Why quota trade should be restricted:
The arguments behind the EU position on emissions trading.[1,2]

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Sammendrag: EU har argumentert sterkt for at kvotehandelen under Kyotoavtalen bør være begrenset, dvs. et supplement til utslippsreduksjoner på hjemmebane. I denne artikkelen fokuseres det på argumentene bak EUs posisjon i forhold til kvotehandel i Kyotoforhandlingene. Økonomiske argumenter for begrenset kvotehandel diskuteres, herunder markedsmakt, transaksjonskostnader og tilleggseffekter av utslippsreduksjoner. Det argumenteres for at disse momentene ikke er sterke nok til å forsvare begrensninger i kvotehandelen. Videre diskuteres det om problemet med varmluft fra Øst-Europa og tidligere Sovjetunionen kan reduseres ved å innføre restriksjoner på kvotehandelen. Her argumenteres det for at restriksjoner på salg av kvoter i en viss grad kan bidra til å redusere varmluftproblemet. Argumenter for a begrense kvotehandelen knyttet til teknologisk framgang diskuteres også, i tillegg til argumenter med utgangspunkt i deontologiske (sinnelagsetiske) holdninger. Dette framheves av forfatteren som viktige argumenter i debatten om begrensninger på kvotehandel.

Abstract: In this paper I try to clarify the background and arguments behind the EU position on emissions trading in negotiating the Kyoto Protocol and their suggestions of how the supplementarity cap in the Kyoto agreement can be operationalized. I discuss economic arguments for restricting quota trade with a focus on the market power issue, transaction costs, and ancillary benefits of reducing emissions of climate gases. I also address the problem of hot air as an important argument to restrict quota trade, and arguments for restrictions connected to technological innovation. Finally, I look into the ethical considerations of restrictions.

Contents

1   Introduction

The Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted in Kyoto in December 1997. The Kyoto Protocol requires the participating developed countries to reduce their collective emissions of six key greenhouse gases by 5.2% below 1990 levels in the period 2008–2012.

Under the Kyoto Protocol, the participating countries will have a certain flexibility in how they make their emissions reductions. At the international level, the Protocol gives the Parties the opportunity to meet their emissions targets through the following flexibility mechanisms[3]:

- *Emissions trading with other Annex B countries.*[4] The relevant principles, rules, and guidelines for emissions trading under the Kyoto Protocol, have not, however, been agreed upon yet. (COP 6 in November last year unfortunately did not make much progress on this issue.) The text of the Kyoto Protocol states that any such trading must be supplemental to domestic actions for the purpose of meeting quantified emission limits and reduction commitments under the Article. (Article number 17).

- *Joint Implementation (JI) projects with other Annex B parties.* JI under the Kyoto Protocol involves cooperation between two Annex B countries to meet their abatement targets. The investor funds and possibly also conducts emissions reduction projects in the host country. This allows the investor country to offset their commitment by the amount of reduced climate gases through the JI project. JI may function as an important interim mechanism while an emissions trading system within Annex B countries is being developed and may afterwards function as an important mechanism for transferring technology and skills. Investment in JI projects must also be supplemental to domestic actions for the purpose of fulfilling commitments under the Kyoto Protocol. (Article number 6)..

- *The Clean Development Mechanism (CDM).* Like JI, the CDM is a project-based mechanism, although the projects involve cooperation between one Annex B country and one developing country. In other words, the CDM allows developed countries to use certified emission reductions from verified and accepted project activities in developing countries to contribute to their compliance with greenhouse gas reduction targets. The Protocol text states that the Parties included in Annex B may use the certified emission reductions accruing from such project activities toward part of their quantified emissions limitation and reduction commitments. (Article number 12).

Thus all three flexibility mechanisms include a reference to supplementarity or as being limited to being *part* of the Parties' quantified emissions limits. This reflects the EU position and the concerns of some developing countries associated with a non-restricted trading system. In this paper I focus on the arguments that can be used or have been used to defend a supplementarity principle, and to a certain extent comment on the validity of these arguments. I will narrow the focus by concentrating on emissions trading (rather than looking at all three

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[3] A fourth flexibility mechanism is also referred to in the literature, namely Article 4 – *Joint Fulfillment* (JF). JF allows Parties with emissions reduction commitments to jointly meet their commitments by entering into an agreement that redistributes the total reductions among parties to the agreement. Once the agreement is finalized and deposited with the secretariat, the revised emissions reduction target for each participating Party becomes enforceable under the Protocol. This flexibility mechanism will not be discussed any further in this paper.

[4] The Annex B countries under the Kyoto Protocol include most members of the OECD (except South Korea, Mexico and Turkey) plus some Central and Eastern European states.

flexibility mechanisms), and I will primarily focus on the EU position that emissions trading must be supplemental to domestic action and their somewhat skeptical views toward emissions trading. Other countries, particularly developing countries, are also skeptical toward emissions trading. However, many of their arguments against emissions trading will be covered through the various arguments found in the EU position.

Below, I briefly discuss the EU proposal for how the supplementarity cap can be operationalized. Furthermore, I discuss the standard economic view of quota trading by both looking at the efficiency and cost-effectiveness concepts and the effects of quota restrictions related to the standard economic view. In section four, I briefly discuss the negotiation process in the Kyoto negotiations connected to the supplementarity cap. In section five, I look at the arguments that can or are being used to defend a supplementarity cap. I discuss economic arguments, arguments connected to technological progress, hot air[5] andethics. Concluding remarks are given in section six.

2   The EU proposal

On May 17, 1999, the European Union Council of Ministers agreed on a Community strategy for climate change. This strategy included recommended definitions of supplementarity; specifically it proposed limits on the share of emissions reductions a country might obtain through use of the Kyoto Protocol's flexibility mechanisms.

The EU proposal is divided into two sections: rules for buyers and rules for sellers. In the buyer case, two options are provided. Annex B parties' purchases may not exceed the higher of the two (refer to UN Framework Convention on Climate Change 2000).

$$5\% \text{ of } \frac{\text{base year emissions multiplied by 5 } + \text{ assigned amount}}{2} \tag{1}$$

50% of the difference between the actual annual emissions of any year between 1994 and 2002 multiplied by 5, and its assigned amount. (2)

However, the limit on acquisitions can be increased. The EU suggests that the ceiling

> on net acquisitions can be increased to the extent that a Party included in Annex B achieves emission reductions larger than the relevant ceiling in the commitment period through domestic action undertaken after 1993, if demonstrated by the Party in a verifiable manner and subject to the expert review process to be developed under Article 8 [in the Kyoto Protocol]. (UN Framework Convention on Climate Change 2000)

An example from Norway could clarify the options. (Alfsen 1999. Year 2010 is here used as a representative year for the first commitment period and 1996 is chosen as the freely chosen year between 1994 and 2002). The first row of the table shows the emissions of climate gases in 1990 and 1996 and the allowed emissions following from the commitment in the Kyoto Protocol in 2010. The second and third rows show the allowed amount of bought quotas. The first option (defined by equation (1) above) gives as we can see, the best outcome for Norway when it comes to the amount of bought quotas. (The second option is defined by equation (2) above).

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[5] Parties that are allocated assigned amounts that exceed what their emissions would be even in the absence of any limitation contribute to the so-called hot air problem when the other Parties purchase these quotas to help meet their targets.

Table 1: Total emissions, emissions targets, and purchased permits. Mt CO$_2$ equivalents.

	1990	1996	2010
Emissions of climate gases	54.1	57.2	54.6
Option 1			2.7
Option 2			0.6

Source: Alfsen 1999.

The EU also suggests restrictions on sale of quotas. The restriction on sales is given by equation 1 above. However, as in the case of a limit for net acquisitions, there is an opportunity in the EU suggestion to increase the ceiling:

> the ceiling on net transfers can be increased to the extent that a Party included in Annex B achieves emission reductions larger than the relevant ceiling in the commitment period through domestic action undertaken after 1993, if demonstrated by the Party in a verifiable manner and subject to the expert review process to be developed under Article 8 [in the Kyoto Protocol]. (UN Framework Convention on Climate Change 2000)

Hence, the limit on transfers is only binding for countries with hot air quotas. (For discussion and definition of the hot air issue see section 5.2). A country with no hot air quotas will not sell any quotas not resulting from an equivalent emissions reduction.

3 Efficiency and cost-effectiveness

Most economists would argue that an emissions trading system connected to climate gases should be unrestricted, i.e. that agents should be able to trade as many quotas they like in the market according to the goal of emissions reductions set by the authorities or as here defined through an international agreement. The reason for favoring free quota trade is connected to the efficiency concept in economics, where free quota trade in a competitive market for quotas would give a cost-effective outcome; that is, emissions goal would be attained in the cheapest way possible. Below, I first discuss what economic efficiency related to the climate change problem would mean, and then I discuss the cost-effectiveness concept.

3.1 An efficient level of climate gases

The optimal level of climate gases in the atmosphere could be defined by using the economic efficiency concept. In order to define the optimal level of climate gases, one has to define both the cost function and the benefit (damage) function of reduced emissions of climate gases. An optimal emissions level is given by the following maximization problem:[6]

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[6] In reality, this is a simplification of the efficiency problem in the climate change context. To be exact, the time dimension of the problem should also be taken into account. We should then maximize the damages from climate change minus the cost of abatement over time, and end up with finding the optimal path of climate emissions through the time horizon.

$$Max_{e_1,\dots,e_N} \sum_{j=1}^{N} B_j (e^0 - e) - \sum_{j=1}^{N} C_j (e_j^0 - e_j) \qquad (3)$$

where e_j is emissions of climate gases from country j, e^0_j is the business as usual emissions of country j, $e = \sum_{j=1}^{N} e_j$ and $e^0 = \sum_{j=1}^{N} e_j^0$. Further, $B_j(e^0\text{-}e)$ represents the benefits (damages) of reducing climate gases (emissions of climate gases) and $C_j(e^0_j\text{-}e_j)$ is the abatement cost function for country j.

This maximization problem gives the following first order condition:

$$\sum_{j=1}^{N} B'_j (e^0 - e) = C'_j (e_j^0 - e_j) \qquad \text{for all } j=1,\dots,N \qquad (4)$$

which signifies that an optimal level for reductions of climate gases for agent j is reached when the sum of marginal benefits of abatement equals the marginal abatement costs.

3.2 Cost-effectiveness

Often there is a considerable degree of uncertainty and lack of information regarding the damage function, which makes it difficult to apply the efficiency concept given above. Instead, a cost-effectiveness approach could be applied. This has the advantage of avoiding the specification of a benefit (damage) relationship for climate gases in the form of a benefit (damage) function.

The optimal level of climate gas emissions is chosen by the regulator, or through a negotiating process (as with the Kyoto Protocol), without considering the optimal level of climate gases given through efficiency considerations. A cost-effective environmental agreement is one that reaches the agreed level of emissions reductions in the cheapest way possible, i.e.

$$Min_{e_1,\dots,e_N} \sum_{j=1}^{N} C_j (e_j^0 - e_j) \qquad (5)$$

$$\text{subject to: } E^0 = \sum_{j=1}^{N} e_j \qquad (6)$$

where E^0 is the chosen target for the total emissions from all agents (countries).

The first order condition of this minimization problem is:

$$C'_j (e_j^0 - e_j) = \lambda \qquad \text{for all } j= 1,\dots,N \qquad (7)$$

where λ is the shadow price of the constraint (6).

This condition signifies that cost-effectiveness requires that the marginal abatement costs are equalized across agents (countries), or, in other words, that the cost of reducing

climate emissions with one more unit in one country is equal to the cost of reducing climate emissions with one more unit in another country.

Obviously, efficiency implies cost-effectiveness. An efficient climate agreement is hence one where the emissions reduction target is optimally chosen, and where this target is reached in the cheapest way possible.

3.3   A tradable quota system

In a competitive tradable market for emission quotas, a cost-effective or efficient solution is reached if the environmental goals are optimally chosen. Each agent in this market minimizes the cost of abatement and the cost (income) of buying (selling) quotas subject to the emissions from the agent being less or equal to the initial endowment of quotas plus (minus) the amount of bought (sold) quotas.

$$\underset{q_1,...,q_N}{Min} \quad C_j(e_j^0 - e_j) + Pq_j \tag{8}$$

subject to: $e_j = q_j^0 + q_j$ (9)

where q_j is the amount of quotas bought ($-q_j$ is the amount of quotas sold), q_j^0 is the initial amount of quotas allocated and P is the price of quotas.

The first order condition of this minimization problem is:

$$C_j'(e_j^0 - e_j) = P \qquad \text{for all } j = 1, ..., N \tag{10}$$

In other words, each agent would set marginal abatement cost equal to the price of a quota in optimum. A cost-effective situation is achieved since the price of a quota is the same for every country, and marginal abatement costs will hence be equalized across agents.

The cost-effectiveness of a competitive quota market could also be illustrated by the following figure, which shows the demand and supply curves for quotas in the quota market (q is the quantity of quotas). Both the supply and demand curves reflect the marginal abatement costs for the agents operating in the market. The buyers would purchase quotas as long as the price of a quota is less than the buyers' marginal abatement costs. With an increasing marginal abatement function, this would signify that the higher the quota price, the lower the demand for quotas and the higher the levels of abatement. Hence, the demand curve slopes downward. On the other hand, the sellers would sell quotas as long as the quota price is higher than the sellers' marginal abatement costs. Likewise, with an increasing marginal abatement cost function, this would imply that the higher the quota price quota, the higher the supply of quotas and the higher the levels of abatement. Hence, the supply curve slopes upward. The equilibrium price and quantity in the competitive quota market is given by (P*, q*). Since the demand and supply curves also reflect the marginal abatement costs of the agent, the competitive equilibrium will be a cost-effective equilibrium where the targets set through the international agreement are reached in the cheapest way possible.
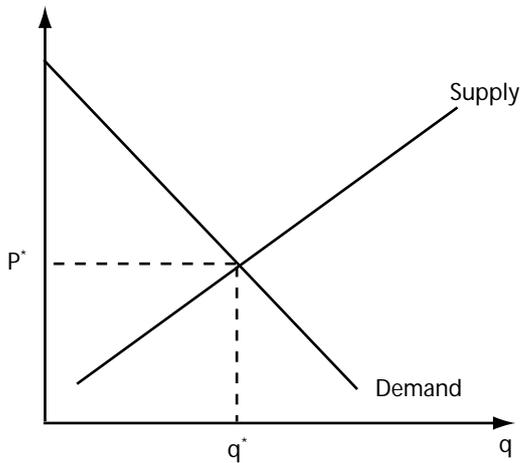
Figure 1: The competitive quota market

3.4   The effects of restricting quota trade

3.4.1   Ceiling on purchases

What would the effects of a ceiling on buying as suggested by EU be? It is assumed that this ceiling leads to binding restrictions on buying quotas, i.e. that the allowed level of purchased quotas is lower than q^*. In figure 2, the ceiling on purchases is given by q^R. In this situation we would no longer have equality between agents' marginal abatement costs (expressed by the supply and demand curves). The marginal abatement costs for buyers are given by P^D, and for sellers, by P^S. As a consequence, a cost-effective solution is no longer secured.
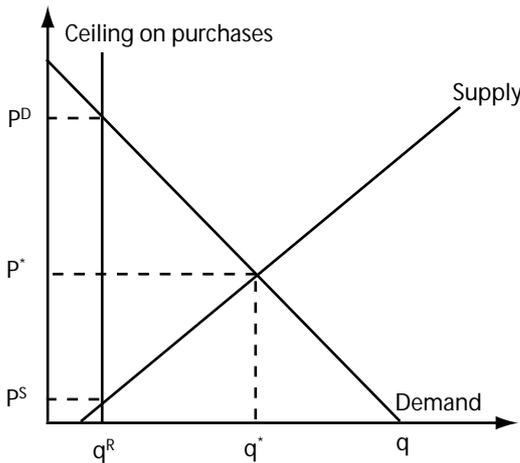
Figure 2: Ceiling on purchases

3.4.2   Ceiling on sales

As mentioned above, the EU proposes that sale of quotas be restricted by equation (1) above. However, a Party could sell more than the amount given by the ceiling if it carries out abatement larger than the ceiling.[7] Hence, the ceiling is in reality only effective for hot air quotas. A Party with hot air quotas then faces a discrete choice. It could either sell the amount given by the ceiling, or it could increase the ceiling (increase the amount sold) if it abates the whole amount that it sells. The decision it actually makes will depend on on the profit resulting from each of these choices.

With a restriction on sales of quotas such as the one explained above (and assuming that the ceiling will be effective), the supply curve would shift inward but at one point the new supply curve will not be continuous, reflecting the fact that the Parties with hot air quotas will at one point have equal incentives to sell quotas according to the ceiling or to abate the whole amount of sold quotas. (See figure 3). The supply curve with the suggested ceiling will have the same slope as the original supply curve when the hot air countries abate the entire amount of quotas sold. The only thing that happens is that they do not sell any quotas that are not a result of an equivalent emission reduction. The curve will be steeper when the hot air countries only sell their amount of hot air quotas according to the ceiling. The new equilibrium after the restrictions with the curves drawn in the diagram is (q^R, P^R). In this case, the marginal abatement costs would be equalized across agents and be equal to P^R, since all supplying agents here abate the entire amount of quotas that they sell. However, the level of emissions reductions would be higher than the level agreed to in the Kyoto negotiations since there are no longer hot air quotas and all the quotas that are sold are a result of an equivalent emissions reduction. The agreed goal could, however, be reached at a lower cost by including the hot air quotas in quota trading (and not over-fulfilling the target defined through the agreement). Marginal abatement costs and total costs would in this case be lower, thus implying that the establishment of restrictions would mean that targets would not be attained in the cheapest way possible.
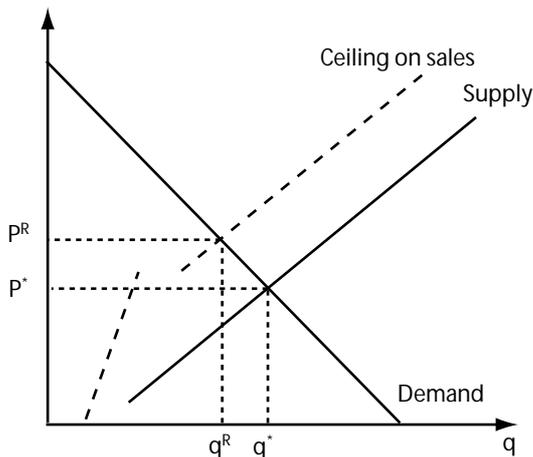
Figure 3: Ceiling on sales, situation 1.

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[7] In reality, the possibility of increasing the ceiling by abating according to the amount of quotas sold signifies that the costs of the compliance system increase compared to only having a ceiling given by equation (1). With a restriction like this, all quota sales above the ceiling require that each source establish the emissions baseline, permitted level, and reduction plan for each trade, since it must be verified that a Party actually carries out abatement according to the quotas it sells. Thus, this is more like a credit-trading mechanism than ordinary allowance trading. For a brief discussion of this issue, see section 5.1.2.

Another situation is sketched out in figure 4. Here the Parties with hot air quotas only choose to sell according to the ceiling, which represents only a part of their hot air quotas. The marginal abatement costs of the hot air quotas are equal to zero. The other selling countries with no hot air will, however, experience positive marginal abatement costs equal to the price P^R. In this situation, we will no longer have cost effectiveness since marginal abatement costs will be unequal across agents.
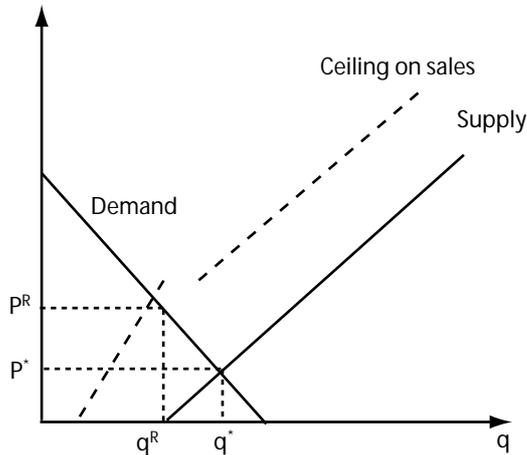
Fig. 4: Ceiling on sales, situation 2.

3.4.3   Ceilings on both purchases and sales

The supply and demand of quotas will be affected for those agents where the ceilings actually restrict their purchases and sales of quotas. The Parties that experience effective restrictions on purchases and those who choose to sell hot air quotas in accordance with the ceiling given by equation (1) will no longer set marginal abatement costs equal to price, and cost ineffectiveness is the result. (As discussed above, Parties with hot-air quotas that choose to sell quotas above the ceiling will have to abate according to the amount of quotas sold, and those agents will set marginal abatement costs equal to price). Hence, the EU ceiling with restrictions on both purchases and sales of quotas will clearly result in ineffectiveness. So, the question is, why argue for having ceilings?

4   The negotiating process

4.1   The EU

In the Kyoto negotiations, the EU's main focus was on internal policies and measures that its member states might adopt, and the effort to hold other countries to flat-rate emission reductions. Before the Kyoto negotiations in March 1997, the EU collectively supported a position that all industrialized countries should reduce emissions to 15% below 1990 levels by 2010. On the topic of emissions trading, the EU remained silent in its March statement. However, in June 1997 the EU indicated that its attitude toward emissions trading would be contingent upon the strength of commitments offered by other countries and the requirement that using mechanisms such as emissions trading be supplementary to domestic actions.

4.2   The United States, Japan, and other OECD countries

The eyes of many OECD countries were focused on how they could lessen domestic pressure, and as a result they argued as hard as possible for international flexibility. Many economic analyses showed that emissions reductions could be achieved most cheaply in the economies perceived to be the least efficient: the EITs and developing countries. International flexibility would thus provide an opportunity to take advantage of these cost-reduction possibilities.

Although positive toward emissions trading, some OECD countries, especially Japan, expressed concerns about the functioning of the emissions trading market. They worried that the US would use its potentially enormous political leverage over Russia to monopolize Russia's surplus of quotas resulting from the commitments of the Kyoto Protocol and its economic development if the emissions trading system was not designed properly. So – along with several other countries – Japan demanded conditions that any trading should be transparent, competitive, and open. However, Japan was positive towards cost-effective actions and thereby emissions trading.

4.3   Economies in transition

There are important differences between the EITs. Most of the Central European countries and some of the FSU are heavily dependent on imported energy. Several of these countries are expected to join the EU early in the twenty-first century, and several others hope to do so subsequently. They have consequently tended increasingly to align themselves with the EU position. Russia itself, however, remains a huge and resource-intensive country that has developed closer political ties to the United States than to the EU. With large amounts of hot air quotas, Russia would profit heavily from the possibility of an unrestricted quota trading system. So, in March 1997, the Russians submitted their own negotiating proposals in favor of emissions trading with flat-rate initial allocations from 1990 levels.

4.4   Developing countries

The majority of developing countries seem opposed to emissions trading. Their opposition is rooted in principles, fed by anger that emissions trading might enable the US to avoid significant domestic action and concern about the hot air problem. Although the Unites States emphasized that the targets set during the Kyoto negotiations would not constitute any more long-term right to emit, there was a deep fear that the whole question of long-term emissions entitlements was being pre-empted.

4.5   The results of the Kyoto process

Thus the EU and the developing countries strongly opposed emissions trading, while the other parties were positive (except for some EITs). For the United States, the issue of its inclusion in the Protocol was important enough to become one of the conditions for joining the agreement.

These conflicting positions resulted in a supplementarity cap that all could accept. This was one of the creative ambiguities that allowed countries to agree while fundamentally disagreeing. However, the problem of operationalizing the supplementarity cap remains to be resolved. Unfortunately, not much headway was made on this issue during the COP 6 in The Hague, either.

5 The arguments behind the EU position

Several arguments have been used to defend the skepticism toward a fully flexible quota trading system, some of which have not been made explicit but are rather implied through cultural differences and different moral positions. Many of the arguments against an unrestricted quota market discussed below are either related to the expectation that distortions would exist in such a market) or that the goal of emissions reductions achieved through the negotiations is not the optimal one. In the following I will examine the most important of these arguments, and to some extent comment on their validity .

5.1 Economic arguments

Objections to allowance trading may derive from genuine concerns about the functioning of a market-based policy design at the international level. First, if the quota market is no longer competitive, marginal abatement costs would not be equalized across traders and an efficiency loss would arise. Furthermore, if these markets should have transaction costs, cost-effectiveness could no longer be viewed as a situation where marginal abatement costs are equalized. And if marginal transaction costs are also included, this would affect the performance (the cost-effectiveness) of the system compared to other policy instruments. Finally, there could be ancillary benefits at the national level following from reductions of climate gases. This would affect the level of optimal emission reductions. All these factors have been used as arguments against an unrestricted quota trade. Below we discuss all three effects.

5.1.1 Market power

To achieve cost-effectiveness (and efficiency) in a tradable quota market, the market for quotas must be competitive. If certain agents could influence the price of quotas, cost-effectiveness in the quota market would no longer be a result. Several authors have discussed the problem of market power in a tradable quota system, the first being Hahn (1984). Westskog (1996) discusses this problem in connection to an international tradable CO_2 quota market.

For the purposes of illustration, assume that there is one large seller in this market denoted M. The rest of the agents are small. These small agents are in total a net buyer of quotas. They are referred to as "the fringe" and denoted F. The fringe emits climate gases until the marginal abatement costs equal the price of a quota.

$$C'_F(e^0_F - e_F) = P \tag{11}$$

The fringe demand function for quotas will thus be $Q_F = Q_F(P)$, and the inverse demand function $P = P(Q_F)$ where Q_F is the sum of quotas bought from the fringe.

The monopolist takes as given the fringe's performance in the market and minimizes the abatement costs minus the income from selling quotas.

$$\underset{q_M}{Min}\, C_M(e^0_M - e_M) - Pq_M \tag{12}$$

subject to $P = P(Q_F)$ and $e_M = q^0_M - q_M$

The first order condition of this minimization problem is

$$C'_M(e^0_M - e_M) = P - P'(Q_F)q_M \tag{13}$$

which signifies that the monopolist sets marginal abatement costs equal to marginal revenue. The consequence is that marginal abatement costs given by equations (11) and (13) are not equalized across agents (monopolist and fringe), and cost-effectiveness is not achieved. The argument against free quota trade is connected to the inefficiency obtained from the existence of market power agents.

The questions are, however:

1. Is the market power problem really of such dimensions that it is better to choose another policy instrument such as non-tradable quotas?

2. Can the market be organized such that this problem does not become excessive?

In the study by Westskog (op.cit.), it is shown that that under specific conditions the market power exercised by certain agents in a tradable quota market could amount to a 10% efficiency loss compared to a competitive market. Seen in the context of the Richels et al (1996) study, which shows that a tradable quota system that allows for flexibility regarding where emission reductions are made can reduce costs by more than 60% compared to a system with no trade of quotas between agents, the market power problem can hardly be an argument against emissions trading. Further, concerns about market power effects could also be raised under supplementarity. In a study by Ellerman and Wing (2000), it is demonstrated that implementing supplementarity by imposing concrete ceilings on permit imports in a market for tradable emission rights gives rise to monopsonistic effects similar to those that characterize a buyer's cartel. Limit permit import may lead to reduction in the costs of meeting importer's emission control obligations for some levels of restrictions because of a lower price for quotas following from demand restrictions.

Because there is now an international antitrust law, the GHG quota trading market must be designed to deal with market power on its own terms. The way quotas are allocated, the way quotas are designed, who participates, and how many will participate are important factors to determine the extent and effects of market power. The Westskog (op.cit.) study shows that the way quotas are initially allocated significantly influences the level of the efficiency loss from market power. Further, in a study by Hagem and Westskog (1998) which focuses on the intertemporal design of the tradable quotas, it is shown that quotas that are durable (last for more than one period) may reduce the market power problem at the cost of increasing inefficiency across periods, compared to a banking and borrowing system where quotas last for only one period, but where quotas can be banked or borrowed across periods.

5.1.2 Transaction costs

Transaction costs may also be a problem in a tradable quota market. Transaction costs may arise by limits and conditions imposed on emissions trading that can result in large search and information costs, bargaining and decision costs, and monitoring and enforcement costs. (See, for instance, Stavins 1995, which discusses this issue).

In a competitive market for tradable quotas where transaction costs exist, the agent would minimize the abatement costs plus the costs of buying quotas and the transaction costs of quota trade.

$$\underset{q_1,\dots,q_N}{Min} \quad C_j(e_j^0 - e_j) + Pq_j + t_j(q_j) \tag{14}$$

subject to: $e_j = q_j^0 + q_j$ (15)

where $t_j(q_j)$ signifies the transaction costs of quota trade and $t_j'(q_j) > 0$. $t_j''(q_j)$ may be positive, negative or zero-valued (ref. Stavins 1995) .

This minimization problem leads to the following first order condition

$$C'_j(e^0_j - e_j) = P + t'_j \qquad \text{for all j= 1, ...,N} \qquad (16)$$

Hence, in contrast to the cost-effective solution with a tradable quota system with no transaction costs, marginal abatement costs are no longer equalized across agents. In the equilibrium with transaction costs, the agents set marginal abatement costs equal to the price of a quota plus the marginal transaction costs.

A clever design of the market and quotas could probably influence the extent of the problem with transactions costs. It is a difference between allowance-trading programs and credit-trading programs when it comes to the extent of the transaction cost problem. Allowance-trading programs impose on each agent an emissions target coupled with the possibility for each agent to engage in trade with the allowances authorized by this target. The emissions trading mechanism in the Kyoto Protocol is an allowance-trading mechanism. A credit-trading program, on the other hand, allows each agent to trade emissions *reductions* that are shown to be below the agent's permitted level of emissions. The CDM is an example of a credit-trading mechanism. Credit-trading systems are project based and require that each source establish its emission baseline, permitted level and reduction plan. An allowance might be comparable to a currency unit, whereas a credit might be better compared to a specific good whose value must be determined for each trade. Consequently, an allowance-trading mechanism normally has very low transaction costs, whereas the transaction costs following from credit trades are much higher. (See UNCTAD 1998 for a further discussion of this issue). Hence, this is again more of a design issue than a question of restricting quota trade to obtain more favorable economic conditions for fulfilling the environmental goal.

5.1.3   Ancillary benefits.

Other arguments against following a cost-minimization strategy like full flexibility in emissions trading have also risen in the debate. Schleicher, Buchner and Kratena (2000) argue that GHG abatement activities can have various beneficial side effects. In addition to the reduction of emissions, abatement activities may also give rise to what they call ancillary benefits, e.g. the improvement of the quality of living in a building that was renovated for improving the thermal energy efficiency. The ancillary benefits are of a local and regional character, and come about in addition to the global effects of reductions of climate gases.

In this case, the level where the sum of marginal global benefits of abatement equals the marginal abatement costs no longer characterizes an efficient level of climate gases. The ancillary benefits warrant higher reduction levels of climate gases. The maximization problem is now given by

$$\underset{e_1,...,e_N}{Max} \sum_{j=1}^{N} B_j(e^0 - e) + \sum_{j=1}^{N} b_j(e^0_j - e_j) - \sum_{j=1}^{N} C_j(e^0_j - e_j) \qquad (17)$$

where $b_j(e^0_j - e_j)$ signifies the ancillary benefits of agent *j*.

An optimal emissions level is in this case characterized by:

$$\sum_{j=1}^{N} B'_j(e^0 - e) + b'_j(e^0_j - e_j) = C'_j(e^0_j - e_j) \text{ for all j=1,...,N (18)}$$

or, in other words, where the sum of the marginal global *and* local benefits of abatement equals marginal abatement costs. Hence, marginal abatement costs should not be equalized

across agents to reach efficiency or cost-effectiveness because of the agent-specific ancillary benefits. However, the question is whether or not the existence of ancillary benefits is an argument for restricting quota trade. Side-effects can be handled properly through the use of other national policy instruments in combination with a fully flexible tradable quota system, for example through the use of national taxes (see Hoel 1993b for a discussion of this issue).

5.2   Hot air

As explained in footnote 5, Parties that are allocated assigned amounts that exceed what their emissions would be even in the absence of any limitation contribute to the so-called hot air problem when other Parties purchase these quotas to help meet their targets. The EITs are expected to have a lot of hot air to trade on an emissions trading market. The hot air issue concerns the implications of their transferring to other Parties what may turn out to be a substantial surplus of quotas, and it is the opportunity to freely trade and bank hot air quotas that makes this a problem. If the hot air quotas can be sold or banked, they will not represent an equivalent emissions reduction amount in the seller or banking country. By transferring the surplus to a country that may use it, emissions increase more than they would in the absence of trading.

Allocating hot air quotas to some countries would not change the efficiency performance of the tradable quota market. Cost-effectiveness will be achieved (as will efficiency if the goal is optimally chosen). As before, a country with hot air minimizes abatement costs minus the income from selling quotas ($q_j<0$ for a country that sells quotas).

$$\underset{q_1,...,q_N}{Min} \quad C_i(h_j + e_j^0 - e_j) + Pq_j \tag{19}$$

subject to: $e_j = q_j^0 + q_j$ \hfill (20)

where h_j is the amount of hot air quotas allocated to agent *j*. Note that the amount of quotas allocated initially is the amount of hot air quotas plus the business as usual emissions of that country, i.e. $q_j^0 = h_j + e_j^0$. The first order condition of this minimization problem is equivalent to equation (10), i.e. $C_j'(h_j + e_j^0 - e_j) = P$.

The problem of allocating hot air quotas to countries is mainly a political one. Assigning to some countries large surpluses that are then transferred to the wealthiest countries, enabling them to avoid substantive action, will be seen by developing countries as violating the spirit of the Kyoto agreement and that of the Convention itself by violating the aim of developed-country leadership. Potentially, the most threatening aspect of hot air trading is its implications for the expansion of the regime. If countries presently within Annex B could trade and bank assigned amounts that do not correspond to equivalent emissions reductions, it would be difficult to negotiate an agreement with new countries that would have no possibility for hot air trading and banking.

The problems connected to the allocation of hot air quotas was one of the reasons that the EU, at the European Council of Ministers meeting in June 1997, concluded that mechanisms such as emissions trading should be supplementary to domestic actions and common coordinated policies and measures (Grubb et al 1999). They suggested restrictions on quota purchases and quota sales, where quota sales that are not a result of an equivalent emission reduction amount in the seller country should be restricted. However, the question is whether restrictions on quota trade could reduce the problem of hot air. Grubb et al (1999) argues that, as agreed in the Kyoto Protocol, a supplementarity cap on the amount of quotas that Parties purchase would not necessarily solve the problem of hot air. It could simply mean

that countries with real surplus assigned amounts would spread their hot air more widely among acquiring countries. A direct ceiling on sales from transferring countries, which is also suggested by EU, could be more effective. Holtsmark and Mæstad (2000) discuss what effects the proposed EU restrictions on quota trade would have on hot air trade. They find that the EU proposal effectively limits the amount of hot air released through the international market for emission permits. However, like Grubb (op.cit), they conclude that in order to reduce the hot air problem, the only appropriate action is restrictions on sales, and that restrictions on acquisitions of quotas is not justified.

5.3   Technological Progress

The requirement that emissions trading should be supplemental to domestic actions for the purposes of meeting commitments reflects the widespread concern that international flexibility may be used to avoid adequate domestic action. Stabilizing the atmosphere will require far-reaching changes in technology and patterns of economic behavior. The Kyoto commitments with full flexibility may turn out to be very lax for the OECD countries, with the consequence that they need not take much action at home. They might shoulder the burden of abatement globally, but only by spreading established techniques and never having to learn about other ways of doing things. If the richest nations never have to seriously change course, the prospects for long-term solutions are very remote. By contrast, if they are forced to implement some difficult measures at home, they might generate solutions that could then spread globally.

If the Parities had agreed on a more stringent emissions target, a more rapid technological change would probably be the result, even with full flexibility through emission trading. This was not achieved through the Protocol. However, the EU wanted a much more stringent emissions target than was achieved in Kyoto. As mentioned above, at the meeting of the EU Council of Ministers in March 1997, the EU collectively supported a position that all industrialized countries should reduce emissions to 15% below 1990 levels by 2010. With restrictions on emissions trading, they would be able to at least achieve the results of a more stringent target than one with full flexibility and 5.2% collective reduction. Since restrictions on quota trading will most likely increase quota prices (see Holtsmark and Mæstad 2000 for an empirical study of the implications of the EU suggestions on restrictions), the incentives to engage in R&D activities that can lead to technological progress that reduces dependency on fossil fuels will also increase. The result could then be a more rapid technological change than obtained otherwise (that is, without restrictions), and then a possibility to agree on a more ambitious target after the Kyoto period is over. This may be one motivation behind their skepticism toward emissions trading, and why they argued for a supplementarity cap in the negotiations of the Kyoto Protocol.

The EU's argumentation on this issue reflects the fact that abatement investments may stimulate endogenous technological progress by improving factor productivity. Most greenhouse gas abatement policy models that incorporate technological change treat such changes as autonomous, that is, unaffected by changes in prices brought about by policy reforms. However, the rate of technological change responds to policy initiatives. Climate change policies, in particular, by raising the prices of conventional carbon-based fuels can create economic incentives to engage in more extensive research and development oriented toward the discovery of new production techniques that involve a reduced reliance on conventional fuels. In addition, such policies may lead to increased R&D aimed at discovering new ways to produce alternative, non-carbon based fuels. To the extent that expanded R&D efforts bear fruit, they lead to technological progress. Thus, climate policies,

R&D, and technological progress are connected: there is an induced component to technological change.[8]

Autonomous technological change may be represented very simply by including these effects in the cost-function of each agent. The higher the amount of emissions reductions, the higher the rate of technological change. Hence, we would have the following abatement cost function, denoted C_j^I, and different from C_j in equation (3):

$$C_j^I = C_j((e_j^0 - e_j), I_j(e_j^0 - e_j)) \tag{21}$$

where I_j signifies the technological change obtained by abatement activities, $I'_j>0$ and $C'_{I_j} < 0$. This would mean that for every level of abatement activities the cost of abatement is now lower and this warrants a higher total emissions reduction level than obtained through the efficiency considerations in section 3.1. (However, still $C'_{e_j^0 - e_j} > 0$). Hence, if these effects are not included in the considerations when the goal of emissions reductions is decided, the goal could be said to be to lax, and by restricting quota trade we would get a higher level of technological change which could reduce the abatement costs and allow the possibility of negotiating a more stringent target at the next crossroads.

Arguments raised around the autonomous technological change effects are also connected to the uneven distribution of opportunities for other agents to introduce technical innovation. If the rate of technological change depends upon who abates, free trade of quotas would influence this rate. For example, if the EIT countries have few opportunities to introduce technological innovation through their abatement activities, whereas the abatement activities carried out by other Annex B countries would induce technological change, sale of quotas from EIT countries to other Annex B countries would reduce technological change. Hence, this might be a valid argument for quota restrictions, since we would expect that the EITs would be sellers of quotas and many other Annex B countries, buyers.

5.4   Ethical arguments

The arguments for cost-effectiveness and cost-effective policy instruments are based on a consequentialistic ethical thinking. Various climate policy instruments should be ranked in accordance with their consequences. The policy instrument that generates the best consequences, e.g. the most cost-effective emissions reductions, should then be chosen.

On the other hand, those holding a deontological ethical position focus on the disposition behind the act and on demands that we should act in agreement with duties and rights (not justified by the value of the consequences from actions). The justification for those rights and duties vary; examples include the ideas that human beings are created in the image of God, that some fundamental duties and rights are somehow included in universal reason, or that basic duties and rights can be derived from the categorical imperative (See Kant 1996). The deontological views connected to quota trade incorporate two elements. First, one could argue that there exist absolute standards that we should uphold in our management of the

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[8] Goulder and Schneider (1999) discuss the significance of endogenous technological change for the attractiveness of carbon abatement. They conclude that climate policies are generally more attractive when the impacts of these policies on technological change are taken into consideration. Schleicher, Buchner and Kratena (2000) also discuss the issue of endogenous technological change and they conclude that "creating appropriate long-term incentives through GHG abatement policies will be an effective way to encourage technical progress which is an important force for improving competitiveness and stimulating economic growth."

natural environment.[9] These standards should define the goal of emission reductions, and not the consequentialistic method defined through the efficiency considerations in equation (3). The point here is that the deontological principles (duties/rights) represent additional constraints on efficiency considerations that should not be violated, regardless of the costs of respecting the duties/rights. However, proponents of these views would often accept a cost-effective method of achieving the exogenously defined goal, such as emissions trading. Another view also rooted in deontological considerations, and often an extension of the view above, is that pollution that causes systematic, foreseeable and preventable harm should be avoided. The reason for this is that pollution inflicts injury to living beings' inherently valuable capacity for flourishing. From this point of view, tradable allowances can be seen as a license to pollute, particularly if grandfathering is used as a principle for initial distribution, and an unsuitable policy instrument.[10]

In Europe, the Green parties and various environmental groups have been quite influential. They often use deontological arguments like those mentioned above and are quite hostile toward emissions trading. These groups appear to be more influential in European politics than their counterparts in US politics. Environmental groups in the United States have traditionally been hostile toward allowance trading, until several policies using tradable allowances were adopted and proved successful. (Weiner 1997).

The European position toward emissions trading can also be understood in a cultural context. The deontological views can be traced back to Kant. In Kant's view, what gives an action moral worth is not the outcome of that action, but the motivation behind the action. The categorical imperative is Kant's famous statement of this duty: "Act only according to that maxim by which you can at the same time will that it should become a universal law". (Kant 1996). Other philosophers such as Spinoza have also been influential in Europe. Spinoza believed that everything that exists is God, or to put it differently, that God, Substance and Nature are at the deepest level the same. (Næss 1977). Traces of his thoughts on this issue can be found in Goethe's work. Goethe rejects the principle of an all-powerful Father God, while embracing the image of Earth as a nurturing mother. (Chapman 1999). Against this tradition stands the Benthamite perspective in which pollution is seen as market failure to be corrected by market pragmatism, and which is a tradition that is much more important in the American context. (Bentham 1948)

These cultural differences also play an important role within Europe. The deontological views found in Kant's philosophy and the non-anthropocentric views in Spinoza's and Goethe's works have naturally been especially important in Germany, but also in continental Europe, whereas the Benthamite perspective has been more important in England. The hostility toward emissions trading follows the same lines. (See Tosteson 1998).

6 Conclusion

In this paper I have tried to clarify the background and arguments behind the EU position in the Kyoto negotiations that quota trading should be restricted and the bulk of emission reductions conducted domestically.

An unrestricted quota trade will (at least in theory) result in a cost-effective allocation of emissions reductions among participants in the agreement. If quota trade is restricted, this will no longer be the case. The arguments for restricting trade should therefore be weighty. Some

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[9] These views can be found in the ecological economic approach to sustainability put forward by, e.g., Herman Daly (1993).

[10] Weiner (1997) briefly discusses this last issue.

of the arguments raised above have these characteristics. In this paper I have discussed the following arguments:

- *Economic arguments* for restrictions, which could be threefold: (1) that the market for quotas will give rise to inefficiencies through the presence of market power; (2) that transaction costs may arise; and (3) that the emphasis on the global benefits of quota trade might detract attention from local or regional ancillary benefits.

- *Hot air*. If the hot air quotas can be sold or banked they will not represent an equivalent emission reduction in the seller or banking country. By transferring the surplus to a country that may use it, emissions may increase more than they would be in the absence of trading. It could be argued that quota trade should be restricted to reduce the hot air problem.

- *Technological progress*. Restrictions on emissions trading are likely to encourage more rapid technological innovation since the quota price will increase, which could bring more opportunities for increased emission reductions in the future. Moreover, the uneven distribution of opportunities for technological innovation between countries could also be put forward as an argument for restrictions. If technological change is dependent upon who abates, free trade would influence the rate of technological change.

- *Ethics*. According to a deontological ethical position, one could argue that pollution that causes systematic, foreseeable, and preventable harm should be avoided. From this point of view tradable, allowances can be seen as a license to pollute, at least if the quotas are initially distributed on a principle of grandfathering, and thus an unsuitable policy instrument.

I argue here that both a deontological position and the existence of autonomous technological change point toward restricting quota trade. In addition, restrictions on the sale of quotas could be effective in reducing the hot air problem. However, it is arguable that restricting net acquisitions is not justifiable as a means to reduce the hot air problem. Moreover, the economic arguments, in my opinion, are not sufficiently weighty to justify restrictions of quota trade.

The argumentation explored in this paper gives rise to two important questions that have not been fully discussed here. First, what explanation does the EU itself give for its position on emissions trading? I have touched upon this question in the discussion of the ethical arguments by pointing at the cultural differences between Europe and the United States where the cultural context in Europe could have given more room for deontological arguments. However, a lot of other explanations could also be put forward, one of which is trade rivalry. Some countries may favor high-cost policy designs because even though such a policy would be costly for them, it would cost their trade rivals far more. Industries in Europe may want to impose higher costs on their rivals in the US and Japan by insisting on non-tradable quotas, which the Europeans would be able to meet at lower costs than could their rivals. Flexible and comprehensive policies would erase this cost advantage for European industry. Preliminary evidence suggests that the industrialized countries that oppose or would limit allowance trading are also the countries that face low abatement costs relative to the other industrialized countries. (Weiner 1997).

Second, what are the concrete implications of the EU proposal for the different issues raised in this paper, and are the proposed restrictions too tight or too loose to achieve the intention of the proposal? In this paper I have referred to the paper of Holtsmark and Mæstad (2000) where the implications on the EU proposal for the hot air problem is analyzed. However, much remains to be studied. For instance, what are the implications for technological change and at what costs? In other words, how much do total costs of emissions reductions increase as a consequence of trading restrictions? It is important to consider these issues are to evaluate whether restrictions on quota trade really are worth the effort.

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