

Modeling the European Directive Establishing a Scheme for Greenhouse Gas Allowance Trading and Assessing the Market Power of Firms

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Abstract

It has long been acknowledged that market mechanisms may decrease the welfare cost of an environmental policy and, in the case of the Kyoto Protocol, three instruments have been designed, Tradable Permits (TP), Joint Implementation (JI) and Clean Development Mechanism (CDM).

European Union long-standing position has been to claim that these flexibility mechanisms may only be supplemental to domestic action, but at the same time to favor trade between firms within Europe, especially among firms belonging to highly energy intensive sectors. This endeavor led to the vote of a Directive (2003/87/CE) establishing a scheme for greenhouse gas allowance trading. Trading is limited, at least in a first stage, to some industrial sectors, precisely defined in the Directive.

Two important features characterize the Directive: on the one hand, the almost free of charge allocation of allowances to firms (only 5% may be sold or auctioned) and on the other hand the responsibility given to each Government to determine the total amount of domestic allowances and to allocate them among sectors and among firms.

This scheme appears to favor the electric generation sector and particularly the German utilities, which are the biggest emitters of GES in Europe. Using a simple representation of the market of tradable allowances calibrated on a General Equilibrium Model (GEMINI-E3), the topic of the paper is to assess the working of the trading scheme, its likely inefficiencies and the possible market power given by Governments to domestic firms.

The main results are twofold: on the one hand, it can be demonstrated that, though it is partial (i. e. concerns only a limited set of sectors), the trading scheme can be as efficient as a generalized European market of permits provided that each country allocate the right quantity of quotas to the firms belonging to the trading sector and that the latter behave competitively; on the other hand, there is a real market power of German firms, which of course depends on the quantity of quotas allocated to them by the Government. But purchasing countries, mainly Italy and The Netherlands, also have the possibility to restrict demand and exert a symmetric market power. The welfare cost of non-cooperative strategies is assessed and shown to be of a very limited magnitude, compared to the gain accruing from the Union-wide trade of emission permits that the European Directive makes possible.

JEL Classification: Q4, Q3, C68, D58.

Keywords: Climate Change; Kyoto Protocol; Computable General Equilibrium Model; Emission Trading, Maximin Equilibrium, Cournot Equilibrium.

1 Introduction

The aim of this paper is to assess the recent European Directive establishing an EU-wide market of allowances of greenhouse gas emissions, complementing the flexibility mechanisms of the Kyoto Protocol. It is well established that a market for emission allowances is an efficient way to allocate abatements among firms in a domestic, regional or world framework (see [6] [9] [11]). Economic theory tells us that the way the emission allowances are initially allocated among the different agents in the economy does not matter, in terms of global welfare effect: Pareto efficiency is achieved irrespective of the initial allocation [5]. However, market imperfections in the European economies may challenge the efficiency of trading. In [2], it is shown that some countries can be worse off with trading than without because of imperfections due to pre-existing tax distortions. Another source of imperfection comes from the limitation of the emission permits market to some sectors of the economy. These market imperfections may create a situation where some dominant countries strategize their allocation of allowances.

1.2. The general economy of the European Directive and the case for strategic allocation of allowances

In the process of pushing forward the implementation of emission trading at the EU level, the European Commission has published a directive for greenhouse gas emission allowance trading within the Community [7]. The directive states that only selected sectors will have the opportunity to participate in the CO₂ allowance market in the first period (2005-2008). According to the Directive, Member States will have to decide on the allocation of allowances across the trading sphere, which will be given for free¹ in the initial period. The Directive does not impose any harmonization on allowance allocation rules but asks for European Commission approval of national allocation plans. In the second period, covering the years 2008 to 2012, the trading scheme will be extended: i) to the new European Union members (e.g. accession countries); ii) to the other GHG emissions and iii) to additional (but not all) sectors. Each Government will then have to implement the allocation scheme for the corresponding period.

Total GHG emissions of each country are bound by the Kyoto Protocol², more precisely the Burden Sharing Agreement that allocates the global European commitment (-8% in 2008-2012 relatively to 1990) among member countries³. Then, for the non-trading sphere in each country, the target of emissions is equal to total commitment less the amount of allowances allocated to the trading sphere. If the allowances are too generous, the target will be very tight for the non-trading sphere, and this would be the sign of a misallocation of efforts between the two spheres.

Contrarily to the trading sphere⁴, firms in the non-trading sphere may resort to the Kyoto flexibility mechanisms, trade of permits (TP), clean development mechanism (CDM) and joint implementation (JI). Some countries have already announced their will to favor the use by domestic firms of these tools.

Focusing on the European trading scheme, one might worry about the possibility that governments play strategically with the initial allocation of permits. They may pursue two different targets. The first is favoring the competitiveness of domestic firms, particularly those of the trading sphere, which are both energy-intensive and open to foreign competition (though, because of high transportation costs, they are somehow sheltered). Such a concern has already been pointed to in various contexts by several economists (see [4], [1],[10], [8]) and systematically assessed in the present case by Bernard et alii [3]. The possibility

¹ More precisely, only 5% of the allowances may be sold or auctioned, but nearly all countries intend to allocate them for free in the first period.

² Only during the Kyoto commitment period but, concerning the 200-2007 period, Governments are invited to follow a path consistent with the 2008-2012 target.

³ For instance, the commitment for France is 0% (stability relatively to 1990)

⁴ A new directive, under discussion, will allow limited possibilities of resorting to the Kyoto flexibility mechanisms.

of substantial gains, both in terms of activity of the concerned sectors and in terms of welfare, appears very limited and this result has already been obtained in the similar case of so-called “leakage”.

The second target is more traditional and is related to the market power that the European trading scheme may confer to some countries. Its peculiarity is, in application of the well-known European principle of “subsidiarity”, the right of each Government to determine independently and freely (within some limits, and under the scrutiny of the European Commission) the total amount of allowances given to the trading sector. Neither a formal co-ordination between Governments nor a consistency check is provided by the trading scheme.

By preventing any trade between firms belonging to the two sectors (“trading” and “non trading”), the Directive will insulate carbon markets with the creation of: i) a global carbon European market for the trading sector; and ii) as many domestic markets as countries for the firms of the non-trading sector. Different carbon prices are likely to emerge in the different markets, generating inefficiency and increased welfare cost at the Union level. Moreover, by allocating more or less allowances to its trading sector, each Government –and in particular the Governments of countries that are big emitters and presumably big sellers or big purchasers- may manipulate the equilibrium market price of allowances and then capture domestic monopolistic or monopsonic welfare gains.

1.3. Aim of the paper and methodology

The European Directive raises several problems, but in line with the previous developments, two issues will be considered. The first one is whether there exists, in the “game” between Governments as defined above, a co-operative solution maximizing global welfare (section 2).

The second one is an exact assessment of the market power of European countries (section 3). Among them, three appear as major players, Germany as a potential seller, and Italy and the Netherlands as potential buyers (other countries are marginal players). Germany “weights” in the market twice each of the two others. In order to have a more “balanced” situation, it will be assumed that there is systematically a collusion between Italy and The Netherlands, i. e. that they decide together the total amount of allowances allocated to their trading sectors.

The methodology is based on a simplified representation of the carbon markets calibrated on a Computable General Equilibrium model (GEMINI-E3). The main inputs from GEMINI-E3 are: on the one hand the reference solution represented by a generalized European market of tradable permits (or, equivalently, a uniform carbon tax); on the other hand abatement curves of the trading and the non-trading sectors of each country.

Two main assumptions are made. The first is that countries (and their domestic firms) do not resort to the Kyoto flexibility mechanisms⁵. The second is that firms behave competitively and in particular price output at the marginal cost⁶ (including the opportunity cost of allowances, whether they are free of charge or purchased).

2. Existence of a co-operative solution

The analysis is based on a modeling of the various sectors concerned by European Directive, the trading and the non-trading sectors of each country, and the associated curves of abatement. It also takes into account the commitment of the European Union to the Kyoto Protocol, and the sharing between member countries via the Burden Sharing Agreement (BSA).

⁵ The same analysis could be carried in the case of full utilization of the Kyoto flexibility mechanisms and similar results would hold. However, the numerical differences between scenarios would be of a very small magnitude, the Kyoto mechanisms largely “dominating” the European trading scheme and imposing a very small –and identical- carbon price in each sector and each country.

⁶ The case of a non-competitive behavior by firms is analyzed in [3]

2.1. Notations

Defining the trading sector by index 1 and the non-trading by sector 2, the notations of the model are the following:

E_i^n : Business as Usual (BAU) emissions of sector i in country n (1 to N)

$\overline{D}^n$: global emissions commitment of country n (Burden Sharing Agreement)

q^n : allowances allocated to the trading sector in country n

a^n : net purchase of allowances by the trading sector in country n

A_i^n : abatement in sector i and country n

C_i^n : abatement cost in sector i and country n (function of A_i^n)

2.2. Modeling

Abatement in the trading sector is equal to the difference between BaU emissions and total allowances, allowances allocated by the Government and (net) allowances purchased to the trading sectors of other countries:

$$A_1^n = E_1^n - q^n - a^n \quad (1)$$

In the non-trading sector, abatement is such that the overall commitment of the country is satisfied. From:

$$A_1^n + A_2^n = E_1^n + E_2^n - \overline{D}^n + q^n \quad (2)$$

it results:

$$A_2^n = E_2^n - \overline{D}^n + q^n \quad (3)$$

Efficiency requires the minimization of the overall abatement cost in the European Union under the constraint of allowances market clearing (and non-negativity conditions which appear, in the present case, to be non-binding):

$$\min Y = \sum_{n=1}^N (C_1^n + C_2^n)$$

under the constraint:

$$(\pi) \quad \sum_{n=1}^N a^n = 0$$

with:

$$C_1^n = C_1^n(E_1^n - q^n - a^n)$$

$$C_2^n = C_2^n(E_2^n - \overline{D}^n + q^n)$$

Neglecting the non-negativity constraints, optimization yields the $2N$ conditions:

$$-\frac{\partial C_1^n}{\partial a^n} = \pi$$

$$\frac{\partial C_2^n}{\partial q^n} = -\frac{\partial C_1^n}{\partial q^n} \quad [= \pi]$$

which show that the marginal abatement cost is identical across sectors and across countries. *The resulting situation is then identical to the one provided by a generalized market of permits in the European Union:*

same carbon price, same abatement in each sector, and same amount of net permits (or allowances) purchased by each country.

The co-operative solution can then be directly determined from the situation corresponding to the generalized market of permits in the following way: *allocate to the trading sector in each country an amount of allowances equal to the sum of optimal emissions in this sector and total sales of permits by the concerned country.*

Actually the total amount of allowances allocated to the EU trading sector is equal to the total amount of optimal emissions in this sector (total net sales being equal to zero) and trade among European firms will equalize marginal abatement cost across countries, thus leading to the optimal level of abatement in each country. Then abatement in the non-trading sector -by difference to the overall commitment of the given country- will also be equal to optimal abatement (as defined by the case of a generalized market of permits).

2.3. Numerical application to the European Directive

Application to the European Directive is straightforward from the results obtained with GEMINI-E3⁷. The model yields, for the scenario of a generalized European market of permits (in millions tons of C):

Table 1 : emissions and net sales in the scenario of a generalized European market of permits

	2005	2010	2020	2025
DEU				
Emissions of the trading sector	77	63	53	49
Emissions of the non-trading sector	129	125	132	136
Net sales of permits	11	21	24	24
FRA				
Emissions of the trading sector	18	16	15	14
Emissions of the non-trading sector	87	84	88	89
Net sales of permits	-2	-3	-5	-6
GBR				
Emissions of the trading sector	50	43	39	38
Emissions of the non-trading sector	89	85	88	89
Net sales of permits	4	7	7	7
ITA				
Emissions of the trading sector	45	41	39	38
Emissions of the non-trading sector	70	70	75	77
Net sales of permits	-5	-9	-12	-12
ESP				
Emissions of the trading sector	29	25	23	22
Emissions of the non-trading sector	46	44	46	47
Net sales of permits	-2	-3	-3	-3
NLD				
Emissions of the trading sector	17	15	14	13
Emissions of the non-trading sector	36	36	37	38
Net sales of permits	-4	-10	-10	-9
BEL				
Emissions of the trading sector	10	8	8	7
Emissions of the non-trading sector	25	24	24	26
Net sales of permits	-3	-5	-5	-4
OEU				
Emissions of the trading sector	47	41	37	36
Emissions of the non-trading sector	64	63	64	66
Net sales of permits	1	2	3	4

⁷ GEMINI-E3 contains 21 countries/regions, 7 of which represent the European Union (Germany, France, Great Britain, Italy, Spain, The Netherlands, Belgium and Other European Countries). See in particular [3]

from which results the efficient allocation of allowances in the European trading scheme:

Table 2: allocation of allowances in the co-operative solution

	2005	2010	2020	2025
DEU	88	84	77	73
FRA	16	13	10	8
GBR	53	50	46	45
ITA	40	32	28	25
ESP	27	21	20	19
NLD	13	5	4	3
BEL	7	3	3	3
OEU	48	42	41	40

Obviously countries that are doomed to be net sellers of permits have to over-allocate allowances to their trading sector, while countries that are doomed to be net purchasers have to under-allocate. This may generate a competitive distortion among the firms of the various members of European Union, which benefits to countries such as Germany, Great Britain and Other European Countries.

This efficient allocation can be compared to two other rules contemplated by the European Commission, the “grandfathering” rule (allocation proportional to emissions in the initial situation⁸) and the allocation corresponding to the domestic climate plan⁹.

Table 3: allocation of allowances according to the “Grandfathering” rule

	2005	2010	2020	2025
DEU	91	87	87	87
FRA	18	16	16	16
GBR	51	44	44	44
ITA	42	36	36	36
ESP	29	23	23	23
NLD	18	16	16	16
BEL	10	8	8	8
OEU	48	41	41	41

Table 4: allocation of allowances according to the Domestic Climate Plan

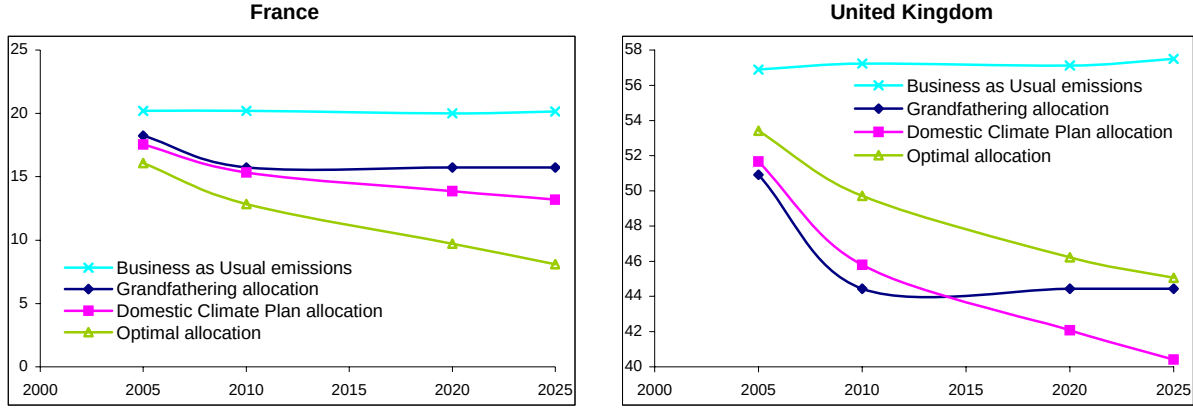
	2005	2010	2020	2025
DEU	85	76	65	59
FRA	18	15	14	13
GBR	52	46	42	40
ITA	42	36	33	32
ESP	28	23	21	20
NLD	15	11	10	10
BEL	8	6	6	6
OEU	48	42	40	38

⁸ 25% below the emissions of the year 1997 (average commitment of the European Union) starting from 2010.

⁹ Corresponding to the optimal allocation of abatement without resorting to Kyoto flexibility mechanisms.

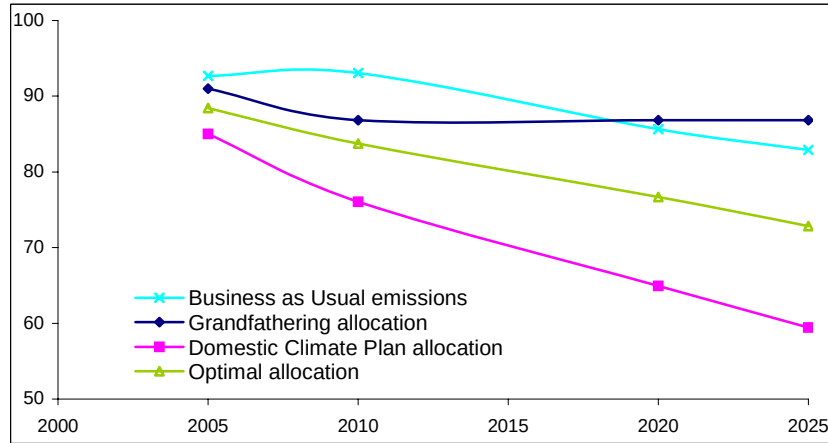
According to the countries, the efficient allocation is below (case of France) or above (case of United Kingdom) the two other allocations:

Figure 1: Comparison of allowance allocation rules (France and United Kingdom)



In the case of Germany, biggest emitter and potentially biggest seller of allowances, the efficient allocation is intermediary between the two other rules, as shown in the Graph below:

Figure 2: Comparison of allowance allocation rules (Germany)



2.4. Local stability

Is any country, either net purchaser or net seller of allowances, inclined to challenge this co-operative allocation of allowances, either by allocating a different amount of allowances or by giving incentive to the firms belonging to the trading sector to sell more or less the amount which is optimal for them. Considering only small variations in the neighborhood of the co-operative solution, the answer is clearly no.

Effectively, taking the price of allowances as given, minimization of the cost for the given country:

$$\min Y^n = C_1^n (E_1^n - q^n - a^n) + C_2^n (E_2^n - \bar{D}^n + q^n) + \pi a^n$$

yields:

$$-\frac{\partial C_1^n}{\partial a^n} = \pi$$

$$\frac{\partial C_2^n}{\partial q^n} = -\frac{\partial C_1^n}{\partial q^n} \quad [= \pi]$$

which are exactly the optimization conditions obtained in the global optimization problem. Any small change from the co-operative solution would be costly for the country.

3. Strategic behavior of Governments

Assessing strategic behavior of Governments needs to go a step further in the modeling of the allowances market, and in particular to determine precisely the abatement cost functions. This is performed by calibration on the reference situation of GEMINI-E3, assuming that the costs functions are quadratic (which is the sensible assumption in the neighborhood of the reference situation):

$$C_i^n = k_i^n (A_i^n)^2$$

Table 5 presents the BaU emissions in each sector:

Table 5: Emissions in the BaU situation

		2005	2010	2020	2025
DEU	Emissions of the trading sector	93	93	86	83
	Emissions of the non-trading sector	134	138	153	163
	Total emissions	227	231	239	246
FRA	Emissions of the trading sector	20	20	20	20
	Emissions of the non-trading sector	91	94	102	107
	Total emissions	111	114	122	127
GBR	Emissions of the trading sector	57	57	57	57
	Emissions of the non-trading sector	96	102	114	121
	Total emissions	153	159	171	179
ITA	Emissions of the trading sector	50	51	54	55
	Emissions of the non-trading sector	73	76	85	89
	Total emissions	122	128	139	144
ESP	Emissions of the trading sector	34	34	35	35
	Emissions of the non-trading sector	48	49	53	56
	Total emissions	82	83	88	91
NLD	Emissions of the trading sector	19	19	19	19
	Emissions of the non-trading sector	38	41	45	47
	Total emissions	57	60	64	66
BEL	Emissions of the trading sector	11	11	11	11
	Emissions of the non-trading sector	26	27	28	29
	Total emissions	37	38	39	41
OEU	Emissions of the trading sector	55	56	57	58
	Emissions of the non-trading sector	66	68	72	75
	Total emissions	121	124	129	133

and table 6 optimal abatements in the generalized European permits market (and co-operative) situation, and table 7 the equilibrium prices of permits:

Table 6: Optimal abatements in the trading and the non-trading sectors

	2005	2010	2020	2025
DEU				
Abatement in the trading sector	16	31	33	34
Abatement in the non-trading sector	5	12	21	27
FRA				
Abatement in the trading sector	2	4	5	6
Abatement in the non-trading sector	4	9	14	18
GBR				
Abatement in the trading sector	7	15	18	20
Abatement in the non-trading sector	7	17	26	32
ITA				
Abatement in the trading sector	5	11	15	18
Abatement in the non-trading sector	3	6	10	12
ESP				
Abatement in the trading sector	5	10	12	13
Abatement in the non-trading sector	2	4	7	9
NLD				
Abatement in the trading sector	2	4	5	6
Abatement in the non-trading sector	2	5	8	9
BEL				
Abatement in the trading sector	1	3	3	4
Abatement in the non-trading sector	1	3	4	4
OEU				
Abatement in the trading sector	8	15	19	22
Abatement in the non-trading sector	2	5	8	10

Table 7: Equilibrium prices of permits

	2005	2010	2020	2025
Price of permits	54	145	217	273

Equalizing marginal abatement costs to prices yields:

$$\pi = 2k_i^n A_i^n$$

from which the calibrated value of the coefficient results:

$$k_i^n = \frac{\pi}{2A_i^n}$$

3.1. The Cases of Monopolistic and Concerted Monopsonic behavior

Restricting supply of allowances to the trading sector increases the equilibrium price of permits, and it is beneficial to countries that are net sellers, in particular Germany. The monopolistic price corresponds to the amount of allowances that maximizes the welfare for Germany, i. e. that minimizes the global cost of abatement less the receipts accruing from the sales of allowance. It is assumed that other countries maintain an optimizing behavior (as defined previously), and allocate an amount of allowances such that the carbon price, in each sector, is equal to the equilibrium price of allowances. Only in the non-trading sector of Germany does the carbon price differ from the allowance market price.

It is also illustrating to compare the previous situation to the case of monopolistic behavior in a generalized European permits market. The potential for monopolistic gains is then higher, because discrimination operates in all sectors, not exclusively in the trading sector. Carbon price is unified among sectors in each country (including Germany), and across countries (excluding Germany).

Concerted monopsonic behavior of Italy And The Netherlands assume that the two countries decide on their combined supply of allowances in order to reap the highest global gain. Global optimization implies that the carbon prices are equalized in the non-trading sectors of the two countries.

Numerical results of the monopolistic and concerted monopsonic scenarios, *measured by differences with respect to the co-operative solution*, are represented in the following figures, for year 2010 and 2020.

Figure 3: Net sales of permits or allowances by country (in millions t of C)

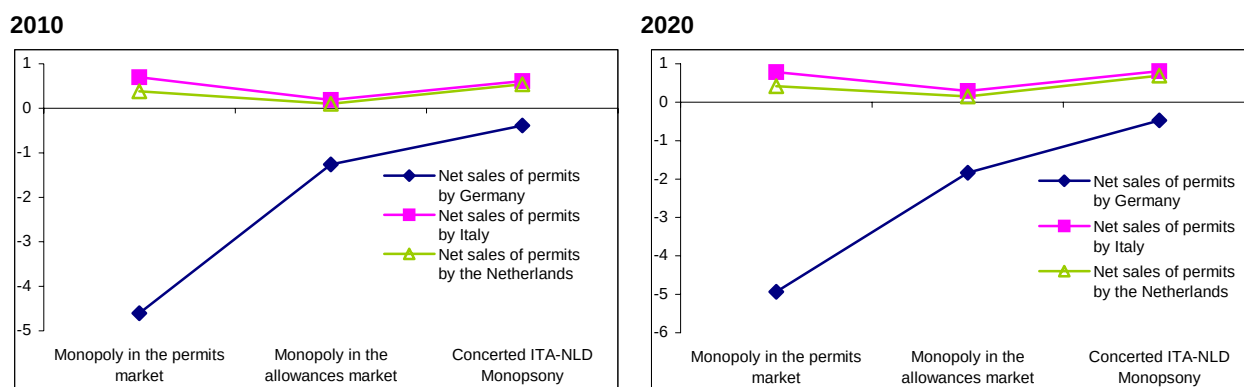


Figure 4: Allocation of allowances by country (in millions t of C)

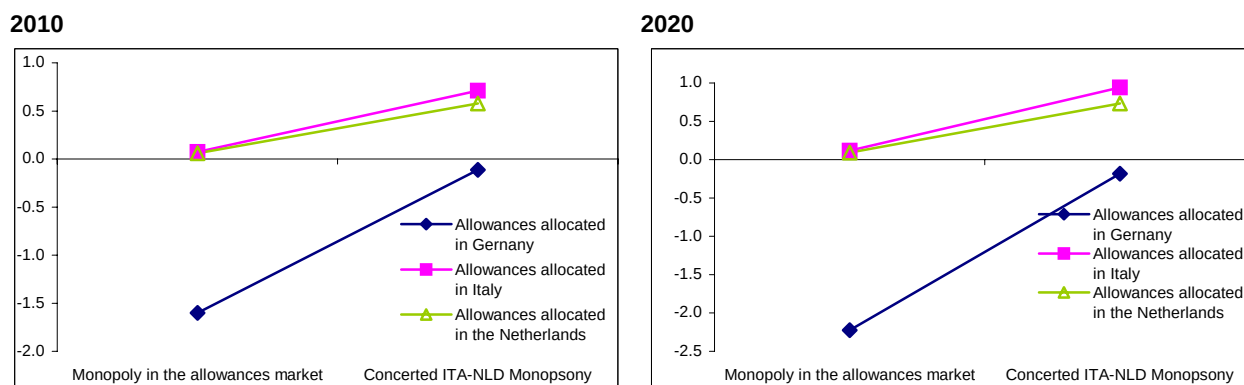
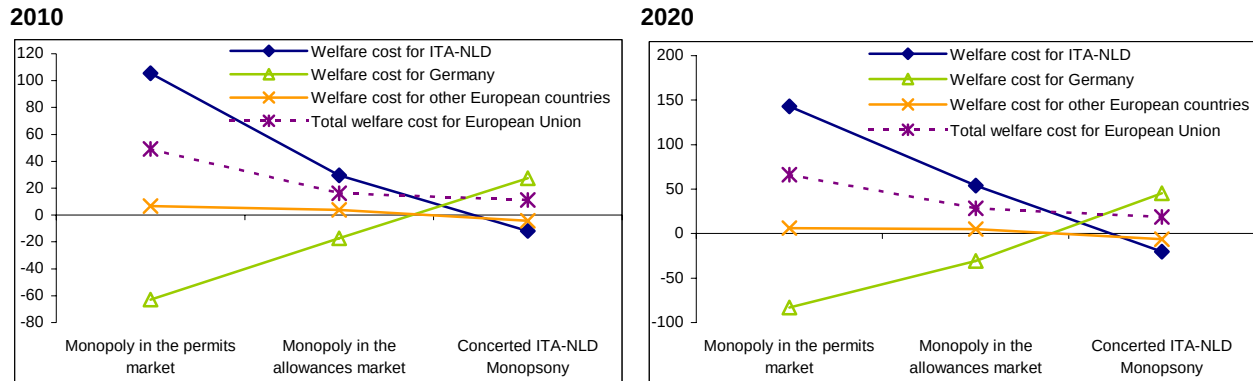


Figure 5: Welfare cost (in millions of Euro)



The main result is that the market power of Germany is much smaller in the case of the trading scheme created by the European Directive on quotas than it would be in a generalized market of tradable permits. Sales of permits are restricted to 1 to 2 millions t of carbon (instead of around 5 millions t), and monopolistic gains to around 20 millions Euro (instead of 70 to 90 millions).

Symmetrically, the combined market power of Italy and the Netherlands is comparable to the market power of Germany. Restriction of demand is around 1 to 2 millions t of carbon, with a gain of 10 to 20 millions of Euro.

3.2. Strategic game between Germany, Italy and The Netherlands

An interesting question is whether the strategic behavior of Germany on the one hand and of Italy and the Netherlands on the other hand, have neutralizing (equilibrium close to the co-operative solution, and then limited welfare cost), or additive effects (higher welfare cost).

A specific feature of the “game” between countries is that Governments are supposed to unveil their domestic allowance allocation Plans simultaneously (at the end of March 2004, according to the Directive, but there will be some delay). Then each Government is in the ignorance of the Plans decided by the others, but it can be assumed that they know the cost of abatement functions of all countries, both in the trading and in the non-trading sectors.

Then the relevant game concept is not the Cournot equilibrium (which assumes that each player can observe the action of other players) but the Maximin equilibrium, defined as the equilibrium between maximin strategies implemented by each player. Each player (Germany, ITA-NLD) is supposed to know all “Pay-Off” functions, to determine for each of his own possible actions the minimum pay-off resulting from all possible actions of other players, and to select the action providing the highest of these outcomes. The wanted equilibrium is the result of these maximin actions.

It is important to determine the limits of the possible actions by each player, because they usually are decisive in determining the equilibrium. In the present case, what limits the actions of the players is the *existence of a welfare gain comparatively to the situation without trade* (each country implementing its Kyoto commitment by its own means). The feasible set contains all combined actions of the players that yield for each of them a non-negative welfare change comparatively to the No-Trade solution.

Determination of the “Pay-Off” functions

In the present case, the pay-off for each country is the opposite of the cost of implementing the Kyoto commitment, i.e. the domestic cost of abatement and the net purchase of allowances. It is easy to check that, in the present case, the PO functions are quadratic with respect to the levels of allowances allocated by Governments. Actually for any given set of allocations, the equilibrium of the economy is

determined by a system of linear equations (equalization of marginal abatement costs in the trading sectors across all countries, and for countries other than Germany and ITA-NLD equalization of the marginal abatement cost in the trading and non-trading sectors). Then the costs of abatement in each sector and the net cost of purchased allowances are also quadratic in terms of allocated allowances. Numerical resolution yields the following cost functions (opposite to PO functions):

$$C_1 = 47570.454(\delta_1)^2 + 2642.567\delta_1\delta_2 - 178.234(\delta_2)^2 + 1958.968\delta_1 + 873.246\delta_2 + 37.7842$$

$$C_2 = 10117.986(\delta_2)^2 + 3053.814\delta_1\delta_2 - 435.679(\delta_1)^2 - 755.1590\delta_2 - 1694.061\delta_1 + 4577.0291$$

δ_1 and δ_2 being the relative change in allocated allowances of Germany and ITA-NLD with respect to the co-operative solution.

Determination of the feasible domain

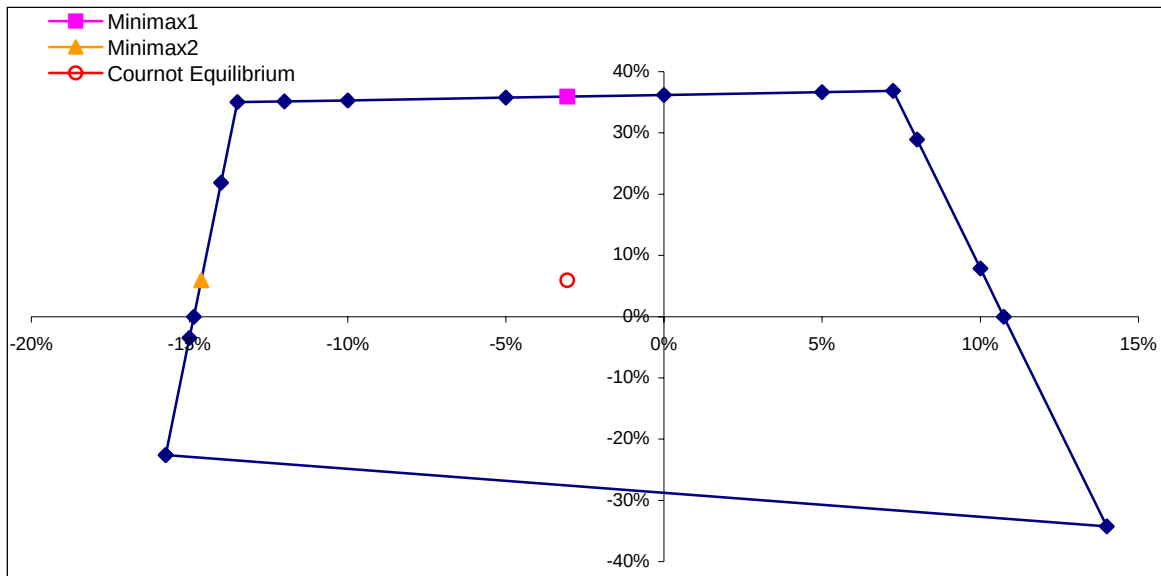
In the No-Trade case the welfare costs are, respectively for Germany and ITA-NLD, 797.50 and 5629.63 millions of Euros. The feasible domain of actions for the two players is then represented by Figure 6, and is defined by the two conditions:

$$C_1 \leq 797.50$$

$$C_2 \leq 5629.63$$

The region of interest is the North-West quadrant, corresponding to a restriction of allowances by Germany and an over-supply by ITA-NLD. The graph shows that restricting the supply of allowances more than around 15% (comparatively to the co-operative solution) would be inefficient for Germany (whatever is the action of ITA-NLD) and over-supplying more than around 35% would be inefficient for ITA-NLD (whatever is the action of Germany). The explanation is that there would result a too large gap in the prices of carbon between the trading and the non-trading sectors.

Figure 6: Feasible domain of actions by the two players



Maximin equilibrium

This equilibrium is defined by the maximin decision of each player. In the present case, the decision is bound by the feasible domain, and then on its frontier. It is:

- for Germany a restriction of 3.06% (obtained with an over-supply of 35.93% by ITA-NLD);
- for ITA-NLD, an over-supply of 5.94% (obtained with a restriction of 14.63% by Germany).

The maximin equilibrium is then defined by a restriction of 3.06% by Germany and an over-supply of 5.94% by ITA-NLD. It is represented in the Figure 6 above.

Comparison of the maximin equilibrium to the No-Trade solution and to monopolistic and monopsonic equilibria is given in the table below, in terms of differences relatively to the co-operative solution¹⁰:

Table 8: Comparison of the Maximin equilibrium to monopolistic and monopsonic equilibria (differences relatively to the co-operative solution)

	Monopoly (Germany)	Monopsony (ITA-NLD)	Maximin equilibrium	No-Trade
Allocation of allowances by Germany	-1.91%	-0.13%	-3.06%	
Allocation of allowances by ITA-NLD	0.35%	3.45%	5.94%	
Net sales of allowances by Germany	-1	0	-2	
Net sales of allowances by Italy	0	1	1	
Net sales of allowances by the Netherlands	0	1	1	
Price of allowances	2	-1	0	
Welfare cost for Germany	-17	27	31	760
Welfare cost for ITA-NLD	30	-12	37	1053
Welfare cost for other European countries	4	-4	1	558
Total welfare cost for European Union	16	11	69	2371

By adopting a strategic behavior, the main players in the allowance market that are Germany on the one hand, Italy and The Netherlands on the other hand, may contribute to increase somehow the welfare cost of the European climate change policy, and in particular the cost of committing to the Kyoto Protocol. This is compared to the most efficient co-operative strategy, shown to be equivalent to a generalized market of permits in Europe.

However compared to the No-Trade solution, which exhibits much larger inefficiencies (an additional welfare loss for the whole Union of 2.371 billions of Euro compared to the co-operative situation), these differences appear negligible. We can then conclude that *there is no real incentive for countries to adopt a strategic behavior*, aiming at manipulating the market price by over-supplying or under-supplying allowances to their trading sector in order to capture monopolistic profits.

4. Main teachings and further developments

One may wonder what the likely benefits of the trading scheme decided by the European Union, and the major risks are. The main target is clearly to create a market structure, imperfect as it may be, in order to accustom the European firms to the use of environmental instruments that are new to them, contrarily to American firms, which have now a several years experience.

¹⁰ The Cournot equilibrium would be still closer to the co-operative solution, with a restriction of 2.17% by Germany and an over-supply of 4.06% by ITA-NLD.

But risks are presumably important, because of the responsibility given to Governments to allocate allowances without any co-ordination and their likely ignorance of the true costs. As it has been shown in the paper, there is not the risk that Governments try, by over- or under-supplying allowances to their firms, to manipulate the equilibrium market price because the profits are negligible compared to the gains brought by the mere existence of a market.

Risks are rather in the will of Governments to use the European trading scheme in order to protect their domestic industry and over-supply allowances to their firms. In such a situation, the market of allowances may never take-off. Governments must release soon their National Plans of Allowances Allocation and what is presently known from existing blueprints is a tendency to over-supplying under the intense lobbying of concerned industries, belonging mainly to the sectors of intermediate goods. The first 2005-2007 period is just a “trial run”, before the decisive five years coinciding with the commitment period of the Kyoto Protocol. What may remain of the European trading scheme if the latter is finally not ratified is another complex question, with legal issues encompassing the mere economic analysis.

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