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THE ALLOCATION OF TRADEABLE EMISSION PERMITS IN THE EU: DISTRIBUTIONAL AND COMPETITIVE ISSUES

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The Allocation of Tradeable Emission Permits in the EU: distributional and competitive issues.

(Preliminary and incomplete)

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1. Introduction

Externalities are a relevant source of market failures and, as such, call for a Government intervention. In this respect, real life observation suggests that national and/or federal environmental authorities are increasingly substituting *command and control* pollution policies, based on the specification of a maximum amount of emissions at plant or firm level, with *incentive based* ones. The latter type of intervention aims at providing the polluting entities with correct incentives, i.e. incentives to include the social costs of pollution into their production and emission choices.

The incentive based approach is gaining consensus also in the European Union: after a first, not very successful attempt to introduce a EU level Carbon tax[1], the Green Paper "*On Greenhouse Gas Emission trading within the European Union*" (2000) has proposed the implementation of a trading system for Greenhouse Gases (GHGs) emissions as a step towards the achievement of the Kyoto targets. This emission trading system has been introduced by Directive 2003/87/CE, and it is supposed to start working by year 2005. According to such Directive, each country has to submit to the European Commission a National Allocation Plan (NAP), specifying:

i) the total amount of permits to be allocated to each country in accordance with Kyoto targets and with the "burden sharing" agreement among European countries (Decision 2002/358/EC);

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[1] The few progresses observed so far are mainly due to the difficulties the introduction of "European" fiscal measures has to face, including the need for unanimity.

ii) how the amount of allowances each country receives are divided among the sectors subject to regulation, and among installations within each sector.

The aim of this paper is to ascertain to what extent the choice of the initial NAP may provide national governments with a way to distribute rents and alter competition among firms operating in different EU countries. Indeed, while there is already some literature on the distributional consequences of the initial allocation of tradeable permits, studies on possible competitive issues are still scarce. As an example of how competitive issues can arise, consider one economic sector, subject to the EU emissions trading directive, in two countries (A and B); firms operating in this sector in country A can gain a competitive advantage with respect to firms operating in the same sector in country B if the amount of pollution quotas per "unit of activity" accruing to the sector in country A is higher than the one going to the same sector in B. Then, by analysing the distribution of permits resulting from NAPs, it would be possible to investigate whether competitive advantages arise among firms operating and/or located in different EU countries.

Roughly speaking, a system of emission permits implies that all sources can emit if they have a permit to do it. A certain number of permits is issued by the environmental regulator according to the total amount of pollution reduction to be achieved. Each permit allows its holder to emit a certain amount of pollution. In this respect, this is still similar to a command and control approach. However, in an "ideal" system of transferable quotas, the "pollution entitlements" are freely transferable on a competitive market: after exchange has taken place, each polluter will have to reduce emissions that exceed held permits.

The choice to adopt emissions trading to control for pollution can be rationalized, at least in part, by referring to its well established theoretical advantages, the most relevant being cost effectiveness: once the environmental regulator has set up a certain environmental quality target, transferable quotas allow to achieve it at minimum cost for society[2]. More specifically, under any possible initial allocation of permits among polluters, exchanges would lead to a point where marginal abatement costs are equalized and total costs of achieving the specified target are at their minimum. This result dates back to Montgomery (1972), and has a simple intuition: if permits can be exchanged in a perfectly competitive market, the allowances will go to the firms that value them the most, that is, they will move from low marginal abatement costs firm, to high marginal costs ones.

[2]For a treatment of the properties of incentive based instruments, see Tietenberg (2004) or, at a more detailed and formal level, Baumol and Oates (1988) and Xepapadeas (1997).

Other market based instruments, such as *optimal* emission taxes, share the "cost effectiveness" property with emissions trading. However, in order to set the tax at the *optimal* level, the environmental regulator should know the regulated firms' marginal abatement cost curves, while emissions trading can achieve cost effectiveness even if the environmental regulator does not have access to such information, so that the environmental authorities' role is reduced to that of providing the institutions to support the market where permits are exchanged.

In spite of the large consensus on cost effectiveness and informational advantages, the practice of emissions trading provides us with a number of new theoretical (and empirical) issues and, in this respect, the EU Emission Trading Directive 2003/87/CE may represent an interesting case study.

The paper is organised as follows. Section 2 provides an overview of the EU ETS Directive, focusing on the role of the NAPs. Section 3 surveys the relevant literature on the efficiency losses related to market power in permits trading. Finally, section 4 focuses on distributional and efficiency issues related to the ways chosen by member states to initially allocate pollution quotas.

2. The E.U. ETS Directive

It has been nearly seven years since the Kyoto Protocol was completed, but it did not enter into force yet. Countries who ratified the Protocol do represent less than 55% of the total carbon dioxide emissions for 1990. Nevertheless, in April 2002 Europe decided to undertake the path of emissions reduction, independently from Kyoto ratification.

In October 2003 the European Directive 2003/87/CE has been approved, introducing an Emission Trading System (ETS) as a step towards the achievement of the Kyoto targets. According to the Directive, installations involved in the activities listed at the end of this paper (*Appendix 1*) must have a greenhouse gas emissions authorization to participate to the scheme; the application can be made to the competent authority and will be issued only if the installation is able to measure and report emissions.

All authorized installations will receive, at the beginning of each year, a quantity of allowances according to a National Allocation Plan (NAP). Each Member State develops a NAP for each period (2005–2007, 2008–2012) and will submit it to the European Commission for approval.

Each country can decide how to allocate allowances, but at least 95% of the allocation must be free of charge (grandfathered) in the 2005–2007 period. In the 2008–2012 period, the minimum percentage of allowances grandfathered is lowered to 90%.

Allowances can be traded freely within the European Community. It means that an installation based in a country A can use an allowance bought from an installation based in a country B and use it to comply with the obligation. Installations with emissions in excess of their allocation of allowances can purchase allowances from the market, while installations with emissions lower than the initial allocation can sell surplus to the market.

By April 30 of each year, starting from 2006, the owner of each installation will surrender a number of allowances equal to its emissions in the previous year, and for those who do not comply with the obligation, a penalty is applicable (€ 40 per tonne in the 2005–2007 period, € 100 per tonne in the 2008–2012 period). According to the theory this would allow reductions to be achieved in the most cost-effective way.

Member States have also the possibility to allow installations to use emissions reduction credits from Clean Development Mechanism (CDM) projects and Joint Implementation (JI) projects to comply with the obligation. As known, Kyoto Protocol outlines JI and CDM as "flexible mechanisms", besides ET, to achieve emissions reduction target, but the Directive 2003/87/CE, as it stands, does not allow participants to deliver credits obtained through JI and CDM projects. Under the Linking Directive, recently approved, Member States may allow participants to use, starting from 2005, Certified Emission Reductions (CERs), obtained with CDM projects, within the EU ETS. Member States may also set a cap over the number of CERs that can be used. From 2008 it will be possible to use also Emission Reduction Units (ERUs), obtained within JI projects.

2.1. The role of NAPs

According to the European Environment Agency, in 2002 emissions in the 15 EU states were 2,9% below their level in the Directive's base year (1990). This clearly shows that the EU is still far from achieving its Kyoto commitment of reducing CO2 emissions by 8%. The success of the EU ETS as a contribution to this achievement will strongly depend on how much NAPs will be ambitious.

Each NAP outlines first how many permits will be allocated among sectors under the Directive, and then the way in which these permits will be distributed among installations of each sector. The number of allowances to be distributed, related to the emission of the countries, gives the drift of future emissions.

So far the NAPs submitted to the Commission show that not all the countries are behaving in the same way regarding the emissions reduction target: Danish NAP allocates an amount of permits that is 15% lower than the projected emissions level of EU ETS sectors; Irish NAP allocates a quantity of allowances that is 2% lower than the projected emissions in 2005-2007 and 16% lower than those in the 2008-2012 period. The British NAP is a part of measures that will bring emissions in 2010 to a level 14,8% lower than the 1990 level, while its target in the *burden sharing agreement* is 12,5%. Some other countries have not been that aggressive and their NAPs will not bring emissions down enough to reach a significant result.

As far as Italy is concerned, according to the final version of the NAP submitted to the Commission, the quantity of allowances to be allocated in the period 2005-2007 will be 239,96, 240,57 and 241,64 millions of tons of CO2 respectively. If we compare these values with the 2000 and 1990 levels of CO2 emissions for EU ETS sectors (224 and 210,2 millions of tons respectively), it means that the initial allocation of allowances will keep emissions within a level which is 14% higher than the 1990 one. The argument leading to this choice is that Italy is a country with a high energy efficiency and a low energy intensity, compared to other European countries. According to the International Energy Agency, in year 2000 the energy intensity ratio (energy consumed over national product) has been roughly 0,13 in Italy against an average of 0,18 at the EU level. This would be an evidence that Italy has already introduced some energy efficiency measures, reducing CO2 emissions and improving the efficiency of economic sectors.

The same argument is also consistent with the possibility for Italian ETS participants to comply with the obligation delivering JI and CDM emission credits without any limitation. The installations will receive a strong incentive to promote projects outside Italy, where marginal costs for emission reductions are lower. To sustain this behaviour, an Italian Carbon Fund has been created as result of an agreement between the World Bank and the Italian Ministry for the Environment and Territory. The goal of a carbon fund is to invest in projects based in developing countries and transition economies, and to benefit by the corresponding emission credits for compliance purposes.

From a general point of view, the different policies in reducing emissions may cause concern about competitiveness among countries. In principle, those who are more determined in reducing emissions will bear a heavier burden, that can undermine relative economic strength and put them in a weaker position than others. On the other hand, countries where firms are relatively more efficient in pollution reduction, could set more stringent abatement targets to increase the price of permits at the EU level, therefore increasing the compliance costs of less efficient firms located in other countries.

Another crucial point is the distribution of the total amount of allowances among sectors within each country. Emissions reduction, especially where energy efficiency is already high, calls for strong investments whose likelihood can be hurt by an unfavourable initial allocation. Further, the more the sector is exposed to international competitiveness, the more it will be sensitive to different NAPs allocation.

A final point to consider is the distribution of permits among installations within sectors. The criteria is usually based either on historical production or historical emissions. The difference is simple: installations producing the same amount of output would receive the same amount of permits under an output based allocation, while those more environmentally virtuous would be penalized under a historical emissions criteria.

3. Departing from the "ideal" theoretical setting: Market Power

The theoretical advantages of ETSs have already been outlined in the introduction. However, such properties rest on a set of assumptions that are likely, in real life, not to hold. One of the most relevant for our purposes is the assumption that the market where permits are exchanged is perfectly competitive. Indeed one or more firms involved in pollution regulation might, by their buying or selling behavior, influence the price of permits. This could happen in two ways:

- *Simple or Cost minimizing* price manipulation occurs when firms that can influence the equilibrium price of permits exploit their "power" to minimize the costs of compliance with environmental regulation
- *Exclusionary Manipulation* occurs when the dominant firm uses its influence in the permits market to gain market shares in the product market by influencing rivals' costs.[3].

Hahn, in his seminal 1984 paper, shows how the static efficiency property of emission permits trading is threatened by the presence of market power, when the latter is exploited to minimize own compliance costs. The author considers a permits market of

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[3]The literature on exclusionary manipulation using the permits market applies the concept of *raising rivals' costs* strategies analysed by Krattenmaker and Salop (1986) and by Salop and Scheffman (1983).

n firms emitting a uniformly mixing fund pollutant, where one firm is assumed to have market power in the sense that it can influence the market price of quotas. The model developed by Hahn reveals essentially that, given the shape of the abatement cost functions, if a firm can “manipulate” permits' price then an upward distortion in total abatement costs results. The consequences of simple permits price manipulation are illustrated in figure 1, where the dominant firm is assumed to be a net seller of permits (that is, a monopolist)[4]

(Figure 1 about here)

The *DD* curve shows the (horizontal sum of the) willingness to pay for permits by the *n-1* firms that act as *price takers*. It is decreasing because, as an additional permit is sold by the monopolist, higher fringe's emissions imply lower abatement and lower related marginal costs. The curve *MAC* is the marginal pollution control cost curve for the “dominant firm”, that is increasing, due to the standard assumption of increasing marginal costs; it represents the marginal opportunity cost for the firm to sell a permit. Finally, the curve *MR* represents the marginal revenues accruing to the dominant firm by selling one more permit. This curve is decreasing and, according to standard monopoly theory, it is below the demand curve. Notice that the origin in figure 1 coincides with the case where the dominant firm causes an amount of pollution equal to its initial endowment of permits, that we call $\bar{E}$.

In a perfectly competitive permits market, the quantity of permits sold by the dominant firm would correspond to the point where *MAC* and *DD* curves cross (it would be, therefore, $NE_c = E_c - \bar{E}$, where E_c is the emissions level that would be chosen in the competitive case). In the presence of market power, the dominant firm would sell permits to the point where marginal abatement costs equal marginal revenues, and the corresponding amount of permits sold ($NE_m = E_m - \bar{E}$, where E_m is the emissions level that would be chosen in the presence of market power) would be lower than the competitive one. As a consequence, a higher level of emissions would be chosen by the dominant firm when exploiting its market power. Finally, the equilibrium price of permits would be higher than the competitive one, and total abatement costs would exceed their minimum by the area FGH.

[4]The illustration in figure 2 is due to Godby et al. (1999).

All these results, that are coherent with standard monopoly theory, can be shown to hold symmetrically in the case when the dominant firm is a net buyer of permits (a monopsonist): the amount of permits purchased, the quantity of emissions and the permits price would be lower than under perfect competition, while higher total abatement costs would result.

We can use Figure 1 to illustrate another remarkable result from Hahn's analysis. Specifically, figure 1 shows that if the initial permits held by the dominant firm were equal to the amount of permits it would choose to use, then no distortion due to market power would arise. This has important implications in the design of the market for pollution quotas, as the environmental regulator can indeed control the "position" of the origin, by changing the initial allocation of permits. As a consequence, if the authorities had full knowledge of permits demand functions, they could choose the initial allocation of permits in order to avoid any distortion related to market power: cost effectiveness would be restored. On the other hand, the further is initial allocation from the amount of permits the dominant firm chooses to use, the higher is the size of area FGH. Intuitively, the lower is the initial endowment of permits with respect to the dominant firm's chosen emissions, the more "powerful" is its monopolistic position, and the higher are the related distortions. All above results can be shown to hold also under the assumption that the dominant firm is a net buyer of permits: also in this case the distortions related to market power could be avoided by choosing the appropriate initial allocation of permits; on the other hand, as the net demand of quotas by the dominant firm increases, so does its monopsonistic "power", leading to a departure of aggregate abatement costs from their first best level. This reasoning lead us to conclude that, in the presence of a dominant firm on the market for permits, the initial allocation not only matters for distributional reasons, but also for efficiency.

While simple price manipulation, analysed by Hahn, implies only an attempt by the firm to influence the price of permits to minimize compliance costs, *strategic or exclusionary* price manipulation, analysed first by Misiolek and Elder (1989), accounts for the chance that a dominant firm on the permits market attempts to manipulate pollution rights in order to raise the costs of rivals in the same industry or to block the entry of new competitors.

Emission permits can be considered as an input with a fixed, exogenously determined, supply. Each firm can substitute away from permits only by engaging in costly pollution reduction and the costs of abatement are likely to depend on the amount of ouput produced as well. Unless firms can reduce to 0 their emissions, permits are to be considered an essential production input and, as a consequence, a firm with market power has the chance to choose the level of permits purchased or sold in order to raise its rivals' costs, and to gain output market shares[5].

In such a setting, Misiolek and Elder (1989) conclude that, if the dominant firm acts strategically in the permits market, and if the impact of price manipulation on rivals' costs is sufficiently strong, then strategic price manipulation results in a lower social welfare (higher total abatement costs) with respect to simple price manipulation. We could provide a graphical illustration for this result using again the monopolistic permits market example in figure 1; if exclusionary manipulation is profitable, then each permit sold by the dominant firm has for the latter an additional marginal cost, tied to the lower resulting price of permits and, then, to the forgone chance of increasing rival firms' costs. Such additional "opportunity" cost could be represented in figure 1 by an upward shift of the *MAC* curve (to *MAC'*). It is clear that under strategic price manipulation the quantity of permits sold by the dominant firm is lower than the one arising under simple price manipulation, and, *a fortiori*, is lower than the competitive level. Figure 1 also shows that strategic price manipulation leads to higher cost distortions than simple price manipulation (area IJH vs. area FGH).

Sartzetakis (1996) and (1997a) improves upon Misiolek and Elder by analysing explicitly production and abatement decisions of firms involved in permits trading, under the assumption that the output market is oligopolistic. The author uses, as a benchmark, the case where the market for permits is perfectly competitive. The conclusions in this case are that minimization of overall abatement costs is obtained, but overall efficiency is not. Trades in the perfectly competitive permits market take place to the point where the price equals marginal abatement costs for each firm, but the presence of oligopolistic power in the output market causes production allocation not to be efficient[6] . Anyway, market power in the product market is not, by itself, enough to make the way permits are initially allocated between regulated firms relevant for efficiency. Market power in the permits market is, then, introduced as follows: one of the two Cournot players in the output market is assumed to have price setting power in the permits market, and exploits this power to pursue positioning strategies. Sartzetakis

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[5]For exclusionary manipulation of permits price to effectively take place two conditions must be fulfilled:

1. a significant share of the output for a particular product market has to be produced in a certain region, and
2. the pollution allowances market in this region must be subject to simple price manipulation, so that one or more firms can influence the emissions trading outcome.

Although these conditions appear quite restrictive, industries depending on specific natural resources or serving markets with local features appear susceptible to this way of exerting market power.

[6]A relevant strand of literature analyzes the effect of competitive permits trading on social welfare when the output market is not perfectly competitive. For an extensive discussion of this issue see Borenstein (1988), Malueg (1990), Hung and Sartzetakis (1994), Sartzetakis (1997b) and (2002).

concludes that the price manipulating behaviour of the dominant firm in the permits market, coupled with an oligopolistic output market, results in a redistribution of production favouring the dominant firm, and a redistribution in abatement going in the opposite direction. Welfare effects of such redistribution, on the other hand, are ambiguous, depending on the relative efficiency in production and pollution reduction of the firms involved in permits trading.

Even if the assumed permits' market structures are rather extreme, an important lesson can be gained from the literature analyzed so far: in any situation where perfect competition in emissions trading does not hold, then the initial allocation of permits can be crucial in determining cost effectiveness.

4. The initial allocation of permits: distributional and competition issues.

The presence of market power could be thought of as a first reason, suggested by the environmental policy literature, why the ideal properties of an emission permits system may fail in "real life", and why a close attention has to be devoted to the initial allocation of pollution quotas. Indeed, it is in general difficult to exclude the chance for market power to arise. In the context of the sectors involved in the EU directive, this could be due to the presence of one or more EU level firms that are sufficiently "large" to influence the equilibrium on the permits market. As Hagem (2004) points out "...the EU system for trading of greenhouse gas permits covers some but not all CO2-emitting industries, increasing the possibility of market power behavior in the permit market." (p.2). This implies that, in the context of the evaluation and approval of the National Allocation Plans, the Commission should devote attention to whether the initial allocation, chosen independently by each EU state, is likely to cause dominant positions in the EU market for allowances. On the other hand, market power is not the only issue that makes the initial allocation of permits relevant. Indeed, as Böhringer and Lange (2004a) point out, "...political feasibility of market-based instruments depends crucially on the specific cost-incidence for influential regulated parties." (p. 2). More generally, different ways of initially allocating permits can have rather different consequences on the distribution of costs of pollution reduction, as well as on the total amount of resources spent by the controlling sources to comply with environmental regulation.

According to Tietenberg (1985) two main categories of initial allocation methods can be identified:

1. initial allocations that involve transfers to or from the government (*Revenue*

auctions, subsidies)

2. initial allocations that involve only financial transfers across sources (*Grandfathering, Zero-revenue auctions*).

1. In a revenue auction the control authority puts a fixed amount of permits up for bid, corresponding to the emissions standard to be achieved. After the auction has taken place, the highest bidders receive a number of permits that equals the number of winning bids. The revenue accrues to the environmental authority. With a subsidy, on the other hand, the permits are initially distributed to regulated firms in a quantity that is sufficient to keep emissions at the unregulated level. Then, the regulator acquires permits from the sources and retires them. As it is clear, the financial implications of these two systems are quite different; they can be evaluated by looking at figure 2[7].

(Figure 2 about here)

Under a subsidy scheme, if the price at which each permit is acquired by the environmental regulator equals *p*, a firm, whose marginal abatement costs are given in figure 2 by the *MAC* curve, would choose to reduce emissions by A^* units, as beyond this point marginal abatement costs are higher than the subsidy that would be received. The total costs of pollution control would be given by the area B, while the total revenue from selling permits to the regulator would equal A+B. Area A represents, therefore, net profits for the firm. On the other hand, under an auction, the same regulated firm would need a permit for all unabated emissions, given by the difference among uncontrolled effluents ($\hat{A}$) and the amount of abatement performed (A^*). Therefore, the firm would bear, under an auction, control costs equal to the area B and permits purchasing costs equal to the area C.

Indeed, a subsidy implies lower costs for the regulated firms, so that it would be likely to imply lower output prices. On the other hand, a transfer from the government requires tax revenue, so that the overall effect on the distribution of pollution abatement costs is likely to depend on the features of the market where regulated firms sell their output as well as on how the tax system works; in any case, we could expect very weak support to a subsidy scheme involving the need for a considerable tax revenue. According to Tietenberg (1985), subsidies also have the relevant shortcoming of providing the wrong "location" incentives to firms. A correctly designed subsidies

[7]Figure 2 is taken from Tietenberg (1985)

scheme requires that permits are purchased at a higher price in locations where a more stringent control is needed, that is, where marginal abatement costs are higher. Pollution sources would then locate to places where environmental regulation is stricter, making the environmental regulator's duties tougher.

2. The two initial allocation schemes analysed above imply transfers from or to the regulated firms. Then, the environmental authorities and/or the government are financially involved in the scheme itself. This is not the case with the second “set” of schemes suggested by Tietenberg. The first of such allocation approach is *grandfathering*, where the environmental authorities choose some baseline control responsibility, and then allocates a corresponding amount of permits free to regulated firms. Grandfathering implies that regulated firms only bear, on average, pollution control costs; on the other hand, each regulated firm's expenses could exceed or fall short of abatement costs, so that the initial distribution rule can generate strong asymmetries in the way abatement costs are born by regulated firms.

A second scheme that does not involve net transfers to or from the government are *revenue neutral auctions,* first proposed by Hahn and Noll (1982). Roughly speaking, such a scheme implies that, once the total emissions target has been set up by the environmental authorities, each source receives a fraction of total emissions according to a distribution rule. Each firm is then required to put all received allowances up for sale in an auction, and to bid up for the credits by specifying its demand schedule. The pollution control authority receives bids, and provides each source with the amount of permits demanded at the equilibrium price resulting from the auction. In this way each regulated firm pays only the amount of permits bought that exceed the initial endowment. As in the grandfathering case, there might be individual “losing” and “winning” firms, but on average the regulated firms pay only control costs. Finally, also under a revenue neutral auction, the initial distribution rule is crucial in allocating the financial burden related to pollution reduction.

A considerable amount of literature suggests that there could be important efficiency advantages by using auctioned in place of grandfathered permits, as the first allocation method generates revenue that can be used to reduce distortionary taxes[8], offsetting social welfare losses related to environmental policy[9].

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[8]See for example Goulder et al. (1997) and Parry et al. (1999).

[9]As Parry (2003) points out, environmental policy can be distortionary because it increases firms' production costs and product prices; as a consequence, real household wages drop, generating adverse effects on labor supply in the same way as a direct tax. The reduction in labor supply leads to a welfare loss in the tax-distorted labor market that can be substantial in magnitude relative to the partial equilibrium welfare effects of environmental policies.

Nevertheless, firms are very sensitive to their pollution control costs. This can be a crucial element in determining the real chances of market based instruments to be implemented in practice: we can, in fact, expect firms to have a stronger incentive than consumers to exert pressure on regulatory authorities[10], so that grandfathering (or zero-revenue auctions) turns out to be preferable on the ground of political feasibility. This is confirmed by the real life observation that the implementation of tradeable permit systems has often been linked to a free initial distribution of permits (Stavins 1998), as it has been the case, for example, in the SO2 permits allocation to electric utilities in the context of the U.S. Clean Air Act (Burtraw 1999). More important for our purposes, the acceptance of the EU Directive on emissions trading was approved by member states only under the condition that emission allowances be freely allocated (Böhringer and Lange (2004a))[11].

On the other hand, the higher political feasibility of revenue rebating schemes, as grandfathering and revenue-neutral auctions, does not come at no cost. From an efficiency point of view, it would be preferable to provide rebates and/or to allocate permits through lump-sum transfers, which correspond to allocations of allowances that do not depend on firm-specific decisions; however, from a distributional equity viewpoint, such transfers can be highly undesirable since they typically benefit stakeholders without lowering adverse effects on production. This is coherent with results obtained by Parry (2003), who shows that grandfathered permits can be highly regressive, as they "...enact an income transfer towards higher-income groups at the expense of other households." (p. 2). Therefore, as evidence from National Allocation Plans submitted to the European Commission suggests, the free initial allowance allocation is often based on firms' output or emission levels. Since, following Böhringer and Lange (2004a), both emissions and production are choice variables of the firm, the allocation of permits conditioned on output or emissions themselves works as an implicit output subsidy that affects firms' behavior and tends to reduce economic efficiency of the environmental policy, creating a trade-off among efficiency itself and regulated industries compensation. In particular, the authors analyze the features of this trade-off in a so-called "open emission trading system", where countries perceive the international market price for emission allowances as fixed. This is how the EU carbon

[10] Cramton and Kerr (1999) show that, under certain conditions, the changes in prices and factor returns due to pollution regulation are quite similar between aucioned and grandfathered emission permits; on the other hand, consumers could, in principle, benefit from the introduction of taxes/auctioned permits, as a part of the resulting revenue could be redistributed to them. However, as the number of consumers affected by environmental policy is, in general, considerably larger than that of firms, it is very likely that the gains accruing to each consumer are not high enough to balance the transaction costs involved in reaching an agreement, while the opposite is expected to hold for firms.

[11] See art. 9, comma 3, Directive 2003/87/CE.

trading is expected to work, if each EU country views the EU permit market as sufficiently large to take the permits price as exogenous (that is if no market power problems arise).

Böhringer and Lange consider the welfare effects of output- and emission-based allocation rules, and conclude that if the allocation of allowances is output based, no distortion arises in emissions per unit of output with respect to the first best. On the other hand, an output based allocation "works" as a subsidy on output, so that the level of the latter will be distorted upward. Turning to an emissions based rule, since such a rule causes emissions per unit of output to be subsidized, they will be chosen at a level that is larger than optimal. This generates an ambiguous effect on output: on one hand, higher emissions per unit of output increase social marginal production costs, reducing then the output level. On the other hand, the emissions-based rule implicitly subsidizes output, increasing its level.

Another relevant point made by Böhringer and Lange (2004a) is that, in an "open system", the excess costs that arise, due to the use of output or emissions-based allocation schemes, depend on the exogenous price for emission allowances. Using numerical simulations, the authors conclude that in an "open trading system", an output-based allocation rule is less costly than the emission-based rule to preserve output in energy-intensive sectors. In particular, if the international (given) permits price is very high, then the implicit emission subsidies, resulting from an emission-based allocation rule, produce huge efficiency losses as they imply high expenditures for carbon permit imports rather than high net revenues from efficient carbon permit exports. Finally, only for small international permit prices there is a relatively small gap in cost-effectiveness between the output- and emission-based rule.

In a companion paper, Böhringer and Lange (2004b) further analyze the impact of output-based allocation schemes, under the assumption that each country sets its total emissions target in line with the "Kyoto burden sharing agreement" among EU countries[12,], and that the emissions reduction in non Directive sectors is chosen by each country at the socially optimal level. The rest of the emissions budget is then allocated to Directive sectors. Böhringer and Lange show that the "burden sharing agreement", if implemented in this way, is likely to cause differences in allocation schemes across countries in terms of allowed emissions per unit of output; as a consequence, firms with

[12]The Kyoto Protocol commits the EU to reducing its greenhouse gas emissions by 8% below 1990 levels during the first "commitment period" 2008 to 2012. Under the "Burden-Sharing Agreement", which became legally binding for the Member States when the EU ratified the Kyoto Protocol (Council Decision 2002/358/EC of 25 April 2002), this target is shared between the 15 Member States.

identical characteristics could receive a different initial allocation of permits per unit of output depending on their location. This effect is quantified, together with its efficiency consequences, through simulations: the output-based assignment of free allowances to identical firms is shown to vary by a factor of 5 among EU countries. This causes concern about the chance that single NAPs could distort competition across firms covered by the Directive. Böhringer and Lange (2004b) quantifies the net gains or losses related to a hypothetical harmonization of emission allowance per unit of output across Directive firms in different regions; such harmonization process is shown to require country-specific adjustments between Directive sectors and Non-Directive sectors, leading the initial allocation of permits in single countries away from cost effectiveness. While these adjustments are negligible with respect to aggregate EU economic impacts, Böhringer and Lange show that the implications at the single country level can be substantial.

Though related costs can be high, the harmonization objective cannot be overridden. Indeed, the initial distribution of permits can affect competitiveness among firms involved in the EU permits trading Directive at least in two ways:

1. Following Woerdman (2001), differences in the permits allocation procedures among Member States involved in a European carbon trading market could lead to state aid[13]: *ceteris paribus*, firms in member States where emission allowances are grandfathered could gain an advantage in terms of available financial resources with respect to firms located in member states where permits are auctioned off. This argument leads to the conclusion that it is desirable to harmonize permit allocation procedures across member states.
2. Following, among others, Barrett (1994) and Ulph (1996), governments could set environmental policy strategically in order to give their domestic producers an advantage in the international output markets (so-called "eco-dumping").

Argument in point 1 should not be a cause of great concern. Indeed, under a "procedures harmonization" point of view, the European Commission seems to be following the right steps, as the Directive on emissions trading explicitly impose to all member states the grandfathering of at least 95% (90% in the period 2008-2012) of total allowances[14].

[13]See artt. 87-89, Treaty establishing the European Community, Official Journal C 325 of 24 December 2002.
[14]See Art. 10, Directive 2003/87/EC.

On the other hand, some contradictions in the Emissions trading Directive arise if we focus on strategic sectoral distribution of permits. Coherently with article 11, Annex III states that "...The plan shall not discriminate between companies or sectors in such a way as to unduly favour certain undertakings or activities in accordance with the requirements of the Treaty, in particular Articles 87 and 88 thereof."[15]. But article 1 underlines that the main objective of the Directive is the introduction of "... greenhouse gas emission allowance trading within the Community in order to promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner."[16]. As should be clear from Böhringer and Lange contributions, such objectives can be in contrast with one another, and both with the need to guarantee political feasibility of emissions trading. A careful evaluation of National Allocation Plans is therefore, also in this respect, a needed pre-requisite for a "well functioning" and sufficiently "competition neutral" emission permits market.

[15]Directive 2003/87/EC, Annex III, comma 5.
[16]Directive 2003/87/EC, Article 1.

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Appendix 1: Activities Included in the E.U. ETS

Energy Activities

- **Combustion installations** with a rated thermal input exceeding 20 MW
- **Mineral oil refineries**
- **Coke ovens**

Production and Processing of Ferrous Metals

- **Metal ore** (including sulphide ore) **roasting or sintering** installations
- Installations for the **production of pig iron or steel** (primary or secondary fusion)
  including continuous casting, with a capacity exceeding 2.5 tonnes per hour

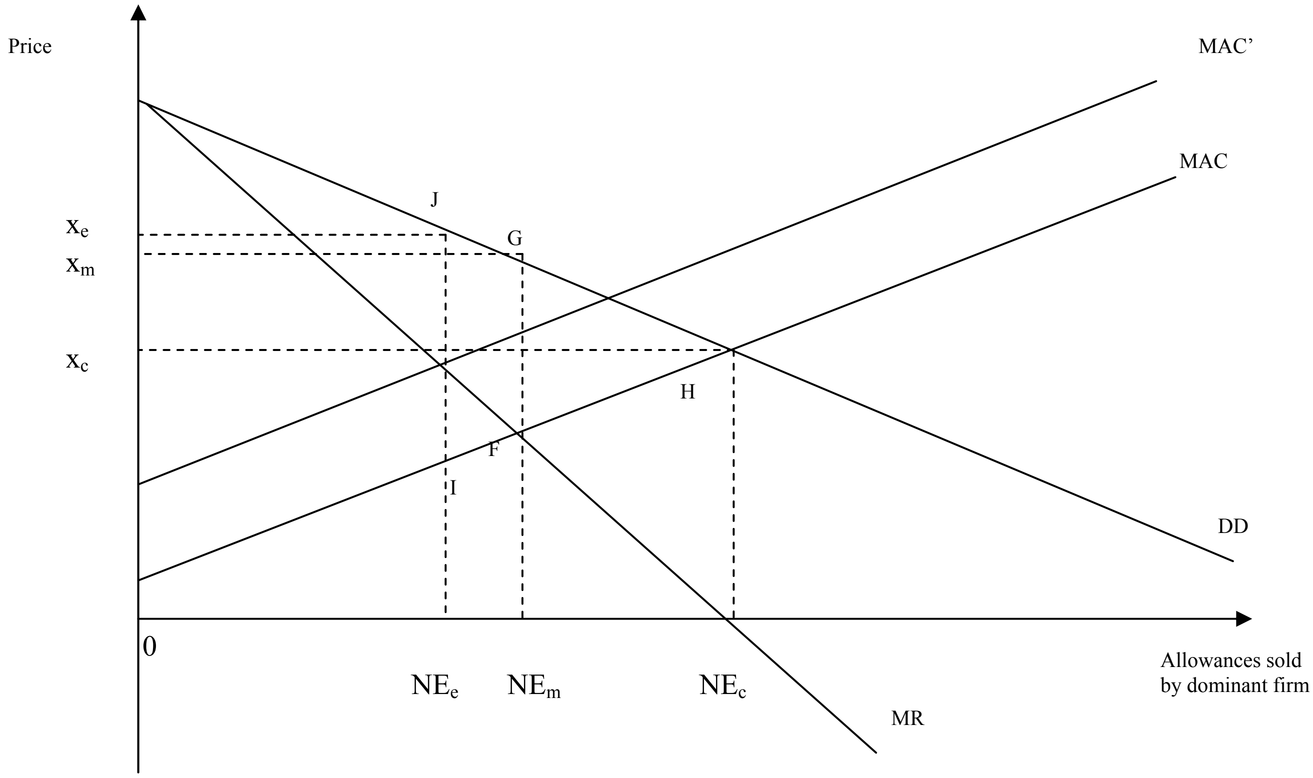
Mineral Industry

- Installations for the **production of cement clinker** in
  - rotary kilns with production capacity exceeding 500 tonnes per day, or
  - lime in rotary kilns with production capacity exceeding 50 tonnes per day, or
  - other furnaces with production capacity exceeding 50 tonnes per day
- Installations for the **manufacture of glass** including **glass fiber** with a melting capacity exceeding 20 tonnes per day
- Installations for the **manufacture of ceramic products** by firing, (in particular, roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain) with
  - production capacity exceeding 75 tonnes per day, and/or
  - kiln capacity exceeding 4 m^3 and setting density per kiln exceeding 300 kg/m^3.

Other Activities

- Industrial plants for the production of
  - **pulp from timber or other fibrous materials**
  - **paper and board** with a production capacity exceeding 20 tonnes per day

Figure 1



Price
MAC'
MAC
J
G
H
F
I
DD
0
NE$_e$
NE$_m$
NE$_c$
MR
Allowances sold
by dominant firm

Figure 2