Climate Change 1995: Economic and Social Dimensions of Climate Change*, Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, Cambridge.
- Kopp, J.R., Morgenstern, R.D., Pizer, W. and M.A. Toman (1998), *Cheap Emission Reductions: Use 'em or Lose 'em*, Resources for the Future, Washington, DC.
- Matsuo, N. (1997), *Key Elements Related to the Emissions Trading for the Kyoto Protocol*, Institute of Energy Economics, Tokyo.
- Mullins, F. and R. Baron (1997), *International GHG Emission Trading*, 'Policy and Measures for Common Action' Working Paper No. 9, Annex I Expert Group on the UNFCCC, OECD, Paris.
- OECD (1998), *Ensuring Compliance with a Global Climate Change Agreement*, ENV/EPOC(98)5, Organisation for Economic Co-operation and Development (OECD), Paris.

- Parry, Ian W.H., Williams III, R.C. and L.H. Goulder (1997), *When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets*, RFF Discussion Paper 97-18, Resources for the Future, Washington, DC.
- Richels, R., Edmonds, J., Gruenspecht, H. and T. Wigley (1996), The Berlin Mandate: The Design of Cost-Effective Mitigation Strategies, in N. Nakicenovic, W.D. Nordhaus, R. Richels and F.L. Toth (eds.), *Climate Change: Integrating Science, Economics and Policy*, IIASA CP-96-1, International Institute for Applied Systems Analysis, Austria, pp. 229-248.
- Rolfe, C. (1998), *Kyoto Protocol to the United Nations Framework Convention on Climate Change: A Guide to the Protocol and Analysis of its Effectiveness*, West Coast Environmental Law Association, Vancouver.
- United Kingdom of Great Britain and Northern Ireland (on behalf of the European Community and its Member States and Czech Republic, Slovakia, Croatia, Latvia, Switzerland, Slovenia, Poland and Bulgaria, 1998), *Non-paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime*, FCCC/SB/1998/MISC.1/Add.3, 5 June, Bonn.
- UNCTAD (1998), *Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountability*, United Nations Conference on Trade and Development (UNCTAD), Geneva.
- UNFCCC (1997), *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (UNFCCC), FCCC/CP/1997/L.7/Add.1, Bonn.
- USDOS (1998), *The Kyoto Protocol on Climate Change*, United States Department of State (USDOS), 15 January, Washington, DC.
- United States Office of the President (1998), *Economic Report of the President*, Transmitted to the Congress, Washington, DC.
- Vaughan, S. (1997), *Tradeable Emissions Permits and the WTO*, Presented at the European Union Advanced Study Course on Goals and Instruments for the Achievement of Global Warming Mitigation in Europe, 20-26 July, Berlin.
- Zhang, Z.X. (1997), *The Economics of Energy Policy in China: Implications for Global Climate Change*, New Horizons in Environmental Economics Series, Edward Elgar, Cheltenham, England.

Zhang, Z.X. (1998), Greenhouse Gas Emissions Trading and the World Trading Systems, *Journal of World Trade*, Vol. 32, No. 5, pp. 219-239.

Zhang, Z.X. and A. Nentjes (1998), International Tradeable Carbon Permits as a Strong Form of Joint Implementation, in J. Skea and S. Sorrell (eds.), *Pollution for Sale: Emissions Trading and Joint Implementation*, Edward Elgar, Cheltenham, England, pp. 322-342.

Notes

² A comprehensive discussion of all the design issues related to emissions trading well goes beyond the scope of the paper. We recommend readers to consult UNCTAD (1998) in this regard.

³ When emissions trading were allowed, a country whose legally binding GHG emissions limits set by the Kyoto Protocol exceed its actual or anticipated emissions requirements would be able to trade these excess emissions, thus creating the “hot air” that would not have had otherwise. The “hot air” problem is particularly acute in Russia whose emissions are not expected to rise to its 1990 level until 2008. The “hot air” forms a “reservoir” from which some advanced Western countries, if not all, can simply buy emissions permits to make up any shortfall, instead of taking any serious domestic actions. This is one of the reasons why some countries have called for imposing a percentage limitation on the use of emissions trading. However, it should be pointed out that although emission trading makes the “hot air” problem explicit, the problem is related to targets setting, not to emissions trading per se.

⁴ We argue here that sub-national legal entities are the best entities to trade emissions permits. However, 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 impact the assigned amounts of the Parties, the Parties might feel a loss of control over the level of their assigned amounts and thus their ability to meet their Kyoto obligations.

⁵ See Zhang (1998) for a detailed discussion on GHG emissions trading and the world trading system.

⁶ Goldberg *et al.* (1998), for example, suggest that one possible approach to assigning the joint responsibility within a non-REIO bubble would be to hold the economically stronger members accountable, in part, for the failure of the weaker members to meet their agreed emissions targets.