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Stringency and distribution in the EU Emissions Trading Scheme: first evidence

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Based on the verified emissions for the 2005 and 2006 trading years, the actual emissions and allowances for each installation covered by the EU Emissions Trading Scheme (EU ETS) were compared. Based on data available for 24 Member States as of May 2007, this article uses a thorough data analysis for about 9,900 installations to investigate evidence on three issues: first, the stringency of the total allocation cap and allocation differences both among the Member States and a selection of emission-intensive sectors; second, the distribution of the size of installations; and third, the spread of allocation discrepancies and possible allocation biases regarding the size of installations. There is a surprisingly high spread of allocation discrepancies, which provide evidence for treating small installations differently from large ones: the inequality of distribution of the size of installations, between allocated and verified allowances, variations in the spread of the allocation discrepancies both by country and by sector reflecting the implementation of National Allocation Plans, the size of an installation and its allocation discrepancy.

Keywords: climate policy; emissions trading; EU Emissions Trading Scheme

A partir des émissions vérifiées pour les transactions des années 2005 et 2006, les émissions réelles de chaque installation couverte par le système européen d'échange d'émissions (EUETS) sont comparées avec leur quotas alloués. Sur la base de données sur 24 Etats membres accessibles à partir de mai 2007, cet article applique une analyse de données rigoureuse sur environ 9900 installations dans le but de clarifier trois enjeux: premièrement, la rigueur du montant total des quotas et les différences d'allocation entre Etats membres et entre certains secteurs à fortes émissions; deuxièmement, la répartition en fonction de la taille des installations; et troisièmement, les écarts d'allocation et une distortion possible en fonction de la taille des installations. L'étendue des écarts entre les quotas alloués est surprenant, montrant la différence de traitement des petites installations par rapports aux grandes: l'inéquité dans la répartition de la taille des installations, entre quotas alloués et quotas vérifiés, la façon dont les écarts d'allocation varient selon le pays ou le secteur, reflétant la manière dont les plans nationaux d'allocation ont été mis en oeuvre, la taille d'une installation et la distortion relative à l'allocation dont elle a été objet.

Mots clés: Echange de droits d'émissions; politiques climatiques; système européen d'échange de quotas

1. Motivation

The EU Emissions Trading Scheme (EU ETS), which covers about 40% of total EU CO_2 emissions, is the biggest implementation worldwide of a cap-and-trade mechanism to curb emissions. This innovative policy instrument is both a milestone and a strong incentive for starting similar activities in other regions of the world. Since May 2007, the results for 2005 and 2006 verified CO_2 emissions at installation level are thus providing indications about short and long positions for the first trading period, 2005–2007, of the EU ETS.

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Based on data available for 24 Member States by May 2007, this article uses a thorough data analysis for about 9,900 installations – with data for 2005 and 2006 – to investigate evidence on three issues: first, the stringency of the total allocation cap and differences, both among the Member States and a selection of emission-intensive sectors, by identifying patterns of allocation discrepancies – the difference between allocated emission allowances and actual emissions; second, the distribution of the size of installations, which is particularly relevant for dealing with very small and very large installations; and third, the spread of allocation discrepancies and possible allocation biases which might point both to successful abatement activities but also to distorting distributional impacts.

By focusing on evidence about distortions created by differences in the behaviour of Member States in their allocation policies and the distributional aspects of the EU ETS, this article complements work presented by Ellerman and Buchner (2006), which emphasizes evidence on abatement activities.

The structure of the article is as follows. After highlighting the main features of the EU ETS, the principles for preparing the National Allocation Plans 2005–2007 are discussed. Subsequently, we present the methodology for the data analysis and indicators for stringency and distributional characteristics of installations and allocations. After providing some caveats as to the interpretation of the trading results for the two years in the context of competitiveness and abatement issues, we draw conclusions that may be relevant for the EU ETS review.

2. Main features of the EU ETS

The Directive 2003/87/EC (EC, 2003a) established a scheme for greenhouse gas emission allowance trading within the Community. The EU Emissions Trading Scheme (EU ETS) started in January 2005. Since May 2007, results for the 2005 and 2006 verified emissions at installation level, and thus indications about short and long positions at country, sectoral and installation levels, have become available. Missing or incomplete data are added continuously.

The EU ETS has a surprisingly short history. Following the Kyoto Protocol in 1997, which aimed to set quantitative, binding reduction targets for greenhouse gas emissions in the industrialized and transition countries, the EU started an internal process of analysing policies and measures in order to reach the set emission reduction targets. As one of the policy instruments, an emissions trading scheme for industry was discussed. In the year 2000 the Green Paper on greenhouse gas emissions trading within the European Union (EC, 2000) was issued, and several design issues for such a system were analysed (Stewart and Sands, 2000). The decision-making process led to a proposal for a Framework Directive for greenhouse gas emissions trading within the European Community in 2001 (EC, 2001) and, after the subsequent discussion process, to the adoption of 'Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC' (EC, 2003a), which defines the benchmarks and criteria used to operate the system and identifies the framework governing national legislation. This is considered the cornerstone of EU climate policy for achieving the reduction targets of the Kyoto Protocol.

Since the beginning of 2005, the European Union has regulated CO_2 emissions from energy-intensive industries in the framework of the EU ETS with the following key design elements.

Limitation to four industrial sectors

- 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 sintering or roasting, production of pig iron and steel)
- Mineral industry (cement clinker, glass, ceramic products)
- Other activities (pulp and paper).

A cap-and-trade system

Using guidelines provided by the Commission, each Member State decides on the total national emission allowances to be allocated to the installations involved. These EU Allowances (EUAs), which were issued for Phase 1 (the pre-Kyoto phase 2005–2007) are tradable. The allocation for Phase 2, congruent with the Kyoto compliance period 2008–2012, is currently under preparation. At least 95% of allowances in Phase 1 and 90% in Phase 2 are allocated free of charge in accordance with the installations' historical emissions ('grandfathering').

National Allocation Plans

In Annex III of the Directive, criteria for the design of the National Allocation Plans are provided. These include consistency with the Member State's emission target and projected progress towards fulfilling the target, considerations regarding the activities' (technical) potential for reducing emissions, consistency with other Community legislation and policy instruments, avoidance of unduly favouring certain undertakings (related to State aid provisions), required information on the treatment of new entrants, and early action.

Linking with the Kyoto Mechanisms

Certified Emission Reductions (CERs) from the Clean Development Mechanism (CDM) have been acknowledged in the EU ETS since 2005, and Emission Reduction Units (ERUs) from the Joint Implementation (JI) mechanism for offsetting domestic emissions will be acknowledged starting in 2008, with Member States determining the limit on the linkage which, in turn, has to be approved by the Commission.

Compliance provisions

Emissions are strictly monitored and must be verified. Penalties for non-compliance are €40 per tonne of CO_2 in Phase 1 and €100 per tonne of CO_2 in Phase 2.

The Member States are responsible for allocating emission allowances to sectors and installations in a National Allocation Plan. The EU provides guidelines (EC, 2003b) for the allocation process, but leaves the allocation details up to Member States. Nevertheless, National Allocation Plans must be approved by the Commission, which sets criteria in Directive 2003/87/EC with respect to the allocated quantities of allowances.

3. The National Allocation Plans 2005–2007

By setting emission caps, the Member States' National Allocation Plans define the market for CO_2 allowances. For a detailed elaboration on the Member States' National Allocation Plans for the first trading period see, e.g., Betz et al. (2004) and the German Emissions Trading Authority (2005).

In general, emissions trading under the EU ETS covers 30–50% of the total national greenhouse gas emissions in each of the Member States, including a minimum of 19 installations in Luxembourg and a maximum of over 1,800 installations in Germany.

In six countries, the National Allocation Plans contain provisions for opt-ins (additional inclusion of installations not captured by the Directive) and opt-outs (exclusion of installations captured by the Directive). Opt-ins play a major role in Finland and Sweden, where small combined heat and power plants are included. Opt-outs are most important for the Netherlands, where 142 smaller installations are instead covered by a voluntary agreement, and the UK, where 59 installations were included in the National Emissions Trading System until 2006 and another 329 installations are covered by other climate change agreements.

When designing the allocation process, most Member States started with a total cap for the ETS sectors before allocating the allowances to the different installations. According to the guidelines of the European Commission, the total cap of each country has to be consistent with the Kyoto target. While most of the new Member States have already substantially 'over-fulfilled' their Kyoto targets in 2005 (calculations based on data from EEA, 2007), only four countries of the former EU-15 (France, Finland, Sweden and the UK) have met their Kyoto targets so far, while the other countries still exceed their reduction target, some by as much as 35% (Austria) or 32% (Spain) in 2005.

All of the 25 Member States allocated the allowances to incumbent installations based on their historical emissions in a certain base period (grandfathering) to which, in some cases, a sectoral benchmark or a sector-specific growth factor were applied. The base periods cover 1 to 10 years; in some countries, the year with the lowest emissions could be excluded. In some countries, process-related emissions and energy-related emissions were treated differently in the allocation process.

In general, all Member States allocated allowances free of charge in the first emissions trading period, but Denmark will auction 5% of its total allocation, Hungary 2.5%, Lithuania 1.5% and Ireland 0.75%. Most countries allocate an equal number of allowances each year, with the exception of Denmark which uses a degressive allocation procedure (for Denmark the allocated allowances per installation were 25% lower in 2006 than in 2005).

Allowances to new entrants are also allocated free of charge in all countries, generally using some kind of sector benchmark. Some Member States differentiate between known and unknown new entrants, where known new entrants are included in the National Allocation Plan, while unknown new entrants are allocated from the reserve. For the overall ETS, the countries' new entrants reserves add up to 102 million tonnes of CO_2 per year, which equals 4.7% of the total volume of allowances.

4. Method of data analysis

Installations covered by the EU ETS need to have an account with their national registries, which record the verified emissions per installation and every transaction between installations. Data collected by national registries are transferred to the European registry, the so-called Community Independent Transaction Log (CITL).

Since April 2007, data on verified emissions for installations for 2005 and 2006 are available from the CITL. The data base for the analysis contains approximately 9,900 installations for which data are available for both years. About 600 installations were omitted due to incomplete data. Using information from National Allocation Plans, these installations were assigned to sectors.

The data analysis was performed for the first two trading years on different levels of aggregation with indicators for the stringency of allocation, the distribution of the size of installations, and the spread of allocation discrepancies.

Levels of aggregation

The analysis of the installation data is based on indicators for three levels of aggregation:

1. the total of all EU Member States
2. the individual Member States and
3. a cross-country selection of emission-intensive sectors.

Indicators for the stringency of allocations

The following indicators were calculated for the stringency of the allocations:

- the short or long position of an installation as the difference between allocated and verified emissions of an installation
- the gross long position of a country or a sector as the sum of all long positions of installations for a country or a sector
- the gross short position of a country or a sector as the sum of all short positions of installations for a country or a sector
- the net long position of a country or a sector as the difference of gross long positions and gross short positions of a country or a sector if this difference is positive
- the net short position of a country or a sector as the difference of gross long positions and gross short positions of a country or a sector if this difference is negative

With these four indicators (gross long, gross short, net short and net long) the differences between allocated allowances and actual emissions – the allocation discrepancy – were calculated in tonnes or as a percentage of allowances.

Indicators for the size distribution of installations

Both for countries and sectors, we ranked the installations according to their allocated emissions as a percentage of the country and sector totals as an indicator of the size distribution, respectively.

Indicators for the spread of allocation discrepancy

Allocation discrepancies – the difference between allocated allowances and actual emissions – vary considerably between countries and sectors. As well as the net position of a sector or a country expressed by net long or net short positions, we analysed the spread of these discrepancies. We started with the mean absolute deviation of allocation discrepancies (as described above) of a country or a sector. We normalized this deviation by the corresponding mean of allocation of the respective group. Thus we obtained a rescaled and comparable cross-country or cross-sector indicator.

5. Stringency of the allocation caps

5.1. The overall evidence

The Commission guidelines for preparing the National Allocation Plans were aimed at setting a unified framework for the EU Member States in their preparation of the first National Allocation Plans. Assuming that all countries had a similar interpretation of the EU guidelines, one would anticipate more or less congruent National Allocation Plans that exhibit similar stringencies of the allocation caps. One could therefore expect that allocation discrepancies, the difference between allocated EU Allowances (EUAs) and verified emissions, would not show large differences between countries. At least one could have expected this for the EU-15. This hypothesis is not supported by our analysis, as we found large variations with respect to allocated EUAs and verified emissions.

TABLE 1 Short and long positions by countries

	Allocation			Verified emissions			Short position		
	2005	2006	Ø 2005-06	2005	2006	Ø 2005-06	2005	2006	Ø 2005–06
	[t CO_2]	[t CO_2]	[t CO_2]	[t CO_2]	[t CO_2]	[t CO_2]	[t CO_2]	[t CO_2]	[t CO_2]
European Union	**2,092,948,482**	**2,061,707,728**	**2,077,389,537**	**1,997,947,015**	**2,018,220,210**	**2,012,645,236**	**170,003,283**	**205,081,788**	**187,459,186**
Austria	32,414,872	32,649,366	32,532,119	33,372,841	32,380,809	32,876,825	3,311,430	3,259,849	3,285,640
Belgium	58,311,087	59,941,527	59,126,307	55,355,164	54,754,719	55,054,942	9,987,450	7,958,096	8,971,874
Cyprus	5,471,353	5,612,379	5,541,866	5,078,877	5,259,273	5,169,075	408,077	426,139	417,108
Czech Republic	96,907,649	96,907,649	96,907,649	82,454,636	83,546,917	83,000,777	100,713	884,387	492,550
Denmark	37,303,720	27,907,569	32,605,645	26,470,128	34,192,976	30,331,552	125,549	8,321,084	4,223,317
Estonia	16,747,054	18,205,035	17,476,045	12,621,824	12,035,392	12,328,608	14,832	55,799	35,316
Finland	43,711,913	43,664,490	43,688,202	32,600,529	43,419,725	38,010,127	414,736	3,317,951	1,860,559
France	149,615,425	149,635,975	149,637,351	130,982,456	123,144,439	127,073,210	4,220,051	3,088,663	3,653,986
Germany	494,988,690	496,190,340	495,589,515	469,396,389	483,032,866	480,800,369	20,599,874	23,063,682	21,825,256
Greece	71,162,432	71,162,432	71,162,432	71,267,752	69,965,151	70,616,452	3,381,154	3,258,868	3,320,011
Hungary	30,236,166	30,236,166	30,236,166	25,954,360	25,666,894	25,810,627	1,105,683	1,102,628	1,102,857
Ireland	19,236,747	19,237,593	19,237,170	22,366,765	21,637,912	22,001,431	4,200,654	4,266,214	4,233,434
Italy	215,795,655	204,315,322	210,055,489	225,174,566	223,217,733	224,196,150	28,218,944	38,208,422	33,194,578
Latvia	4,070,078	4,058,197	4,064,138	2,852,578	2,925,569	2,889,074	21,988	128,267	75,128
Lithuania	13,503,454	10,579,740	12,041,597	6,603,869	6,476,140	6,540,005	7,046	175,785	91,416
Luxembourg	3,229,321	3,229,321	3,229,321	2,603,349	2,712,972	2,658,161		6,898	3,449
Netherlands	86,407,529	86,387,889	86,420,190	80,319,831	76,667,072	78,509,182	6,151,089	5,807,072	5,979,081
Poland	237,041,100	237,111,700	237,103,700	202,254,631	208,701,440	205,501,276	1,903,757	3,241,944	2,574,309
Portugal	36,896,041	36,906,333	36,901,187	36,424,737	33,022,328	34,723,533	1,771,813	1,329,970	1,550,892
Slovakia	30,470,677	30,486,877	30,478,777	25,231,769	25,543,243	25,387,506	46,789	604,750	325,770
Slovenia	9,138,064	8,691,991	8,915,028	8,703,921	8,797,574	8,750,748	137,055	433,524	285,290
Spain	171,976,163	160,100,956	166,038,560	183,096,994	175,753,632	179,425,313	34,467,947	36,345,975	35,357,141
Sweden	22,281,227	22,483,587	22,382,407	19,381,661	19,879,909	19,558,842	3,560,407	3,535,713	3,548,032
UK	206,032,065	206,005,294	206,018,680	237,377,388	245,485,525	241,431,457	45,846,245	56,260,108	51,052,201

TABLE 1 Short and long positions by countries *(Cont'd)*

	Long position			Net position			Net position*		
	2005 [t CO_2]	2006 [t CO_2]	Ø 2005–06 [t CO_2]	2005 [t CO_2]	2006 [t CO_2]	Ø 2005–06 [t CO_2]	2005 [%]	2006 [%]	Ø 2005–06 [%]
European Union	**264,959,957**	**254,982,517**	**258,663,404**	**94,959,272**	**49,918,649**	**71,235,647**	**4.5**	**2.4**	**3.4**
Austria	2,351,243	3,525,706	2,937,125	–960,187	265,857	–348,515	–3.0	0.8	–1.1
Belgium	12,943,373	13,126,492	13,031,640	2,955,923	5,186,808	4,069,226	5.1	8.7	6.9
Cyprus	800,553	779,245	789,899	392,476	353,106	372,791	7.2	6.3	6.7
Czech Republic	14,621,924	14,327,043	14,474,484	14,521,211	13,442,656	13,981,934	15.0	13.9	14.4
Denmark	10,960,607	2,033,985	6,499,005	10,835,058	–6,283,681	2,275,689	29.0	–22.5	7.0
Estonia	4,135,473	6,215,040	5,175,257	4,120,641	6,159,241	5,139,941	24.6	33.8	29.4
Finland	11,526,120	3,562,468	7,535,917	11,111,384	244,517	5,691,113	25.4	0.6	13.0
France	22,853,020	24,666,559	23,264,876	18,632,969	21,577,896	19,610,890	12.5	14.4	13.1
Germany	46,116,676	47,667,027	46,527,817	25,516,802	24,603,345	24,702,561	5.2	5.0	5.0
Greece	3,240,328	5,093,176	4,166,752	–140,826	1,834,308	846,741	–0.2	2.6	1.2
Hungary	5,384,891	5,598,584	5,468,066	4,281,806	4,492,046	4,365,210	14.2	14.9	14.4
Ireland	1,070,636	1,575,133	1,235,601	–3,130,018	–2,691,081	–2,997,834	–16.3	–14.0	–15.6
Italy	18,654,460	18,479,645	18,488,890	–9,564,484	–19,728,777	–14,705,688	–4.4	–9.7	–7.0
Latvia	1,239,488	1,260,895	1,250,192	1,217,500	1,132,628	1,175,064	29.9	27.9	28.9
Lithuania	6,906,631	4,282,241	5,594,436	6,899,585	4,106,456	5,503,021	51.1	38.8	45.7
Luxembourg	625,972	523,247	574,610	625,972	516,349	571,161	19.4	16.0	17.7
Netherlands	12,238,787	15,551,267	13,901,778	6,087,698	9,744,195	7,922,697	7.0	11.3	9.2
Poland	36,544,326	31,491,004	34,020,578	34,640,569	28,249,060	31,445,365	14.6	11.9	13.3
Portugal	2,243,117	5,213,975	3,728,546	471,304	3,884,005	2,177,655	1.3	10.5	5.9
Slovakia	5,285,697	5,544,464	5,393,834	5,238,908	4,939,714	5,068,065	17.2	16.2	16.6
Slovenia	571,198	327,941	449,570	434,143	–105,583	164,280	4.8	–1.2	1.8
Spain	23,685,196	21,889,052	22,770,816	–10,782,751	–14,456,923	–12,586,325	–6.3	–9.0	–7.6
Sweden	6,459,319	5,997,133	6,216,752	2,898,912	2,461,420	2,675,840	13.0	10.9	12.0
UK	14,500,922	16,251,195	15,166,969	–31,345,323	–40,008,913	–35,885,232	–15.2	–19.4	–17.4

* Net position as percentage of allocated allowances.
Source: CITL (2007); authors' own calculations.

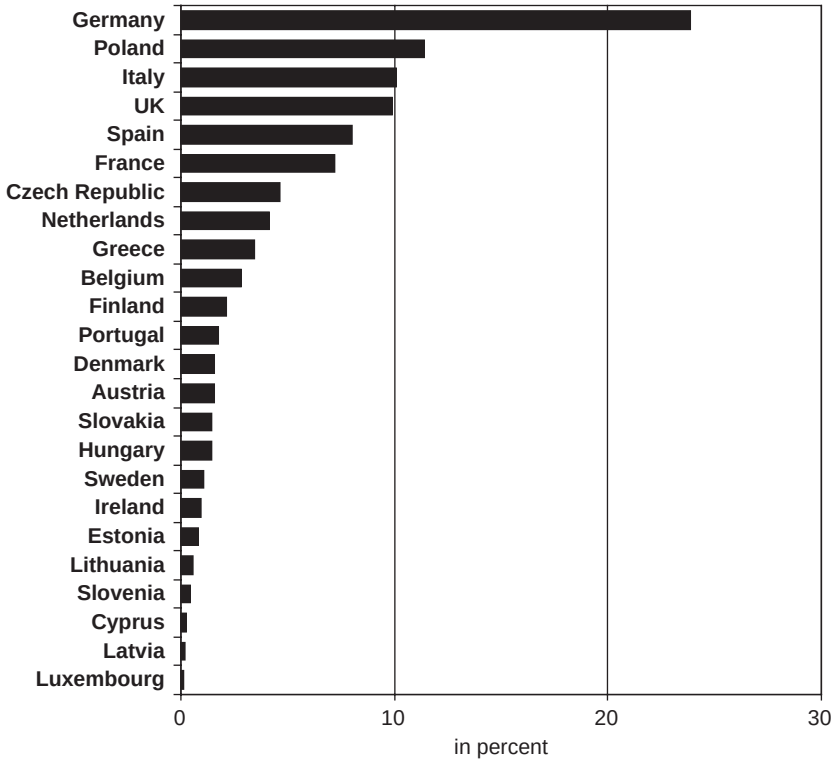

FIGURE 1 Country's share in total EU ETS allowances (average 2005–2006).
Source: CITL (2007); authors' own calculations.

As indicated in Table 1, in 2005 (2006) EU allowances for 2,093 (2,062) million tonnes CO_2 were allocated, but only 1,998 (2,018) million tonnes verified. The market was long, with 95 (50) million tonnes (based on installations where data on both allocated EUAs and verified emissions for both years were available), corresponding to 4.5% (2.4%) of the allocated allowances. This net long position is the balance of a 12.7% (12.3%) gross long position, the relative amount of allowances allocated to installations above their verified emissions, and an 8.2% (9.9%) gross short position, the relative amount of allowances below their verified emissions. Obviously, in addition to the net position, the spread of allocation positions also deserves attention. On average over the two years, the market was long, with 3.4%, stemming from a 9.1% gross short position and a 12.5% gross long position.

At this stage, a first caveat for the interpretation of these numbers is appropriate. We deliberately do not use the terms 'over-' or 'under-allocation' since this might suggest faulty allocations by the authorities responsible for the Allocation Plans. It is conceivable that the observed allocation discrepancies – the difference between allocated EUAs and the verified emissions – resulted from abatement efforts. The extent to which this is plausible will be discussed in Section 7.

5.2. The Member States evidence

Table 1, in addition, presents a summary of the allocation discrepancies by Member States. Differences as to the size of the Member States and their emissions intensity can be seen from Figure 1, which ranks the Member States according to their average emission allowances over the

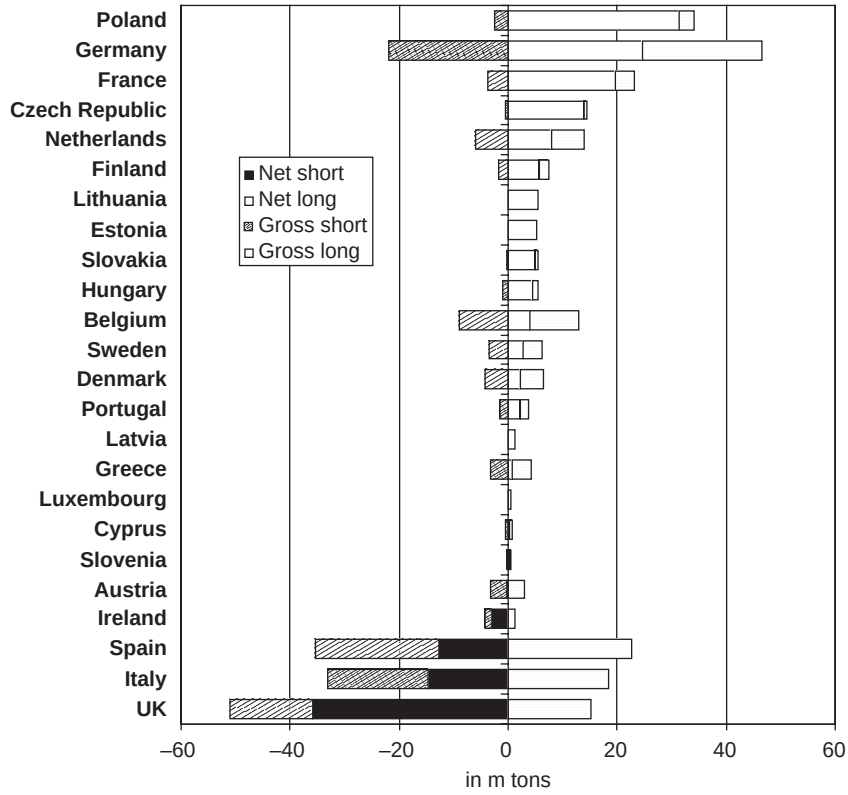

FIGURE 2 Short and long positions by countries (average 2005–2006).
Source: CITL (2007); authors' own calculations.

two years. An outstanding position with a share of 24% of EU-allocated allowances accrues to Germany which, together with Poland, Italy and the UK, accounts for more than half of the emissions covered by the EU ETS.

As indicated in Figure 2, only five out of the 24 countries were in a short position up to 35.9 million tonnes (UK). The remaining 19 countries were long up to 31.4 million tonnes (Poland). A similar ranking according to the relative allocation discrepancy, the percentage of net long or net short positions relative to the amount of allowances, is contained in Figure 3. We realize that all new Member States allocated more allowances to their installations than were needed. Between 2005 and 2006 a major change can be observed for Denmark, with a net long position of 29% in 2005 compared with a net short position of 23% in 2006. This is probably a result of the degressive allocation procedure (see above). Changes from a net short position to a net long position can be found in Austria (although on average over the two years a net short position can be observed). The opposite is true for Slovenia over the two-year period.

Figures 2 and 3 also visualize the extent to which the net long or the net short position is influenced by the gross long and gross short positions of the countries. The net short positions in countries such as Austria, Italy and Spain stem from the balance of roughly equal-sized gross long and short positions at the installation level. For countries such as Belgium and Denmark, the balance of the gross long and short positions results is a small overall net long position.

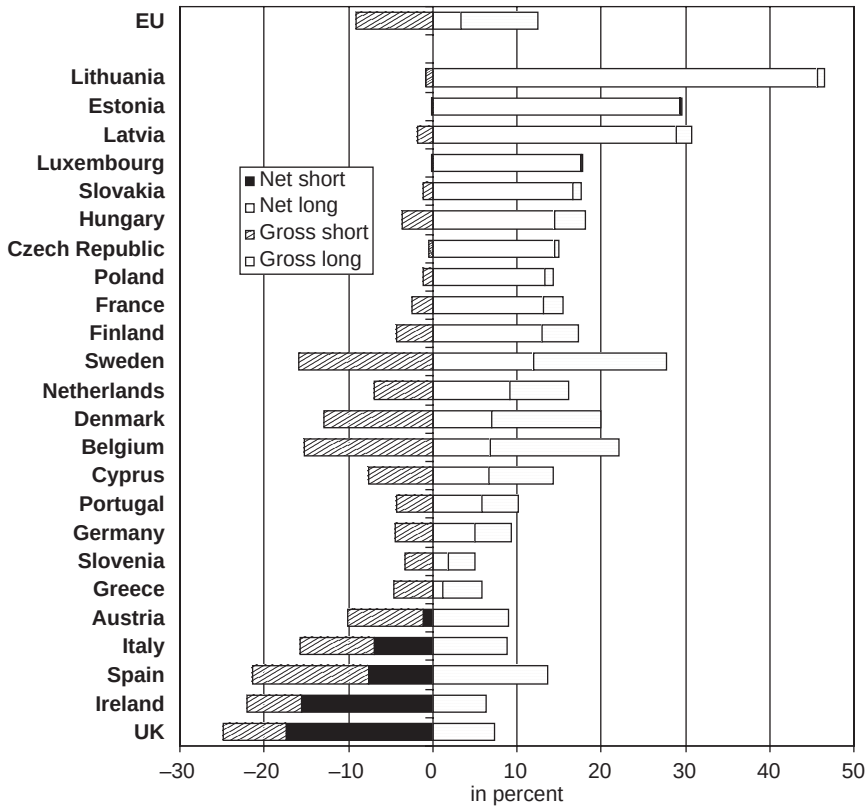

FIGURE 3 Short and long positions by countries (average 2005–2006).
Source: CITL (2007); authors' own calculations.

Evidence presented so far suggests that National Allocation Plans create substantial inequalities as to the allocation positions between Member States on country aggregates, but also within Member States between individual installations. Information on production activities and abatement efforts at installation level would make it possible to single-out the role of the national allocation authorities in explaining the observed discrepancies between allocated EAUs and verified emissions.

For the two trading years, the Member States can be grouped according to the observed allocation positions into the following groups:

- EU-15 countries that exhibit sectors both with net long and net short positions, such as Austria, Belgium, Finland, Greece, Ireland, Italy, Spain and the UK.
- EU-15 countries that show a pronounced net short position in the heat and power sector but are generally long in all other sectors, such as the Netherlands and Sweden.
- EU-15 countries with net long positions in their sectors, such as Denmark, Portugal and Luxemburg. Germany and France show a slight short position in one sector only.
- New Member States that are long in all sectors, such as Cyprus, Estonia, Poland, Latvia and the Czech Republic.
- New Member States that have, in total, a long position but are short at least in a few sectors, such as Hungary, Slovakia, Lithuania and Slovenia.

5.3. The sectoral evidence

While we would expect rather small allocation discrepancies at country level, this would not necessarily be anticipated at the sectoral level since Criterion 11 of Annex III of Directive 2003/87/EC states that the Member States' National Allocation Plans 'may contain information on the manner in which the existence of competition from countries or entities outside the Union will be taken into account'.

Kolshus and Torvanger (2005) show sectoral differences in the generosity of allocation motivated by competitiveness assumptions. As to the vulnerability of distorted allocations, it is common to distinguish between

- sectors not exposed to international competition (electricity, district heating, energy, cogeneration, power, heat, and steam), and
- sectors exposed to international competition (refineries, iron and steel, cement, glass, lime, ceramics, pulp and paper and others).

The overall evidence for the sectoral breakdown allocation positions signals a rather pronounced long position for all sectors except for power and heat, as indicated in Table 2 and Figure 4. An obvious explanation is the strong exposure of the energy and emission-intensive sectors to international competition, which might have induced generous allocations to these sectors. Ellerman et al. (2007) concluded that most Member States explicitly allocated the power sector fewer allowances relative to expected need than the other sectors because of concerns about competitiveness and a belief that the abatement potential was larger in the power sector than in the other sectors. The reason for the short position of the power and heat sector may also be linked to the observation that wholesale electricity prices echo the fluctuations of prices for EUAs because of the ability to pass on additional costs due to market power.

6. Distribution of installations and allocations

6.1. Distribution of the size of installations

An outstanding characteristic of the EU ETS is the inclusion of a large number of small installations. Figure 5 ranks the almost 9,900 installations according to their verified emissions and reveals striking insights about the extreme inequality in the size of installations included in the EU ETS:

- The smallest three quarters of all installations (7,451 installations) contribute only 5.2% of the verified emissions.
- The biggest 1.8% of all installations (180 installations) account, however, for 50% of the emissions.
- The biggest 500 installations (5%) emit 72.4% of all emissions.
- The 1,000 biggest installations (10.1% of all installations) are responsible for 85.6% of the EU ETS emissions.

This extreme inequality in the size distribution of installations suggests a need to differentiate between the large and small installations in the framework of the EU ETS. Currently, small installations complain about excessive transaction costs for reporting, monitoring and the registry account. In addition, the large number of small installations clogs the capacities of the administration. Big installations, on the other hand, often express concern about unequal treatment in the allocation procedures of different Member States. This burden is especially noticeable in the set-up phase of the emissions trading scheme, but might be softened after a learning phase or once initial problems have been solved.

TABLE 2 Short and long positions by sectors

	Allocation			Verified emissions			Short position		
	2005 [t CO_2]	2006 [t CO_2]	Ø 2005–06 [t CO_2]	2005 [t CO_2]	2006 [t CO_2]	Ø 2005–06 [t CO_2]	2005 [t CO_2]	2006 [t CO_2]	Ø 2005–06 [t CO_2]
European Union	**2,092,948,482**	**2,061,707,728**	**2,077,389,537**	**1,997,947,015**	**2,018,220,210**	**2,012,645,236**	**170,003,283**	**205,081,788**	**187,459,186**
Cement and Lime	187,049,893	185,463,183	183,302,364	172,445,989	177,127,267	171,699,326	5,045,180	6,110,958	5,578,069
Iron and Steel	194,807,773	194,296,534	194,558,404	157,672,703	163,882,730	160,785,425	3,154,508	5,327,456	4,241,141
Power and Heat	1,116,638,484	1,088,814,550	1,088,298,534	1,142,384,172	1,144,685,785	1,127,051,935	150,874,298	179,779,532	165,289,359
Pulp and Paper	42,017,976	42,093,689	42,042,753	33,697,589	33,347,555	33,521,665	889,056	1,259,345	1,070,890
Refineries	149,048,754	148,245,571	148,348,271	139,282,791	138,137,266	138,418,995	2,727,622	3,166,366	2,941,285
Ceramics	18,663,100	18,638,316	18,626,274	15,231,197	15,278,260	15,234,000	517,730	741,310	626,586
Glass	21,093,425	21,156,096	21,122,201	18,827,352	18,633,306	18,728,690	468,094	590,907	528,838
Other	363,629,077	362,999,789	381,090,738	318,405,222	327,128,041	347,205,202	6,326,795	8,105,914	7,183,020

TABLE 2 Short and long positions by sectors *(Cont'd)*

	Long position			Net position			Net position*		
	2005 [t CO_2]	2006 [t CO_2]	Ø 2005-06 [t CO_2]	2005 [t CO_2]	2006 [t CO_2]	Ø 2005–06 [t CO_2]	2005 [%]	2006 [%]	Ø 2005–06 [%]
European Union	**264,959,957**	**254,982,517**	**258,663,404**	**94,959,272**	**49,918,649**	**71,235,647**	**4.5**	**2.4**	**3.4**
Cement and Lime	19,649,084	15,171,326	17,106,203	14,603,904	9,062,943	11,529,421	7.8	4.9	6.3
Iron and Steel	40,592,073	36,020,458	38,297,406	37,440,163	30,689,092	34,056,265	19.2	15.8	17.5
Power and Heat	124,036,412	117,803,038	120,228,839	–25,746,440	–60,693,234	–43,865,794	–2.3	–5.6	–4.0
Pulp and Paper	9,099,654	9,683,781	9,307,738	8,210,598	8,426,757	8,238,009	19.5	20.0	19.6
Refineries	12,493,585	13,274,671	12,884,128	9,765,963	10,108,305	9,937,134	6.6	6.8	6.7
Ceramics	3,886,426	3,925,050	3,848,449	3,368,696	3,183,740	3,220,959	18.1	17.1	17.3
Glass	2,159,866	2,468,847	2,321,584	1,785,660	1,982,376	1,890,199	8.5	9.4	8.9
Other	53,042,857	56,635,346	54,669,059	45,530,728	47,158,670	46,229,456	12.5	13.0	12.1

* Net position as percentage of allocated allowances.
Source: CITL (2007); authors' own calculations.

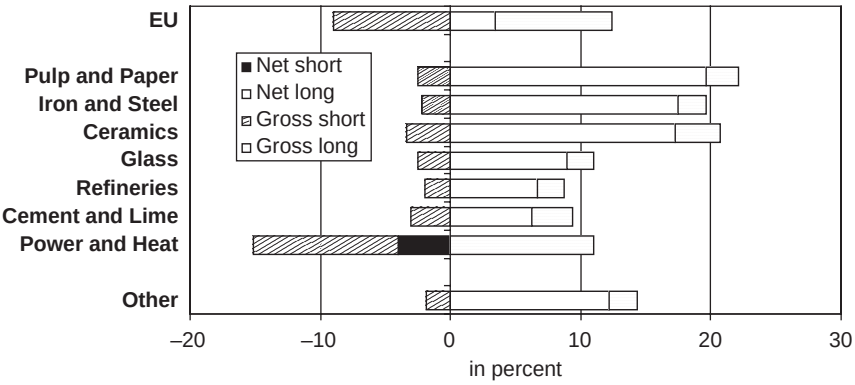

FIGURE 4 Short and long positions by sectors (average 2005–2006).
Source: CITL (2007); authors' own calculations.

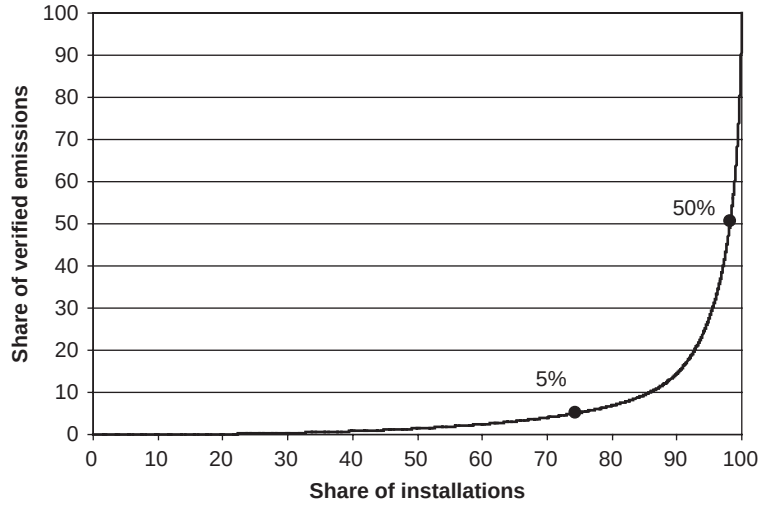

FIGURE 5 Distribution of size of installations with respect to verified emissions (average 2005–2006).
Source: CITL (2007); authors' own calculations.

6.2. Distribution of the allocation discrepancies

The surprisingly wide dispersion of allocation discrepancies, the difference between allocated and verified allowances, has been rather neglected in the evaluation of the first trading year of the EU ETS. Obviously these discrepancies reflect the actions of the allocation authorities and abatement activities by the installations. Figure 6 indicates that, out of the approximately 9,900 installations analysed, 2,685 were short on average and the remainder long. The tails in this figure with 100% long positions refer to installations for which zero emissions were verified. With respect to short positions, 100% refers to installations with verified emissions at least twice the size of the allocation.

In the following we compare the dispersion of allocation discrepancies, both in the dimension of countries and the dimension of sectors, in order to obtain evidence of differences. We start

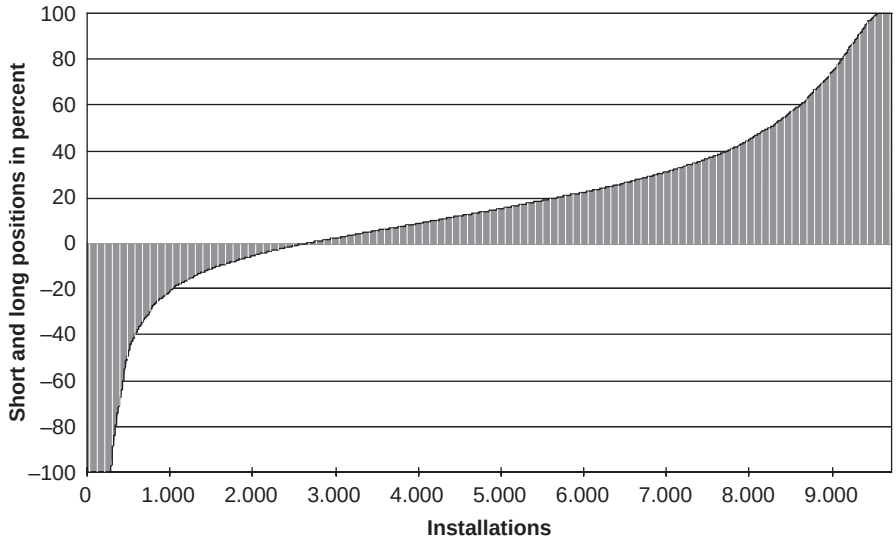

FIGURE 6 Distribution of allocation discrepancies of installations (average 2005–2006).
Source: CITL (2007); authors' own calculations.

with the mean absolute deviation of allocation discrepancies (as described above) of a country or a sector. We normalize this deviation by the corresponding mean of allocation of the respective group. Thus we obtain a rescaled and comparable cross-country or cross-sector indicator. The results of this analysis are summarized in Table 3 for countries and in Table 4 for sectors. For both dimensions we diagnose substantial differences in the dispersion of the allocation discrepancies.

As Table 3 indicates, for the total EU ETS we observe on average over the two years a dispersion of the differences between allocated EUAs and verified emissions of 14% of the mean size of all installations, which is measured by the allocated allowances. This dispersion indicator varies substantially over the Member States. Slovenia shows the lowest dispersion with only 6%, in contrast to Lithuania with 68%. Assuming that in the short run the installations have only limited ability for abatement actions, a high dispersion indicator is a reason for concern for the installations, since it points to an allocation procedure that failed to take into account specific information relevant to the emissions of an installation. The resulting wide dispersion of allocation discrepancies creates distributional distortions.

Table 4 reports the dispersion of allocation discrepancies over the sectors and exhibits higher values for power and heat in comparison with the remaining sectors.

6.3. Installation size and allocation discrepancies

Given the pronounced inequality of the size of installations, we finally wanted to investigate whether there is a significant relationship between the mean and the spread of allocation discrepancies, on the one hand, and the size of an installation, on the other. The scatter diagram of Figure 7 exhibits this relationship for all installations in the EU ETS. A first look suggests that installations with a smaller size of emissions have a higher dispersion of the allocation discrepancy in contrast to big installations. We may also presume from this graph that smaller installations are biased to long positions and big installations to short positions.

We approached this issue by dividing the installations into three groups as to their size: the first group included installations that had accumulated emissions up to 5% of the total; the

TABLE 3 Allocation discrepancies by countries (average 2005–2006)

	All installations				Accumulated verified emissions: less than 5 %			between 5 % and 50 %			more than 50 %		
	Number of installations	Net position in tons	Net position in %*	Normalized mean abs. dev. in %**	Number of installations	Net position in %*	Normalized mean abs. dev. in %**	Number of installations	Net position in %*	Normalized mean abs. dev. in %**	Number of installations	Net position in %*	Normalized mean abs. dev. in %**
European Union	**9,934**	**71,235,647**	**3.4**	**14**	**7,370**	**33.5**	**47**	**2,385**	**7.7**	**20**	**179**	**–5.8**	**18**
Austria	197	–348,515	–1.1	18	127	20.7	37	62	2.5	15	8	–7.1	18
Belgium	306	4,069,226	6.9	37	190	26.8	37	103	18.4	23	13	–9.3	53
Cyprus	13	372,791	6.7	23	11	9.9	11	1	28.1		1	–35.0	
Czech Republic	387	13,981,934	14.4	20	301	35.7	39	75	18.0	16	11	8.2	7
Denmark	377	2,275,689	7.0	25	304	45.2	57	66	14.0	23	7	–6.8	16
Estonia	43	5,139,941	29.4	44	33	45.9	41	9	36.5	49	1	23.0	
Finland	522	5,691,113	13.0	22	430	26.9	52	79	15.5	18	13	9.0	4
France	1,061	19,610,890	13.6	20	587	36.4	37	448	16.1	21	26	7.8	13
Germany	1,803	24,702,561	5.0	14	1,382	30.8	46	394	7.3	14	27	–0.9	8
Greece	136	846,741	1.2	10	105	11.3	26	26	–1.3	11	5	2.1	7
Hungary	221	4,365,210	14.5	26	130	37.5	44	85	15.0	19	6	10.8	20
Ireland	103	–2,997,834	–15.8	39	77	11.3	29	21	–28.8	49	5	–9.2	19
Italy	904	–14,705,688	–7.0	27	623	7.1	29	253	1.2	21	28	–17.6	24
Latvia	89	1,175,064	28.9	35	46	67.9	79	39	33.5	32	4	17.3	26
Lithuania	93	5,503,021	45.7	68	62	60.6	54	28	44.3	56	3	44.8	33
Luxembourg	15	571,161	17.7	15	4	37.2	51	9	24.1	16	2	12.5	1
Netherlands	207	7,922,697	9.2	25	119	22.1	28	79	6.5	19	9	9.9	22
Poland	815	31,445,365	13.3	20	576	27.9	27	227	17.1	19	12	7.9	12
Portugal	243	2,177,655	5.9	15	186	26.0	27	52	10.8	17	5	–0.8	11
Slovakia	173	5,068,065	16.6	23	132	51.8	60	37	25.0	19	4	1.1	5
Slovenia	94	164,280	1.8	6	62	18.7	24	31	2.8	10	1	–0.9	
Spain	788	–12,586,325	–7.6	39	510	58.5	99	254	–6.5	22	24	–29.1	39
Sweden	686	2,675,840	12.1	48	572	54.2	88	107	6.9	24	7	8.2	53
United Kingdom	659	–35,885,232	–17.5	46	540	18.1	33	105	–2.4	23	14	–41.9	22

*Net position as percentage of allocated allowances.
** Mean absolute deviation of allocation discrepancies normalized by the mean size of installations with respect to allocated allowances.
Source: CITL (2007); authors' own calculations.

TABLE 4 Allocation discrepancies by sectors (average 2005–2006)

EU	All installations				Accumulated verified emissions: less than 5 %			Accumulated verified emissions: between 5 % and 50 %			Accumulated verified emissions: more than 50 %		
	Number of installations	Net position in tons	Net position in %**	Normalized mean abs. dev. in %***	Number of installations	Net position in %**	Normalized mean abs. dev. in %***	Number of installations	Net position in %**	Normalized mean abs. dev. in %***	Number of installations	Net position in %**	Normalized mean abs. dev. in %***
Total*	**9,934**	**71,235,647**	**3.4**	**14**	**7,370**	**33.5**	**47**	**2,385**	**7.7**	**20**	**179**	**–5.8**	**18**
Power and Heat	2,920	–52,759,498	–5.1	29	2,404	35.4	56	445	–1.4	25	71	–16.0	19
Other	6,012	86,998,133	11.6	20	3,608	30.1	42	2,254	11.1	18	150	9.6	14

* Since a distinction between power and heat and other sectors is not possible for all countries, total figures do not equal the sum of the sectoral breakdown.

** Net position as percentage of allocated allowances.

*** Mean absolute deviation of allocation discrepancies normalized by the mean size of installations with respect to allocated allowances.

Source: CITL (2007); authors' own calculations.

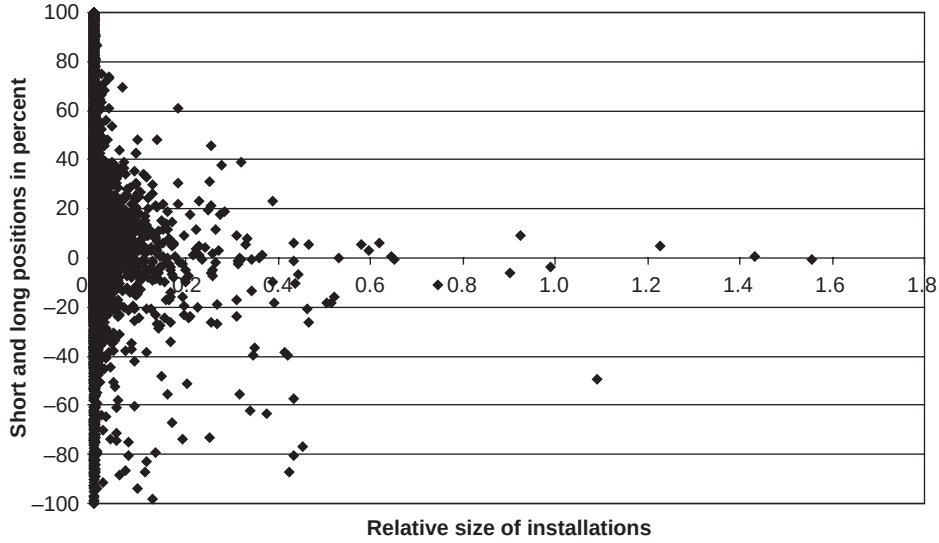

FIGURE 7 Allocation discrepancy and size of installations with respect to verified emissions (average 2005–2006).
Source: CITL (2007); authors' own calculations.

second group included installations that had accumulated emissions between 5% und 50%; and the third group comprised the largest installations responsible for 50% of the emissions. The results are reported in Table 3 for the countries and in Table 4 for the sectors.

For the total EU ETS we diagnosed a net position of 33.5% for the smallest and of –5.8% of the largest installations. The matching measures of dispersion are 47% and 18%, respectively. This means that our presumption from the visual inspection of Figure 7 is confirmed: small installations tend to be long but with a high dispersion, but large installations are expected to be short with a small dispersion.

This overall result becomes more transparent if we look at the sector dimension of this grouping of installations according to their size. We notice in Table 4 that it is the heat and power sector that shifts from long to short positions the larger the installation, accompanied by a sharp reduction in the dispersion of allocation discrepancies. In contrast, the installations of the remaining sectors have long positions in all size groups, again accompanied by lower dispersions for larger installations.

This leads to the conclusion that it was the stringency of allocations to the big installations in the heat and power sector that made them short and reduced the overall long position of the EU ETS. The lower dispersion of the allocation discrepancies of big installations may be an indicator that the allocation authorities considered information specifically related to these installations.

7. The issues of competitiveness and abatement

Since it is tempting to draw conclusions as to abatement efforts and competitiveness impacts from observed allocation discrepancies, the difference between allocated and verified emissions, we add a few caveats to these issues.

The analysis of the verified emissions for 2005 and 2006 merely reveals which countries and sectors showed a tendency to a short or long position in the first trading period 2005–2007. Final conclusions about short and long positions on country, sector and installation level will, however, only be possible in the year 2008, when verified emissions data for 2007 will be available. When interpreting the currently available data, it is important to bear in mind that there might be other reasons for long or short positions of installations than generous or very stringent allocations. For example, long or short positions can reflect an unexpected rise or fall in production, abnormal weather conditions, specific situations regarding the availability of raw materials and fuels, or changes in production processes.

Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community emphasizes the avoidance of distortions in competition as a requirement in the allocation procedures of individual Member States and the European Union as a whole. In the world market, the introduction of the EU ETS might lead to competitive disadvantages of European installations in comparison with installations in countries not covered by the EU ETS. At the European level, competitive distortions can arise from differences in the 'generosity' of the Member States' National Allocation Plans, which might result from differences in the individual Kyoto targets as specified by the EU's Burden Sharing Agreement.

The concept of competitiveness comprises many different dimensions such as input costs, market prices or the quality of the product. Decreasing competitiveness can thus result from an increase in the firms' production costs which might occur due to the inclusion of the costs of CO_2. Effectively, the level of these impacts crucially depends on factors such as

- the degree to which an industry is subject to (international) competition
- the industry's emissions reduction costs
- the share of CO2 costs in total production costs
- the possibility for passing on additional costs to consumers.

An evaluation of the effects of the EU ETS on competitiveness would thus require a more detailed analysis at installation, sector and country levels with respect to the above-mentioned factors.

Related to the competitiveness issue is the choice of different allocation methods, in particular grandfathering with, or instead of, auctioning. This has already been discussed extensively, e.g. by Woerdman (2001) and Grubb and Neuhoff (2006). This issue is of limited relevance for the first trading phase 2005–2007, as only four countries have adopted auctioning in their National Allocation Plans in the first ETS period, and even in the second EU ETS period countries can only auction up to 10% of their total allowances according to the Emissions Trading Directive.

Another caveat holds true for conclusions about abatement activities induced by the EU ETS. A first attempt to estimate their extent for 2005 was made by Ellerman and Buchner (2006). In general, the following abatement options are available to installations:

- Reducing production if the marginal costs for additional emission allowances are not covered by marginal revenues.
- A fuel shift if this option is technically available and the fuel with the lower carbon content creates lower marginal costs than the marginal costs for emission allowances.
- Improved operating of the existing equipment if this involves lower costs than buying additional emission allowances.

- Finally, investments that change processes, e.g. by switching to combined heat and power generation, and improve factor productivity in general. Such decisions will hardly be justified only by the price for emission allowances.

Looking at this spectrum of abatement options, it is rather unlikely that the EU ETS has already created incentives for abatement investments in the first trading years. Given the rather low carbon prices, it is also extremely unlikely that industries with a heavy CO_2 cost component, such as cement and lime, have reduced their production levels because of the stringency of allowances. In a few installations the option for a fuel shift may have been used. Most probably the only reduction option that was widely used was the improved operation of existing equipment. The reduction potential of this option is, however, rather limited.

8. Conclusions

The data analysis performed on the allocated and verified emissions for 2005 and 2006 suggests a number of conclusions, some being more obvious and some less so.

A first set of conclusions deals with the discrepancy between allocated and verified emission allowances. Obviously, in the two trading years, the whole system was in a long position with 3.4% more emission allowances available than were actually needed. When it first became known in May 2006 that the market was long, the spot prices for EUAs plummeted. The average long position for 2005 and 2006 for the EU total is the balance between a 12.5% long and a 9.1% short position of the total emissions. Out of the 9,900 installations reported up to May 2007, only 2,685 were short. These allocation differences vary, however, between Member States and sectors. Out of the 24 Member States, only five countries were short in the range of 1.1% (Austria) and 17.4% (UK) but the remaining 19 countries were long up to 45.7% (Lithuania). Looking at sectors, only power and heat was short, with 4%.

A second set of conclusions refers to the pronounced inequality of the distribution of the size of installations when ordered according to their emissions. The smallest three-quarters of all installations contribute only about 5% of all emissions whereas the biggest 1.8% of all installations account for half of the emissions. The 1,000 biggest installations, or one-tenth of all installations, are responsible for 86% of the EU ETS emissions.

A third set of conclusions deals with the hitherto neglected issue of the distribution of the allocation discrepancies both in countries and in sectors. This measure of the dispersion of allocation discrepancies reflects the treatment of individual installations by the authority responsible for the National Allocation Plan and the resulting impacts on the profits of installations and potential abatement activities. Surprisingly, we observe variations in the spread of the allocation discrepancies both by country and by sector. With regard to the countries, we observe a range for the mean absolute deviation (with the mean installation size normalized) between 6% for Slovenia and 68% for Lithuania, compared with the EU total of 14%. As to the sectors, the power and heat sector exhibits a higher dispersion than the other sectors.

A fourth set of conclusions suggests a correlation between the size of an installation and both the dispersion of the allocation discrepancies and their size. For the smallest installations, which accumulate only 5% of the emissions, the normalized mean absolute deviation of the allocation discrepancies is 47%, compared with 18% for the biggest installations, which emit 50% of the EU ETS emissions. This means that the larger an installation is, the smaller the expected allocation discrepancy will be. As to the size of the allocation discrepancy, we observe a higher short position the bigger the installation, but an inverse relationship for the remaining sectors.

These conclusions may have some significance for the review of the EU ETS. They strongly suggest treating small installations differently from big ones. Three-quarters of those small installations, which accumulate only 5% of all emissions, seem to be prone to a very large dispersion of allocation discrepancies. This might, on the one hand, indicate that the allocation authorities are less prone to use information that is specific for a smaller installation because of administrative bottlenecks. On the other hand, the biggest tenth of all installations, which contributes 86% of all emissions, is particularly interested in equal treatment in the allocation procedures among Member States.

Conclusions about competitiveness impacts and abatement effects are rather premature because, after only two years of operation, it is extremely difficult to disentangle the net position of an installation, a sector or a country, and the interwoven impacts of changes in output and technologies. Nevertheless, the surprisingly high spread of allocation discrepancies, in particular with regard to small installations, creates uncertainty and distributional distortions.

The responsibility of Member States for allocating emission allowances to sectors and installations in the National Allocation Plans creates inherent incentives to allow for generous allocations. Incomplete information concerning the allocations of other Member States and the impact of lobbying groups can be traced in the performance of the 2005 and 2006 results of the EU ETS and comments by Peter Zapfel.

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