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# Public Interest vs. Interest Groups: Allowance Allocation in the EU Emissions Trading Scheme

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## Non-Technical Summary

The central instrument of Europe's current climate policy is the EU Emissions Trading Scheme (EU ETS) which was established in 2005 and enters its second trading period in 2008. The free allowance allocation in the EU ETS has recently been criticized for its generous and differential treatment of regulated industries. Against this background, this paper analyzes the process of allowance allocation in the EU ETS on political-economy grounds. A theoretical framework suggests that the preferences of sectoral interest groups are considered by the government when allocating emissions permits. Therefore, industries represented by more powerful lobby groups face a lower regulatory burden, which for sufficiently high lobbying power leads to an inefficient emissions regulation. An empirical analysis of the first trading phase of the EU ETS corroborates our theoretical prediction for a cross-section of German firms, but also shows that the political-economy determinants of permit allocation depend on characteristics of the regulated firms. We find that large carbon emitters that were heavily exposed to emissions regulation and simultaneously represented by powerful interest groups received higher levels of emissions allowances. In contrast, industrial lobbying power stand-alone or threats of potential worker layoffs did not exert a significant influence on the EU ETS allocation process.

## Das Wichtigste in Kürze

In diesem Papier untersuchen wir den Allokationsprozess für Verschmutzungsrechte im europäischen Emissionshandelssystem (EU ETS). Im theoretischen Modell werden Industrien, die von stärkeren Interessengruppen repräsentiert werden, im Vergleich zu anderen Sektoren weniger strikt reguliert. Daher kann der Einfluss von Interessengruppen auf die Allokationsentscheidung der Regierung zu einer ineffizienten Ausgestaltung von Umweltregulierung führen. Eine empirische Analyse der ersten Handelsperiode des EU ETS untermauert die Aussagen des theoretischen Modells. Die ökonometrische Untersuchung für Deutschland zeigt zudem, dass die politökonomischen Determinanten der Allokation von Emissionsrechten durch Charakteristika der regulierten Unternehmen bestimmt werden. Große Emittenten, die sowohl der Regulierung durch das EU ETS stark ausgesetzt als auch von einflussreichen Interessengruppen vertreten sind, profitieren demnach von einer vergleichsweise großzügigen Zuteilung mit Verschmutzungsrechten.

# Public Interest vs. Interest Groups:

# Allowance Allocation in the EU Emissions Trading Scheme

Niels Anger[a], Christoph Böhringer[b] and Ulrich Oberndorfer[c]

**Abstract.** This paper presents a political-economy analysis of allowance allocation in the EU Emissions Trading Scheme (EU ETS). A common-agency model suggests that a political-support maximizing government considers the preferences of sectoral interest groups besides public interest when allocating emissions permits. In the stylized model, industries represented by more powerful lobby groups face a lower regulatory burden, which for sufficiently high lobbying power leads to an inefficient emissions regulation. An empirical analysis of the first trading phase of the EU ETS corroborates our theoretical prediction for a cross-section of German firms, but also shows that the political-economy determinants of permit allocation depend on firm characteristics. We find that large carbon emitters that were heavily exposed to emissions regulation and simultaneously represented by powerful interest groups received higher levels of emissions allowances. In contrast, industrial lobbying power stand-alone or threats of potential worker layoffs did not exert a significant influence on the EU ETS allocation process.

**JEL classification:** Q58, P16, C10

**Keywords:** Emissions trading, interest groups, regression analysis

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# 1 Introduction

The central instrument of Europe's current climate policy is the EU Emissions Trading Scheme (EU ETS) which was established in 2005 and enters its second trading period in 2008 (EU, 2003). Aiming at emissions reductions at least cost, the EU ETS was celebrated as a "new grand policy experiment" already before its implementation (Kruger and Pizer, 2004). However, the actual implementation of the EU ETS suggests that due to a generous allowance allocation to covered industries, the induced emissions abatement is rather limited. This paper investigates whether the permit allocation design in the EU ETS is representing public interest in terms of economic efficiency or can be explained by the presence of sectoral interest groups.

The outspoken objective of the EU ETS is to achieve Europe's greenhouse gas emissions reduction commitments under the Kyoto Protocol at minimal cost through the tradability of emissions rights (or likewise abatement efforts) across major emissions sources. The EU ETS covers more than 10,000 energy-intensive installations that belong to mainly five industrial sectors: power, heat and steam generation; oil refineries; iron and steel production; mineral industries (e.g. cement, lime and glass); pulp and paper plants (EU 2003). Each Member State is obligated to set up a National Allocation Plan (NAP) where it defines the cap on emissions allowances for sectors (installations) included in the trading scheme and the specific allocation rule for grandfathering, i.e. the entitlement with free pollution rights based on historical emissions.

Standard economic theory suggests that the introduction of market-based instruments of environmental policy – such as (uniform) emissions taxes or (auctioned) tradable emissions allowances – can generate cost-efficient emissions reductions by equalizing marginal abatement costs across polluters. However, over the last decades the implementation of environmental taxes in industrialized countries most commonly implied a differentiation of tax rates between sectors (OECD, 2007). On efficiency grounds, also the free allowance allocation in the EU ETS has been criticized for its generous and differential treatment of regulated industries, as well as its incomplete sectoral coverage. This invokes scientific interest in the role of lobbying for the observed allocation pattern across sectors: Can the power of sectoral interest groups explain the differential treatment of EU industries in the entitlement with free emissions permits? If lobbying for emissions allowances is effective, can it induce economic inefficiencies by shifting the economic burden of emissions abatement to those sectors excluded from emissions trading? While a number of studies on the economic impacts of EU ETS regulation indicate the existence of such a burden shifting (see Böhringer et al., 2005; Kallbekken, 2005; or Peterson, 2006), its rationale has remained implicit to date.

The lacking welfare-economic explanation for the observed regulatory design represents the initiation of our political-economy analysis of the EU ETS. Building on Olson's (1965) theory of the formation and power of interest groups, positive theories have presented alternative approaches to study the political-economy determinants of policy outcomes (see Oates and Portney, 2003 for the context of environmental policy). As a prominent example, rent-seeking models describe how interest groups compete for group-specific rents (Tullock 1980), specifically in the context of environmental instrument choice (Dijkstra 1998). Moreover, models of information transfer describe the exchange of truthful information between interest groups and policy makers, upon which politicians base their decisions (Grossman and Helpman 2001, Naevdal and Brazee 2000, Potters and van Winden 1992).

Previous studies on political-economy determinants of environmental taxation include Frederiksson (1997) and Aidt (1997, 1998) who investigate the implications of international competition and revenue recycling for the design of environmental tax reforms. In this context, Anger et al. (2006) provide a first combined theoretical and empirical analysis of the role of interest groups in environmental tax differentiation. They show that a sectoral differentiation of green tax reforms is not only determined by the activity of lobby groups favoring reduced environmental tax rates, but also by the groups' interest in revenue rebates to labor. The existing political-economy literature on emissions regulation by tradable permits focuses on the choice between free permit allocation based on historic emissions levels and auctioning of pollution rights. Hanoteau (2005) theoretically shows that in the presence of interest groups an environmental regulator prefers a free allocation of permits over auctioning, and relaxes the underlying emissions cap. Markussen and Svendsen (2005) argue that dominant industrial lobby groups influenced the corresponding EU ETS directive towards a grandfathered allocation rule, thereby affirming Hanoteau's (2005) findings. Analyzing data from the first EU ETS trading phase, also Buchner et al. (2006) mention the presence of industrial lobby groups in order to explain the political allocation process. Hanoteau (2003) empirically shows that political influence by means of financial campaign contributions affected the distribution of permits within the U.S. sulphur emissions trading system.

The present paper tries to complement the political-economy analysis of the EU ETS with an explicit and combined theoretical and empirical assessment of the role of interest groups in the EU emissions trading system by providing a twofold contribution: First, we develop a stylized *common-agency* framework for the allocation of emissions allowances in a cap and trade system, where the regulator values political contributions from sectoral interest groups when determining the stringency of allowance allocation. Second, we test the predictions of our analytical model with an empirical analysis on the political-economy determinants of permit allocation in the EU ETS for a large cross section of regulated firms in Germany. To our best knowledge we thereby provide the first econometric assessment of the role of interest groups in the EU ETS.

The remainder of this paper is structured as follows. In section 2, we develop a political-economy framework for the allocation of emissions allowances in a cap and trade system. In section 3, we present our empirical analysis of the determinants of permit allocation in the EU ETS. In section 4, we conclude.

## 2 Theoretical framework

In this section we present a stylized analytical framework of the role of interest groups for the allocation of emissions allowances in a cap and trade system. The model is structured as a *common-agency* problem, in which principals (interest groups) aim to induce an action from an agent (the government). As introduced by Grossman and Helpman (1994) in the context of international trade, lobby groups may influence political decisions – here: the stringency of allowance allocation – as the government does not only care about social welfare but also values political contributions by interest groups.

In order to analyze the firm's behavior on the emissions market, we build on the one-sector partial equilibrium model by Böhringer and Lange (2005) assessing emissions-based allocation rules in cap-and-trade systems. In our model we consider an emissions-constrained economy with two production sectors $i \in \{ets, nets\}$, one of which is regulated by an emissions trading scheme (*ets*) while the other is excluded from the scheme (*nets*). Sectoral emissions $e_i$ are the product of the emissions rate (or intensity) $\mu_i$ and the output level $q_i$ ($e_i = \mu_i q_i$). Marginal production costs $c(\cdot)$ are constant in output, decreasing in emissions rate ($c(\mu) \geq 0,\ c'(\mu) < 0,\ c''(\mu) > 0$). Inverse demand for output $P(q)$ is decreasing in $q$ and differentiable.

In order to fulfill a given economy-wide emissions target $\overline{E}$ (as committed to e.g. under the Kyoto Protocol) the national government implements a hybrid system of emissions regulation:

tradable emissions allowances for the covered *ets* sectors and emissions taxation for the remaining *nets* sectors of the economy. Motivated by the EU Emissions Trading Scheme, emissions permits are freely allocated to *ets* sectors based on pollution levels, i.e. emissions rates and output levels. The stringency of emissions regulation is represented by an *allocation factor* $\alpha$ that denotes the fraction of benchmark emissions freely allocated as allowances, so that the sectoral permit allocation equals $\alpha\mu_{ets}q_{ets}$. Emissions allowances are tradable internationally at an exogenous permit price $\sigma$. For *nets* sectors, the regulator allows the remaining emissions budget of $\overline{E}-\alpha\mu_{ets}q_{ets}$ in order to fulfill the economy-wide target.

The political process involves an incumbent government (i.e. an environmental regulator) and an industrial lobby group that represents sectoral (i.e. firms') interests. Motivated by current EU emissions regulation, we assume the formation of interest groups only for the covered *ets* sector, while the *nets* industry does not feature lobbying activities. We base this assumption on the fact that the EU Emissions Trading Scheme covers mainly energy-intensive industries and represents the dominant instrument of environmental regulation for these sectors. In contrast, the remaining segments of EU economies (e.g. the transport sector or households) are subject to a more diverse set of environmental policy instruments (such as energy taxes or subsidies). Besides their single-targeted motive of lobbying for free emissions allowances, energy-intensive industries also feature a relatively high degree of concentration, which according to Olson (1965) should enable a better organization of interests by overcoming the problem of free-riding.

Motivated by Grossman and Helpman (1994), in the model the lobby group can offer a set of political contributions $K_{ets}(\alpha)$ to the government depending on the envisaged policy decision. In our context, sectoral contributions are thus a function of the allocation factor. Political contributions may either represent monetary campaign donations by interest groups or a more general form of political support, such as information transfer between interest groups and policy makers (Grossman and Helpman 2001). In our analysis we abstract from interest group formation and behavior and thus focus on the political equilibrium in which lobby contributions $K_{ets}(\alpha)$ reflect the true preferences of interest groups: a marginal change in the lobby contribution for a marginal policy change corresponds to the effect of the policy change on the group's welfare.

Against this political-economy background, aggregate profit maximization in sector *ets* (firms are price taker on the goods and emissions market), including the costs or revenues from emissions trading as well as efforts for political contributions, is given as:

$$\max_{q_{ets},\mu_{ets}} \pi_{ets} = p_{ets}q_{ets} - c_{ets}(\mu_{ets})q_{ets} - \sigma(1-\alpha)\mu_{ets}q_{ets} - K_{ets}(\alpha).$$

Likewise, aggregate profit maximization in the *nets* sector which is regulated by an emissions tax (firms are price taker on the goods market) is given as:

$$\max_{q_{nets},\mu_{nets}} \pi_{nets} = p_{nets}q_{nets} - c_{nets}(\mu_{nets})q_{nets} - \tau\mu_{nets}q_{nets}.$$

The corresponding first-order conditions of the firm can be found in Appendix A.1. Social welfare (gross of political contributions) is composed of aggregate consumer and producer surplus including the costs or revenues from emissions trading and emissions tax payments:

$$W = \sum_i \int_0^{q_i} P_i(r_i)dr_i - \sum_i c_i(\mu_i)q_i - \sigma(1-\alpha)\mu_{ets}q_{ets} - \tau\mu_{nets}q_{nets}.$$

### 2.1 Emissions regulation in the presence of lobbying

The problem of the incumbent government is to maximize its political support. To this aim it values the level of political contributions by interest groups besides social welfare (the latter presuming that a higher standard of living increases the chances for reelection). The regulator thus maximizes a weighted sum of contributions and welfare given an environmental constraint (i.e. the total emissions target) by choosing the allocation factor for *ets* sectors and the emissions tax for *nets* industries:[1]

$$\max_{\alpha,\tau} G(\alpha,\tau) = K_{ets}(\alpha) + \theta W(\alpha,\tau) \quad \text{s.t.} \quad \overline{E} = \alpha_{ets}\mu_{ets}q_{ets} + \mu_{nets}q_{nets}.$$

In this framework, the government maximizes a social-welfare function that weights sectors represented by a lobby group with the weight $1+\theta$ and the remaining members of society with the (smaller) weight of $\theta$. This formulation of the political-support function implies no restriction on the value of the parameter $\theta$.[2] Obviously, the higher the value of $\theta$, the higher the regulator values social welfare in comparison to political contributions by interest groups (the regulator fully ignores lobby contributions in the extreme case of $\theta \to \infty$, whereas she only cares about political contributions for a $\theta$ equal to zero).

[1] As we consider a Pigouvian tax that aims to achieve the emission target $\overline{E}$, we abstract from tax revenues here.
[2] Grossman and Helpman (1994) argue that one could alternatively formulate the government's objective function as $\theta_1 \sum_s K_s((\alpha_s)_s) + \theta_2[W((\alpha_s)_s - \sum_s K_s((\alpha_s)_s)]$, which for $\theta = \theta_2/(\theta_1 - \theta_2)$ yields a maximization problem equivalent to the one presented above.

In the following, we analyze the regulatory behavior of the government in terms of allowance allocation and emissions taxation for two cases: the absence and the presence of interest groups. Denoting the Lagrange multiplier as $\lambda$ yields the following first-order conditions for the government:

<u>a) Absence of lobbying:</u> $K_{ets}(\alpha) = 0$ and (for transparency) $\theta = 1$

Based on the firm's first order conditions, implicit differentiation of the government's objective function w.r.t. the allocation factor subject to the environmental constraint yields:

$$0 = \frac{\partial G}{\partial \alpha} = \frac{\partial W}{\partial \alpha} \Leftrightarrow \alpha^* = \frac{-c_{ets}'(\mu_{ets})}{\lambda - \sigma} - \frac{\mu_{ets}}{\frac{\partial \mu_{ets}}{\partial \alpha}}. \tag{1}$$

In the absence of lobbying the regulator maximizes social welfare. The optimal allocation factor thus depends on the marginal cost of emissions abatement in the *ets* sector, the shadow-price of the environmental constraint, the allowance price as well as the emissions rate and its sensitivity to changes in the allocation factor. Analogously, the welfare-maximizing emissions tax can be derived based on the firm's first order conditions:

$$0 = \frac{\partial G}{\partial \tau} = \frac{\partial W}{\partial \tau} \Leftrightarrow \tau^* = -c_{nets}'(\mu_{nets}) - \lambda - \frac{\mu_{nets}}{\frac{\partial \mu_{nets}}{\partial \tau}}. \tag{2}$$

<u>b) Presence of lobbying:</u> $K(\alpha) > 0$

In the presence of lobbying for emissions allowances by the *ets* sector, implicit differentiation of the regulator's objective function w.r.t. $\alpha$ yields the allocation factor that maximizes the political support for the government:

$$0 = \frac{\partial G}{\partial \alpha} \Leftrightarrow \alpha = \frac{-\theta c_{ets}'(\mu_{ets})}{\lambda - \theta\sigma} - \frac{\mu_{ets}}{\frac{\partial \mu_{ets}}{\partial \alpha}} + \frac{K_{ets}'(\alpha)}{(\lambda - \theta\sigma)\frac{\partial \mu_{ets}}{\partial \alpha} q_{ets}}. \tag{3}$$

Condition (3) shows that in the political equilibrium the allocation factor additionally depends on two policy-relevant factors: the government's weight on welfare relative to political contributions $\theta$ and marginal political contributions by the lobby group $K_{ets}'(\alpha)$. Likewise, implicit differentiation of the government's objective function w.r.t. the emissions tax yields:

$$0=\frac{\partial G}{\partial \tau} \Leftrightarrow \tau = -c_{nets}'(\mu_{nets}) - \frac{\lambda}{\theta} - \frac{\mu_{nets}}{\frac{\partial \mu_{nets}}{\partial \tau}}. \tag{4}$$

The emissions tax in the political equilibrium thus differs from the welfare-maximizing emissions tax only by the government's weight on social welfare relative to political contributions. In the following, we analyze the efficiency implications of the political equilibrium regarding the allocation of allowances in greater detail.

## 2.2 Efficiency implications of lobbying for allowances

In order to analyze how the political-support maximizing behavior of the government in the presence of lobbying affects the economic efficiency of emissions regulation, we compare the welfare-maximizing allocation factor, as given in (5), with the allocation factor that maximizes the political support for the government, as given in (7):

$$\alpha > \alpha^* \;\Leftrightarrow\; K_{ets}'(\alpha) > -c_{ets}'(\mu_{ets})q_{ets}\frac{\partial \mu_{ets}}{\partial \alpha}\frac{(1-\theta)\lambda}{\lambda-\sigma}. \tag{5}$$

We find that if and only if marginal political contributions exceed the threshold value on the right-hand side of condition (5), the political-support maximizing allocation factor results in a higher level than the welfare-maximizing allocation factor. This threshold value is the higher, the higher the marginal cost of emissions abatement, the output level, and the sensitivity of the emissions rate of the *ets* sector to changes in the allocation factor are. Condition (5) thus suggests that if the *ets* sector's interest group is able to increase political contributions to a sufficiently large extent for a higher allocation factor (i.e. if the lobby group is sufficiently strong), the regulator implements an inefficiently high allowance allocation. More specifically, as the firm behavior in Appendix A.1 implies that marginal political contributions are ever positive, condition (5) states that for $\theta = 1$ the regulator will always implement an inefficiently high allocation factor in the presence of lobbying. This is the case when it values social welfare and political contributions from interest groups equally high.

The government's environmental constraint immediately suggests that a higher allocation factor for the *ets* sector translates into higher emissions from this segment of the economy, which, ceteris paribus, increases the emissions reduction requirements for the *nets* sector in order to achieve the overall emissions target $\overline{E}$. Conditions (13) and (14) in Appendix A.1 imply that larger emissions reductions by the *nets* sector require the implementation of increased emissions taxation.

**Proposition 1:** *If the government values social welfare and political contributions from interest groups equally high, the presence of lobbying induces an inefficient emissions regulation.*

### 2.3 The structure of allowance allocation

In the following we assess the sub-sectoral distribution of allocated allowances within the emissions trading scheme. To this aim we describe the *ets* sector as being composed of $s = 1 \ldots S$ sub-sectors, each of which is represented by an industrial lobby group. Political contributions at the sub-sectoral level depend on a sub-sectoral allocation factor and are given by $K_s(\alpha_s)$. The political equilibrium within the *ets* sector can be derived analogously to condition (3) by profit maximization in the respective sub-sectors and the political-support maximizing behavior of the government on the aggregate sectoral level.

We now analyze comparative statics in the resulting political equilibrium. Considering two exemplary sub-sectors 1 and 2, we can assess the determinants of allowance allocation within the emissions trading scheme:

$$\alpha_1 > \alpha_2 \;\Leftrightarrow\; \left[ \frac{-\theta c_1'(\mu_1)}{\lambda - \theta\sigma} - \frac{\mu_1}{\frac{\partial \mu_1}{\partial \alpha_1}} + \frac{K_1'(\alpha_1)}{(\lambda - \theta\sigma)\frac{\partial \mu_1}{\partial \alpha_1} q_1} \right] > \left[ \frac{-\theta c_2'(\mu_2)}{\lambda - \theta\sigma} - \frac{\mu_2}{\frac{\partial \mu_2}{\partial \alpha_2}} + \frac{K_2'(\alpha_2)}{(\lambda - \theta\sigma)\frac{\partial \mu_2}{\partial \alpha_2} q_2} \right]. \quad (6)$$

Given that $\partial \mu_s / \partial \alpha_s > 0$ (see condition (12) in the Appendix), we arrive at the following conclusions. For a sufficiently small government weight on social welfare relative to political contributions (i.e. for $\theta < \lambda / \sigma$), the sub-sectoral allocation factor is (ceteris paribus) higher and thus regulatory stringency lower for industries of the emissions trading scheme featuring: (i) higher marginal cost of emissions abatement, (ii) lower emissions rates, (iii) higher marginal contributions of sub-sectoral interest groups and (iv) lower output levels. Result (iii) implies that sub-sectors represented by lobby groups which are able to increase political contributions to a larger extent for a higher sub-sectoral allocation factor (i.e. that are more powerful) face a lower regulatory burden. As the allocation factor represents the fraction of emissions freely allocated as allowances, our theoretical analysis predicts that firms belonging to industries that are represented by a more powerful lobby also receive a higher level of allowance allocation $\alpha_s \mu_s q_s$ for a given level of emissions. We will test this central theoretical prediction by an empirical analysis in the next section.

Moreover, together with condition (5), condition (6) implies that if sub-sectoral lobbying power $K_s'(\alpha_s)$ within the emissions trading scheme is strong enough to induce a sufficiently high allowance allocation for the aggregate *ets* sector (i.e. if $\sum_s \alpha_s \mu_s q_{ets} > \alpha^* \mu_{ets} q_{ets}$), sub-sectoral lobbying does not only lead to allocation factor differences within the emissions trading scheme, but also to economic inefficiencies in the overall emissions regulation.

**Proposition 2:** *If the government values political contributions from interest groups sufficiently high relative to social welfare, those sub-sectors of the emissions trading scheme with higher lobbying power receive a higher level of allowance allocation. Sufficiently strong lobbying activities at the sub-sectoral level induce overall inefficiencies of emissions regulation.*

# 3 Empirical analysis for Germany

In this section we present an empirical assessment of the determinants of EU ETS emissions allowance allocation at the German firm level in order to test our central theoretical prediction of the previous section. In its first trading phase, the EU ETS exclusively covers installations in energy-intensive sectors (such as electricity, iron and steel, or paper and pulp), while the remaining industries of EU economies (such as households or the transport sector) have to be regulated by complementary abatement policies in order to meet the countries' overall emissions targets. The EU ETS prescribes the (mainly free) allocation of emissions allowances to installations according to historic levels by means of National Allocation Plans (NAPs) of the respective Member States, specifying an overall cap in emissions for the covered sectors. Our regression analysis particularly aims at investigating the role of interest groups for the allowance allocation design of the first trading phase of the EU Emissions Trading Scheme.

## 3.1 Data and variables

For the empirical analysis, we use a unique economic and environmental cross-sectional data set for Germany at the firm level. It is a data compilation based on three different sources: First, we employ the CREDITREFORM database, an economic database of German firms, from which we selected those firms regulated by the EU ETS (see Appendix A.2 for details of the data base). In this respect, it should be noted that Germany is the most important country within the EU ETS in terms of carbon emissions, its companies representing roughly a quarter of all allowances allocated. Second, we make use of a data set on verified emissions and EU ETS allowances allocated in 2005 that is publicly available from the EU Community Independent Transaction Log (EU, 2007b). Given the fact that the Community Transaction Log contains information at the installation level only, emissions and allowance data were aggregated at the firm level. Third, for our political-economy analysis we integrated data on representatives of German industrial associations. This interest group data refers to the subsectoral level and was generated from a telephone survey conducted in 2004 (see further down). All in all, data including 175 German firms could be consistently compiled.

The dependent variable of our regression analysis is the number of allowances allocated to regulated firms, as it represents the main governmental decision variable of emissions regulation in the EU ETS. As explanatory variables, we control for the verified emissions of installations in the year 2005 (both in levels and in squared terms) and the employment level (i.e. the number of employees) at the firm level. Our central explanatory variable is the number of sectoral lobby representatives, measuring potential political support provided by sectoral interest groups. In addition, we employ two interaction terms of the lobby variable. The corresponding descriptive statistics are shown in Table 2.

Table 2 shows that our data set includes a broad firm interval of verified emissions and allowances allocated, e.g. allowances per firm ranging from 272 up to 346.000.000 tons of $CO_2$-equivalent. Regarding the relationship between the number of allowances allocated and the verified emissions in 2005, the table suggests that the number of allocated allowances is relatively high compared to the level of 2005 emissions. In our German sample, the (firm) mean of allowances allocated is 533645.9 against 511996.5 (tons of $CO_2$-equivalent) of verified emissions, which means that in 2005 allowance allocation to regulated firms exceeded actual emissions by about 30 per cent. This is in line with the findings of previous studies on EU ETS emissions allocation (see Kettner et al., 2007 or Anger and Oberndorfer, 2008). In this context, it is important to note that verified EU ETS ex-ante emissions (e.g. from 2004 or earlier) were not published by the European Commission. Given this, verified emissions from 2005 are, on the one hand, the best available proxy variable for historical emissions as the main official allocation criterion. On the other hand, this lack of historical emissions data makes it impossible to exactly identify why verified emissions in 2005 exceeded the respective number of allowances allocated. Although Ellerman and Buchner (2006) or Kettner et al. (2007) have considered abatement of emissions in the early EU ETS phase as both less important and realistic – and have therefore interpreted the phenomenon of verified emissions exceeding allocated allowances mainly as a sign of "over-allocation" of firms with EU allowances[3] – reverse causality with respect to verified emissions in a regression of allowances allocated on verified emissions cannot be excluded. Table 3 in Appendix A.3 underpins that these two variables are strongly interrelated.

As a further potential determinant of allowance allocation within the EU ETS, the CREDITREFORM database reports the number of employees at the firm level. Here, we can especially make use of time series information from 2000 to 2004 on employment of the respective EU ETS firms. Given that EU ETS allowance allocation for the first trading phase was decided on in 2004 and the EU ETS came into force in 2005, 2004 employment levels could represent a determinant of allowance allocation, as worker lay-offs are traditionally a prominent argument of industries against environmental regulation (Kirchgässner and Schneider, 2003). However, also 2002 to 2000 employment levels are relevant for our analysis as they may serve as an instrument for possibly endogenous explanatory verified emissions variables (see above). In this context, we can also make use of firm revenues between 2000 and 2002 from the CREDITREFORM database.

The central explanatory variable of our political-economy analysis is the number of lobby employees of the representative industrial association in each subsector. Subsectoral classification is based on the Input-Output Table (IOT) 1993 (see Table 5 in Appendix A.3 for a mapping between all IOT sectors and respective associations). This is the best available proxy for potential political support of sectoral interest groups for the government, as data on e.g. financial budgets of interest groups is not available for Germany. One example of political support provided by interest groups is information transfer from interest groups to policy makers (see e.g. Grossman and Helpman 2001). Accordingly, political support is the stronger, the more representatives a lobby group employs (e.g. by processing and providing a larger amount of relevant information to the policy maker. Our lobby variable contains the number of lobby representatives of industrial associations based on an extensive telephone survey conducted in 2004, the year of the decision on EU ETS allowance allocation for the first trading phase.[4] For our sample, we can make use of lobby representative data of 14 EU

[3] According to this interpretation, participating firms had received allowances for a higher amount of $CO_2$ emissions than they actually emitted, implying a very loose emissions cap of the EU ETS.

[4] The survey has been conducted at the Centre for European Economic Research (ZEW) in Mannheim, Germany, during June and July, 2004. Contact details of associations were taken from a database of German industrial organizations (Hoppenstedt, 2003). For 42 manufacturing subsectors of the German economy (only 14 are relevant for our sample given the restriction of EU ETS to the four industry domains energy, production and

ETS subsectors. On average, each of these sectors employed 108 representatives. However, the number of such employees at the sectoral level is very heterogeneous, ranging from 7 to 350. In order to differentiate between sectoral differences in allowance allocation that originate from lobbying activities and other sectoral factors (Buchner et al., 2006), we additionally generate three dummy variables (electricity, other energy, and manufacturing, with other sectors as reference category; see Appendix A.2) at the aggregate sectoral level in order to control for such industry effects. Controlling for industry effects at the less aggregated sub-sectoral level according to the Input-Output Table 1993 is not feasible as it would lead to perfect multicollinearity of sectoral dummy variables with the employed lobby variable.

Given our set of explanatory variables, we can construct both nonlinear transformations and interaction terms in order to analyze how the impact of one explanatory factor depends on the magnitude of others: We make use of squared verified emissions in order to account for possible nonlinearities in the relationship between verified emissions and allocated allowances (e.g. if large emitters have been treated differently than small emitters). Interaction terms between the lobby variable and both verified emissions and the number of firm employees are included in order to test whether the lobby influence on the allowance allocation depends on economic characteristics of the respective firm. As instrumental variables for verified emissions-related variables, we introduce lagged employment at the firm level (in levels and squared terms) for the period 2000 to 2002. Those variables are measures of firm size which are assumed to be correlated with emissions-related variables, and (due to their historical character) are exogenous to the equation assessing the determinants of allowance allocation.

### 3.2 Methodology

For our cross-sectional analysis, we depart from the ordinary least squares estimator (OLS) for equation:

$$y_i = \beta' x_i + \varepsilon_i \tag{7}$$

with $y_i$ representing allowances allocated of firm $i$, $x_i$ being the vector of explanatory variables of the respective firm as presented in the previous section, and $\beta$ giving the vector of

processing of ferrous metals, minerals and pulp and paper) we covered the representative industrial associations, with a focus on members of the Federation of German Industries (BDI).

coefficients to be estimated. $\varepsilon_i$ is a disturbance term that is independent and identically distributed across firms $i = 1,2,...,N$ . Using OLS, the parameter vector is determined by:

$$\beta = [X'X]^{-1} X' y \tag{8}$$

where matrix $X$ consists of rows $x_i'$, and $y$ is the dependent variable's vector. While OLS serves as the starting point for our empirical analysis, it does not take into account the important issues of potential reverse causality, making robustness checks an all-important issue for our empirical analysis.

Within the OLS approach, reverse causality problems may cause biased parameter estimation. As lined out in the preceding chapter, firm data on historical emissions is not available to date, which is why 2005 verified emissions (and possible variations of it) have to be used as explanatory variable(s) in the regression analysis. Given the nature of the EU ETS allocation process that is officially based on historical emissions, neglecting emissions data is not an option due to the problem of causing biased parameter estimates because of omitted variables. Still, firm emissions in 2005 could have been influenced by the number of allocated emissions allowances. Such effect would cause reverse causality problems rendering the regression with allowances allocated (as dependent variable) and verified emissions (as explanatory variable) biased and inconsistent. Instrumental variable technique is the usual remedy to such econometric problem. Within a Two Stage Least Squares (2SLS) approach, in the first stage the fitted values $x_i^*$ from a regression of the (possibly) endogenous variables $x_i$ on the instruments $z_i$ are produced, while in the second those fitted values $x_i^*$ replace the endogenous regressors $x_i$ in the regression of actual interest

$$y_i = \gamma' x_i^* + \varepsilon_i . \tag{9}$$

Given this, the 2SLS estimator for the parameter vector $\gamma$ can be written as.

$$\gamma = [X^{*\prime} X^*]^{-1} X^{*\prime} y \tag{10}$$

where matrix $X^*$ consists of rows $x_i^*$ (first stage regression fitted values for endogenous explanatory, i.e. emissions variables, and exogenous explanatory variables, respectively). In the 2SLS approach, for instrumental variables to be valid two prerequisites have to hold: correlation between $z_i$ and the endogenous variable to be instrumented $x_i$ should be non-negligible, while $z_i$ and the second-stage error term ($\varepsilon_i$ from equation (9)) have to be uncorrelated. Firm employment (levels and squared terms) between 2000 and 2002 appear to be appropriate instruments for the verified-emissions variable and respective transformations:

they can be interpreted as indicators of firm size, a natural determinant of the amount of $CO_2$ emissions of energy-intensive companies. Moreover, being predetermined, there is no reason to expect correlation with the second stage regression error term.

In the following, we empirically assess the determinants of EU ETS allowance allocation at the German firm level. In order to circumvent possible problems due to omitted variables, we make use of an extensive specification. In addition to verified emissions and the lobby variable, whose importance have been lined out in our theoretical framework, we additionally include squared verified emissions and the number of employees at the firm level, as well as interaction terms of the lobby variable with verified emissions and employees, respectively. In the 2SLS estimation, the verified emissions variable and its interaction terms and nonlinearities are instrumented in a first stage regression by lags (2000-2002) and the associated squared terms of the employment variable in addition to the explanatory variables of the 2SLS second stage equation.

### 3.3 Estimation results

Our quantitative estimation results, presented in, Table 1 suggest that the empirical set-up provides a very good fit to our data set, as shown by a very high R-squared for both econometric techniques used. Particularly verified emissions of the firms analyzed here have very strong explanatory power for the allowances allocated manifesting in a high statistical significance of the respective coefficients (at the 1%-level for each estimation technique). Accordingly, also the null hypothesis of joint insignificance of all explanatory variables can be rejected at the 1%-level for both techniques (F-Test). According to an F-Test, there is no indication for a misspecification of the 2SLS approach. First stage regressions of the verified emissions, squared verified emissions and the interaction terms between verified emissions and the lobby variables on the instruments (2000 to 2002 levels and squared terms of employment at the firm level) are well specified, as the null hypothesis of joint insignificance of all explanatory variables can be rejected at any conventional level (see Table 4 in Appendix A.3).

Table 1 shows a positive sign of the estimated coefficient of the verified emissions variable, which corresponds to the nature of the EU ETS allocation process suggesting that emissions levels have a positive impact on the level of allowance allocation. For both estimation techniques, also the squared term of the emissions variable (included in order to control for nonlinearities in the relationship between emissions and the allocation process) enters highly significantly into the estimated regression equation. Its negative sign suggests a concave relationship between verified emissions and allowances allocated.

*Table 1: Estimation results*

| **Dependent variable: Allowances allocated** | **OLS** | **2SLS** |
|---|---|---|
| Verified Emissions | 1.13*** (0.00) | 0.91*** (0.00) |
| Squared Verified Emissions | -0.19*** (0.01) | -0.32*** (0.00) |
| Employment 2004 | -0.01 (0.25) | -0.00 (0.79) |
| Lobby | -0.01 (0.16) | -0.00 (0.33) |
| Lobby x Verified Emissions | 0.05 (0.58) | 0.40*** (0.00) |
| Lobby x Employment 2004 | 0.01 (0.32) | 0.00 (0.82) |
| **No. Obs.** | 175 | 131 |
| **R-sq.** | 0.99 | 0.99 |
| **F-Test (P-Val.)** | 0.00*** | 0.00*** |

**Note:** Standardized coefficients (regression coefficients obtained by standardizing all variables to have a mean of 0 and a standard deviation of 1) are reported. P-values in brackets (based on White robust std. errors). Estimations include sectoral dummy variables (estimated coefficients not reported). *, **, and *** indicate significance at the 10%-, 5%-, and 1%-level, respectively.

In contrast, the estimated coefficient for the variable indicating the number of lobby employees does not significantly differ from zero at any conventional level, a result which at first sight does not confirm our theoretical prediction of Proposition 2 in the previous section. This holds for both estimation techniques applied. The estimated coefficient for the lobby variable does neither alter substantially when the instrumental variable technique to verified emissions-related variables is applied.

However, we find an interesting result concerning the coefficient of the interaction term between the lobby and emissions variable: while standards OLS estimation does not yield significant parameter estimates, the coefficient of the interaction term is highly significant and positive under 2SLS. Note that the latter represents the adequate technique for our setting, as it eliminates estimation biases due to reverse causality of the emissions variable.[5] This central

[5] The magnitude of the (highly significant) estimated coefficient of the emissions variable for 2SLS is smaller than for OLS estimation, which may be a sign of actual reverse causality of the emissions variable, as one would

empirical result suggests that the combination of high emissions at the firm level and powerful lobbying activities in the respective sector induced higher levels of allocated allowances for German firms in the EU ETS.

Given the insignificant coefficients of the lobby variable itself, the employment variable and the employment-lobbying interaction term, the 2SLS estimation results indicate that lobbying may influence the allocation process only in combination with specific economic characteristics of the respective industries: in our case, a high exposure to environmental regulation in terms of a high emissions level. In contrast, there is no indication that the level of firm employment matters for allowance allocation. Put differently, we find that in the EU ETS industrial arguments against environmental policy which were directly linked to regulatory exposure played a more critical role than more indirect policy issues.

Both estimations include dummy variables indicating the sectoral affiliation at an aggregate level (electricity, energy, and manufacturing sector), in order to control for general sectoral effects within the allocation process. The central results for the analysis also hold when these sectoral indicator variables or, alternatively, insignificant explanatory variables are eliminated from the estimation. Moreover, the coefficient of the lobby variable remains insignificant if the interaction term between lobby power and verified emissions is dropped from the estimated equation (all estimations are available on request from the authors).

In summary, the empirical analysis corroborates our theoretical Proposition 2 of the previous section which suggested a positive impact of sub-sectoral lobbying power on allowance allocation, but suggests that the lobbying effect is conditional on firm characteristics. The empirical analysis thereby provides important insight into the complex political-economy determinants of permit allocation in the EU ETS. Moreover, besides our empirical finding on the important role of lobbying for the allowance distribution *within* the EU ETS, in combination with Proposition 2 the estimation results suggest that considerable sub-sectoral lobbying activities were able to induce inefficiencies in the overall allocation design.

## 4 Conclusions

This paper assessed the political-economy aspects of allowance allocation in the EU Emissions Trading Scheme (EU ETS) both on theoretical and empirical grounds. We

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expect the effect of allowances allocated on verified emissions to be positive. For this case, i.e. that "over-allocation" led to higher actual emissions and more stringent allowance allocation led to more abatement, OLS would over-estimate the impact of verified emissions on allowances allocated. Such a bias can be eliminated using the 2SLS technique.

developed a simple analytical framework of the role of interest groups for the allocation of emissions allowances in a cap and trade system. The model is structured as a *common-agency* problem, in which several principals (sectoral interest groups) aim to induce an action from a single agent (the government). In the stylized model, lobbying may influence political decisions, as the government does not only value social welfare but also political contributions by interest groups. In this setting, sectors represented by more powerful lobby groups thus face a lower regulatory burden in terms of less stringent allowance allocation. This does not only lead to distributional impacts within the emissions trading scheme, but for sufficiently high lobbying power can induce overall inefficiencies of emissions regulation: the political-support maximizing government implements an inefficiently high aggregate allowance allocation and shifts the abatement burden to those sectors excluded from emissions trading. As a consequence, these industries have to be regulated by a higher emissions tax in order to fulfill the national emissions target.

An empirical analysis of the first trading phase of the EU ETS employing instrumental variable estimation technique affirms this theoretical prediction for a cross-section of German firms, but also shows that the political-economy determinants of allowance allocation depend on firm characteristics. While we do not find stand-alone lobbying effects on the overall number of allocated emissions allowances, we show that particularly large emitters represented by stronger German industrial interest groups were allocated significantly higher levels of allowances in the EU ETS. Our empirical analysis thus provides important insights into the complex political-economy determinants of permit allocation in the EU ETS: While a powerful interest group alone did not influence the allocation process significantly, lobbying paid off in combination with the political argument of exposure to emissions regulation. According to our analysis, those industrial arguments against environmental policy that were directly linked to emissions regulation played a more critical role than more indirect issues such as a political-economic importance in terms of employment levels. Together with the propositions from our theoretical model, these empirical results offer an explanation for the potential abatement burden shifting to sectors outside the EU ETS. Our results suggest that those EU ETS sectors represented by more powerful interest groups have not only benefited from a preferential allocation of emissions allowances compared to other ETS sectors – they were also able to lower the abatement burden of the EU ETS as a whole at the expense of overall economic efficiency.

Suggesting that industrial lobbying has played a crucial role for emissions allocation at the German level, our results corroborate the existing critique on the allocation process of the EU

ETS. The findings of both our theoretical and empirical analysis thus provide arguments in favor of the use of auctioning instead of a grandfathered allowance allocation. The claim for an increased use of auctioning in emissions trading systems has, up to now, been mainly based on theoretical arguments concerning the reduction of tax distortions, the enhanced provision of innovations, and the elimination of potential lobbying influence (Cramton and Kerr, 2002). Despite the more stringent allowance allocation in the second trading phase of the EU ETS and the increasing application of auctioning, our empirical results thus provide new support for the auctioning debate in international emissions trading. To complement our primary insights into the determinants of EU emissions allowance allocation, empirical assessments for additional EU Member States as well as the second EU ETS trading phase constitute interesting directions for future research.

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# Appendix A

## A.1 Theoretical framework: Firm behavior

Profit maximization in sector *ets* yields the following first-order conditions for firms in the *ets* sector:

$$0 = \frac{\partial \pi_{ets}}{\partial q_{ets}} = p_{ets} - c_{ets}(\mu_{ets}) - \sigma(1-\alpha)\mu_{ets} \;\Leftrightarrow\; p_{ets} = c_{ets}(\mu_{ets}) + \sigma(1-\alpha)\mu_{ets} \tag{11}$$

$$0 = \frac{\partial \pi_{ets}}{\partial \mu_{ets}} = -c_{ets}'(\mu_{ets})q_{ets} - \sigma(1-\alpha)q_{ets} \;\Leftrightarrow\; -c_{ets}'(\mu_{ets}) = \sigma(1-\alpha)\,. \tag{12}$$

While condition (11) states that given the firm's behavior the marginal benefit of sectoral production equals its social cost, condition (12) implies that the marginal cost of emissions abatement equals the permit price adjusted by the marginal cost or benefit from allowance allocation. Moreover, differentiation of the profit function w.r.t. $\alpha$ implies that $K_{ets}'(\alpha) = \sigma\mu_{ets}q_{ets} > 0$, i.e. political contributions increase in the allocation factor (as do sectoral profits).

Profit maximization in sector *nets* yields the following first-order conditions:

$$0 = \frac{\partial \pi_{nets}}{\partial q_{nets}} = p_{nets} - c_{nets}(\mu_{nets}) - \tau\mu_{nets} \;\Leftrightarrow\; p_{nets} = c_{nets}(\mu_{nets}) + \tau\mu_{nets} \tag{13}$$

$$0 = \frac{\partial \pi_{nets}}{\partial \mu_{nets}} = -c_{nets}'(\mu_{nets})q_{nets} - \sigma q_{nets} \;\Leftrightarrow\; -c_{nets}'(\mu_{nets}) = \tau\,. \tag{14}$$

Analogously to the first-order conditions in the *ets* sector, condition (13) states that the marginal benefit of *nets* production equals its social cost, while condition (14) implies that the marginal cost of emissions abatement equals the value of the emissions tax.

## A.2 Empirical analysis: The CREDITREFORM database

The CREDITREFORM database is a financial and economic database that includes information of sales and employment of German firms. It is the most comprehensive database on German firms, containing a random sample of 20,000 solvent and 1,000 insolvent firms in Germany. From the CREDITREFORM database, we use levels and differences from firm revenue and employment data between 2002 and 2005. Those data have been matched with the allocation factor (allowances allocated divided by verified emissions) from the EU Independent Community Transaction Log. This has been conducted by supplementing allocation data that has been aggregated at the firm level with CREDITREFORM data. The main criteria for this database matching were the respective company names and addresses. The matching results have been carefully checked for consistency reasons. Sectoral dummy variables have been constructed as follows: electricity: NACE code between 4000 and 4020; other energy: NACE code between 4020 and 4500; manufacturing: NACE code between 2600 and 3700.

## A.3 List of tables

*Table 2: Descriptive Statistics*

| | ***Obs.*** | ***Mean*** | ***Std. Dev.*** | ***Min.*** | ***Max.*** |
|---|---|---|---|---|---|
| Allowances Allocated | 175 | 533645.90 | 2808694 | 272 | 3.46e+07 |
| Verified Emissions (t $CO_2$) | 175 | 511996.50 | 2907576.00 | 50 | 3.65e+07 |
| Squared V. Emissions | 175 | 8.67e+12 | 1.01e+14 | 2500 | 1.33e+15 |
| Lobby (no. of representatives) | 175 | 108.39 | 74.77 | 7 | 350 |
| Lobby x Emissions | 175 | 6.48e+07 | 4.50e+08 | 8000 | 5.84e+09 |
| Lobby x Employment 2004 | 175 | 114553.80 | 282992 | 14 | 2370760 |
| Employment 2004 | 175 | 1279.56 | 3422.74 | 1 | 33810 |
| Employment 2002 | 175 | 1351.07 | 3875.96 | 1 | 33049 |
| Employment 2001 | 155 | 1088.37 | 3191.49 | 1 | 37707 |
| Employment 2000 | 144 | 1370.72 | 4645.31 | 1 | 42317 |
| Employment 2002 squared | 175 | 1.68e+07 | 1.16e+08 | 1 | 1.09e+09 |
| Employment 2001 squared | 155 | 1.13e+07 | 1.14e+08 | 1 | 1.42e+09 |
| Employment 2000 squared | 144 | 2.33e+07 | 1.82e+08 | 1 | 1.79e+09 |

*Table 3: Correlation matrix of main regression variables*

| | Allowances Allocated | Verified Emissions | Squared V. Emissions | Employ-ment | Lobby | Lobby x Emissions | Lobby x Employ-ment |
|---|---|---|---|---|---|---|---|
| Allowances Allocated | 1.0000 | | | | | | |
| Verified Emissions | 0.9988 | 1.0000 | | | | | |
| Squared V. Emissions | 0.9792 | 0.9870 | 1.0000 | | | | |
| Employ-ment 2004 | 0.0631 | 0.0648 | 0.0667 | 1.0000 | | | |
| Lobby | 0.0858 | 0.0799 | 0.0591 | -0.0790 | 1.0000 | | |
| Lobby x Emissions | 0.9985 | 0.9996 | 0.9872 | 0.0608 | 0.0892 | 1.0000 | |
| Lobby x Employ-ment 2004 | 0.7180 | 0.1531 | 0.1519 | 0.8775 | 0.2450 | 0.1531 | 1.0000 |

Note: 131 observations. Pearson’s correlation coefficient for the respective variable pairs is given.

*Table 4: Specification tests for first stage regressions*

| ***Dependent variable*** | Verified Emissions | Squared V. Emissions | Lobby x Emissions |
|---|---|---|---|
| F-Test first stage regression specification (1) | 0.00*** | - | - |
| F-Test first stage regression specification (2) | 0.00*** | 0.00*** | 0.00*** |

Note: 131 observations. F-Test (p-value) on null hypothesis of joint insignificance of all explanatory variables.*, **, and *** indicate significance at the 10%-, 5%-, and 1%-level, respectively. The full results from these first stage regressions are available on request from the authors.

*Table 5: German manufacturing sectors and respective industrial associations*

| Sector No. | Name of sector | Industrial associations |
|---|---|---|
| 1 | Agricultural products | German Farmers Association (DBV) |
| 2 | Forestry & fishery products | German Forestry Council (DFWR)<br>German Fishery Association (DFV) |
| 3 | Electric power & steam & warm water | German Electricity Association (VDEW) |
| 4 | Gas | Association of the German Gas and Water Industries (BGW) |
| 5 | Water (distribution) | Association of the German Gas and Water Industries (BGW) |
| 6 | Coal & coal products | German Mining Association (WVB)<br>German Hard Coal Association (GVST)<br>German Lignite Industry Association (DEBRIV) |
| 7 | Minery products (without coal & gas & petroleum) | German Mining Association (WVB) |
| 8 | Crude oil & natural gas | Association of the German Oil and Gas Producers (WEG) |
| 9 | Chemical products & nuclear fuels | Association of the German Chemical Industry (VCI) |
| 10 | Oil products | Association of the German Petroleum Industry (MWV) |
| 11 | Plastics | Association of the German Plastics Processing Industry (GKV)<br>Federation of German Woodworking and Furniture Industries (HDH)<br>Federation of German Paper, Cardboard and Plastics Processing Ind. (HPV) |
| 12 | Rubber | German Rubber Manufacturers' Association (WDK) |
| 13 | Stone & lime & cement | German Building Materials Association (BBS) |
| 14 | Ceramic | German Federation of Fine Ceramic Industry (AKI) |
| 15 | Glass | German Glass Industry Federation (BV Glas) |
| 16 | Iron & steel | German Steel Federation (WV Stahl)<br>German Federation of Steel and Metal Processing (WSM) |
| 17 | Non-ferrous metals | Federation of the German Non-Ferrous Metals Industry (WVM)<br>Federation of German Steel and Metal Processing (WSM) |
| 18 | Casting products | German Foundry Association (DGV) |
| 19 | Rolling products | Association of German Drawing Mills (STV)<br>Association of German Cold Rolling Mills (FVK) |
| 20 | Production of steel etc | German Structural Steel and Power Engineering Association (SET) |

*Table 5 (continued)*: *German manufacturing sectors and respective industrial associations*

| Sector No. | Name of sector | Industrial associations |
|---|---|---|
| 21 | Mechanical engineering | Federation of the German Engineering Industry (VDMA) |
| 22 | Office machines | – |
| 23 | Motor vehicles | Association of the German Automotive Industry (VDA) |
| 24 | Shipbuilding | German Shipbuilding and Ocean Industries Association (VSM) |
| 25 | Aerospace equipment | German Aerospace Industries Association (BDLI) |
| 26 | Electrical engineering | German Electrical and Electronic Manufacturers' Association (ZVEI) |
| 27 | Engineers' small tools | German Industrial Association for Optical, Medical and Mechatronical Technologies (SPECTARIS)<br>Federation of German Jewellery, Watches, Clocks, Silverware and Related Industries |
| 28 | Metal and steel goods | – |
| 29 | Music instruments & toys etc. | National Association of German Musical Instruments Manufacturers (BDMH)<br>German Association of the Toy Industry (DVSI) |
| 30 | Timber | Federation of German Woodworking and Furniture Industries (HDH)<br>Association of the German Sawmill and Wood Industry (VDS) |
| 31 | Furniture | Federation of German Woodworking and Furniture Industries (HDH) |
| 32 | Paper & pulp & board | German Pulp and Paper Association (VDP) |
| 33 | Paper & board products | German Pulp and Paper Association (VDP)<br>Federation of German Paper, Cardboard and Plastics Processing Industry (HPV) |
| 34 | Printing and publishing | German Printing Industry Federation (BVDM) |
| 35 | Leathers & footwear | German Leather Federation (VDL)<br>Federation of the German Shoe Industry (HDS) |
| 36 | Textiles | Federation of German Textile and Fashion Industry |
| 37 | Clothing | Federation of the German Clothing Industry (BBI) |
| 38 | Food products | Federation of the German Food and Drink Industries (BVE) |
| 39 | Beverages | Federation of the German Food and Drink Industries (BVE) |
| 40 | Tobacco products | Federation of the German Cigarette Industry (VdC) |
| 41 | Building & construction | German Construction Industry Federation (HDB) |
| 42 | Recovery & repair | German Construction Industry Federation (HDB) |