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The Impacts of the European Union Emissions Trading Scheme on Competitiveness in Europe

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Non-technical Summary

In 2005, the European Emissions Trading Scheme (EU ETS) came into force. It is the cornerstone of the EU member states' efforts to fulfil their emission reduction targets of the Kyoto Protocol. The protocol requires European countries to reduce their greenhouse gas emissions by eight per cent until 2008. Our paper analyses the future impacts of the EU ETS on competitiveness. To achieve this we identify the relevant key characteristics of emission trading systems in general, and review the literature simulating the competitiveness impacts of the EU ETS.

We have identified the choice of the reference scenario as the most critical issue for an appropriate analysis of the relevant literature. The results from all theoretical and simulation studies analysing environmental regulation depend substantially on the reference scenario, i.e. whether the impacts of the EU ETS are compared to a business as usual-scenario (BAU) with no regulation in place at all, or whether the impacts are compared with the impacts of another instrument such as Command and Control regulation (CaC). Given the legally binding framework of the Kyoto Protocol, the EU has no alternative but to engage in environmental regulation to reduce CO_2 emissions.

If the reference scenario and other key assumptions of the models are identified and analysed, it is possible to obtain a relatively clear picture of how the introduction of the EU ETS influences Europe's competitiveness. Most of the studies model the EU ETS and compare it with other regulation scenarios. The reference point is often Kyoto compliance without allowance trading. It makes sense to choose this scenario as it clearly demonstrates the efficiency or cost effects of emissions trading in relation to given environmental objectives. The alternative BAU scenario without emission reductions is used in single cases.

The competitiveness record of the EU ETS is mixed, with emission trading coming out as the cheapest option, if we accept a reality with climate change and Kyoto compliance. Simulation studies suggest that the system offers major cost benefits when compared with Kyoto-based non-trading scenarios. Possible positive innovation effects must also be taken into account, depending on the actual design of the scheme. Winners and losers at the firm and sector level are identified, particularly in comparison with the BAU scenario, but even here the results of the studies analysed suggest only modest costs. The main reasons for potential negative impacts on Europe's competitiveness found by some studies are the heterogeneous National Allocation Plans (NAPs) and the limitation of emissions trading to a handful of sectors. This means that the mechanism is by no means optimal from an economic point of view. Improvements in the system with significantly lower costs whilst retaining the same

ecological goals are certainly possible. The potential this represents for the instrument should not, however, obscure just how much has already been achieved with the EU ETS. If countries were required to comply with their Kyoto commitments without engaging in any trading at all, this would result in a substantial increase in costs. A well designed EU ETS is found to clearly be the cheapest option.

Summing up, the impacts of the EU ETS on competitiveness are modest, and they are smaller than the impacts of alternative regulation scenarios. Compared to these other regulation methods ETSs can have positive competitiveness effects. However, the EU ETS is not designed to boost Europe’s economy. Its prime purpose and justification is to ensure that Europe’s CO_2 emissions are brought down and Kyoto targets are reached at minimal costs.

The EU ETS should be justified on environmental grounds. It is especially important that modifications to the system due to economic considerations do not undermine the environmental goals associated with this policy instrument. The EU ETS will not be responsible for a significant reduction of EU competitiveness.

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Abstract: This literature review analyses the impacts of the EU ETS on competitiveness focussing on existing simulation studies. We have identified the choice of the reference scenario as the most critical issue for an appropriate analysis of the relevant literature. We find, however, that effects of the scheme on competitiveness are modest, even given the business as usual case that does not take the legally binding framework of the Kyoto Protocol into account. Furthermore, the impacts of the EU ETS are smaller than the impacts of alternative Kyoto-based regulation scenarios. Compared to these other regulation methods ETSs can have positive competitiveness effects. However, the EU ETS is not designed to boost Europe’s economy. Its prime purpose and justification is to ensure that Europe’s CO_2 emissions are brought down and Kyoto targets are reached at minimal costs. To our opinion, it is therefore important that the system as well as modifications to it do not undermine the environmental goals associated with this policy instrument.

Keywords: emissions trading, competitiveness, environmental regulation

JEL-Classification: Q21, Q28, Q43

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1. Introduction

In 2005, the European Union Emissions Trading Scheme (EU ETS) came into force. This scheme is a crucial cornerstone of the efforts being made by the EU member states to fulfil the emissions reduction targets of the Kyoto Protocol. The protocol requires European countries to reduce their greenhouse gas emissions by eight per cent until 2008. The baseline is the level of emissions in 1990. The ETS does not apply to all emissions generated in the EU, however. It is confined only to CO_2 emissions of installations in the four sectors of energy (e.g. electric power, direct emissions from oil refineries), production and processing of ferrous metals, minerals (e.g. cement, glass) and pulp and paper. The ETS will cover almost half (46 per cent) of total CO_2 emissions in the EU countries. In the scheme's first phase (2005 to 2007) the emission allowances are grandfathered according to National Allocation Plans (NAPs) of the member states, in the second phase (2008 to 2012) up to 10 per cent can be auctioned. European firms may partly fulfil their emissions reduction obligations outside of the EU by using flexible instruments such as Joint Implementation (JI) and Clean Development Mechanism (CDM). However, the relevant European Directive demands member states to restrict the use of these credits, suggesting a review in case a 6 per cent limit for the use of JI and CDM is exceeded[1].

The current design of the EU ETS has been heavily criticised by the scientific community for its lack of environmental effectiveness and economic efficiency. With respect to the ETS' ecological effectiveness, it seems obvious that Kyoto and national targets were not considered sufficiently in setting caps. Consequently, only few countries are actually on a path to achieve their Kyoto targets. Furthermore, many countries shifted reduction obligations to the non-trading sectors (Böhringer et al., 2005), weakening the economic efficiency of the system in relaxing the reduction obligations without having a clear mechanism to ensure reductions in the non-trading sectors.

As a result of the scheme's implementation in January 2005, companies in energy intensive industries have criticised an anticipated loss of competitiveness partially due to increasing energy prices. The claim that competitiveness in Europe is strongly affected by the introduction of the ETS is not unchallenged, though. Generally, e.g. compared to labour costs, even for the energy intensive industry the importance of energy costs remains modest[2]. Furthermore, the Porter hypothesis suggests positive impacts of an ETS on innovation and,

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[1] For a general description of the EU ETS see for example Kruger and Pizer (2004).

[2] Given the German example, a 6 per cent increase in energy costs for the energy intensive sectors corresponds to an increase of labour costs of only 1 per cent (Eikmeier et al., 2005).

consequently, on competitiveness. Additionally, one has to bear in mind the predominance of grandfathered rather than auctioned emissions certificates as well as the costs of inaction, i.e. the external costs of climate change[3].

Our paper attempts to analyse this future impacts of the EU ETS on competitiveness. To achieve this we aim at identifying the key determinants and characteristics of emission trading systems, and review the relevant literature. We admit, however, that it is not at all clear how the EU ETS will develop subsequent to the planned trading period from 2008 to 2012. Therefore, the long term effects on competitiveness are highly uncertain.

The paper is structured as follows: Section 2 discusses the methodolody and the guiding principles of the study: How did we select our reviewed studies? What is the reference case analysed in the simulation studies? What is the relevance of the famous Porter hypothesis in the EU ETS case and what can the US experience from emissions trading tell us? And what is the theoretical background of an expected impact of the EU ETS on competitiveness? In the third section, we discuss the existing simulation studies. Section 4 sums up the main findings of this paper and gives concluding remarks.

2. Methodology and guiding principles of this study

2.1. Business as usual vs. alternative instruments as reference case

We have identified the choice of the reference scenario as the most critical issue of the study. This is crucial in all theoretical and simulation studies analysing environmental regulation since the results depend substantially on the chosen reference standard, i.e. whether the impacts of the EU ETS are compared to a business as usual scenario (BAU) with no regulation in place at all, or whether the impacts are compared with the impacts of another instrument such as taxes or Command and Control regulation (CaC).

This question is highly relevant for the analysis of an EU ETS since the BAU is hardly a realistic reference scenario for policymakers. The EU ETS is the key approach Europe takes to achieve compliance with the emission reduction targets defined in the Kyoto Protocol. Given the existence of this agreement, the EU has no alternative but to engage in environmental regulation. Inaction is not a realistic option.

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[3] In their latest methodology update, the ExternE project refers to damage costs of 9€/tC for a medium discount rate (Bickel and Friedrich, 2005). The assessment of such costs is difficult and controversial, however, especially given that they are uncertain and occur in the future (cp. e.g. Rennings and Hohmeyer, 1999).

2.2. The Porter hypothesis and early US ETS experience

The view that environmental regulation like an emission trading scheme is merely a source of costs and thus entails competitive disadvantages for the affected firms and companies is controversial. The key argument against this view – i.e. that environmental action can actually generate competitive advantages – is based on what is referred to as the 'Porter hypothesis'. This hypothesis postulates that, in the long run, the objectives of environmental protection and commercial competitiveness are congruent with each other (cf. for example Porter and van der Linde, 1995). Specifically, Porter argues that a pioneering environmental policy role can create technological first mover advantages and make companies more innovative. This is based on the assumption that other countries follow in the footsteps of the pioneering country and adopt environmental regulations at some later point in time. If this does actually happen, the regulation imposed on domestic industry at an earlier point in time will give the pioneering country an adjustment head start. It enables providers of environmental technologies to export their solutions to other countries and the greater (ecological) efficiency of such technology on the domestic market will place them at an advantage vis-à-vis their foreign competitors.

The empirical evidence for the Porter hypothesis is mixed. Most studies tend at least to demonstrate that stricter environmental regulations do not result in a significant deterioration in competitiveness (cp. Rennings et al., 2004). An example of the validity of the hypothesis is provided by Albrecht (1998). In relation to the 1978 Montreal Ozone Protocol Albrecht identifies the USA and Denmark as pioneers and demonstrates that the competitive position of the relevant companies in these countries improved.

It would seem therefore that, ideally, strict environmental regulations can have a positive impact on innovation and competitiveness. However, if the conditions are not right – if other countries do not follow suit, or to a much lesser extent – Porter’s case for enhanced competitiveness ceases to be quite so persuasive. In the case of climate protection it is possible that other regions outside the EU might "follow suit" and that, as the lead market, the EU could profit from a first mover advantage. There are some developments indicating that the EU ETS is a first step towards a global diffusion of emissions trading systems. A regulation trend towards ETS can be interpreted as a forecast for a demand trend towards carbon-efficient technologies, and thus towards first mover advantages for the pioneering country (Beise-Zee and Rennings, 2005). What is more, the EU ETS could even extend to other parts of the world on a mid-horizon view[4]. This is by no means certain, however, as it would – at least theoretically – be worthwhile for other countries to adopt a free rider position with regard to public goods such as climate protection (cp. e.g. Hoel, 1991).

What is more, the ETS can only establish the EU as a lead market for CO_2 reducing innovations if the mechanism delivers sufficient incentives to innovate. In its present form, however, the system is not particularly demanding with regard to CO_2 reductions and this could lessen its innovation incentives. The main reason for this is the design of the NAPs. For example, the German NAP is less demanding compared to the earlier voluntary agreement of the German industry (cp. e.g. SRU, 2006). Furthermore, experience from the comparable American schemes (US Acid Rain and Regional Clean Air Incentives Market) shows that innovation effects are limited (Gagelmann and Frondel, 2005). The reasons for this are mainly to be found in the overly weakening design of flexible mechanisms, indicating small innovation incentives for the EU ETS, as well.

Initial evidence from the EU ETS does, however, suggest that the system could trigger compensatory innovations in the relevant industries. In a survey conducted by the European Commission DG Environment, McKinsey and Ecofys (2005), half of the surveyed companies stated that the mechanism had a strong or medium influence on their innovation decisions. Time will tell if these statements will be reflected in real innovations and efforts by companies to increase energy efficiency and to reduce energy demand.

2.3. Short-term background of EU ETS impacts on competitiveness

There are not only a number of different definitions of competitiveness, various aspects of competitiveness can also be measured in completely different ways. What we want to analyse is the economic performance of producers. There are various means of measuring this, such as a company's sales or productivity. Studies of the EU ETS usually only provide information about the costs of the emissions trading system, in other words about the possible increases or reductions in costs induced by the introduction of the ETS or in comparison with other regulations. Considering the lack of any better measures, they can be used here as a measure of companies' competitiveness as these costs are part of the productivity of companies. In general, one can say that increasing costs result in falling corporate productivity. An alternative measure is the change in output or GDP. To our understanding, these are also indicators of the competitiveness or economic performance of companies, sectors or entire economies.

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[4] Norway and Switzerland are currently designing schemes closely related to the EU ETS and therefore could be linked to it relatively soon. Other linking candidates are e.g. Canada, Japan, and Russia.

A study undertaken by Carbon Trust (2004) identifies three factors which determine the impact of an ETS on competitiveness in the short run. Here, Porter-like innovation effects that may become relevant in a mid- or long-horizon view are neglected. An overview of the short-run impacts is given in Figure 2.

Figure 2: The short-term factors determining the impact of the EU ETS on competitiveness

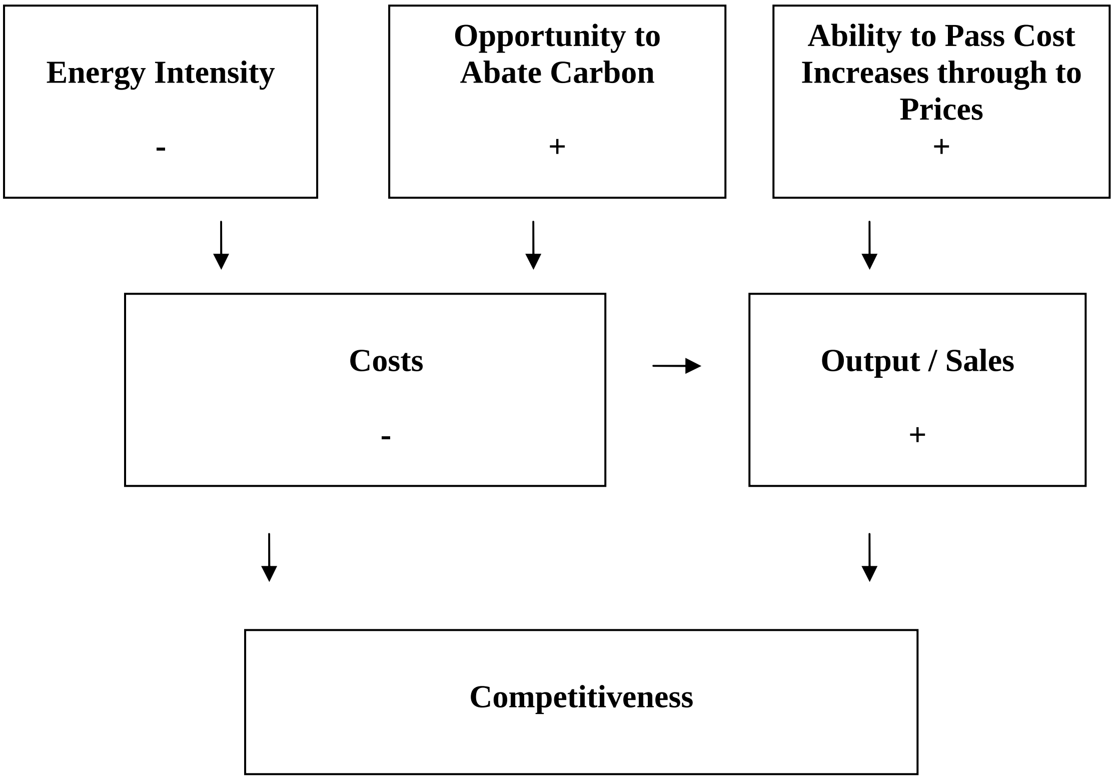

Figure 2 shows that the first and foremost factor is energy intensity. The second factor is the ability to pass on higher costs via prices and the third is the ability to avoid CO_2 consumption during production or to replace CO_2 intensive inputs. The impact of energy intensity on competitiveness can be broken down into two effects. The first effect only concerns companies or sectors which participate in the system and is based on the fact that companies have to purchase additional allowances if they wish to emit more CO_2 than they are allowed to under their free permits. This gives rise to additional costs and impairs competitiveness. If the opposite case applies, however, the ETS introduction can have the opposing effect ("windfall profits" or "hot air"). The second effect, on the other hand, also affects non ETS participants and is based on the fact that the system could induce higher electricity prices. Given opportunity cost reasoning of utilities, this is a plausible scenario. In this case, all companies or sectors in the EU are subject to higher prices via their electricity bills. Due to the flexibility induced, however, the effect on energy intensity is likely to be significantly lower under the EU ETS than under alternative regulations.

The more effectively prices can be passed on the less companies or sectors will suffer under an ETS. Determining factors in this context are the price elasticity of demand and the competitive situation. The less elasticity and competition the less impact the ETS will have on competitiveness.

Finally, and as mentioned previously, the ability to avoid CO_2 emissions or to substitute CO_2 intensive inputs also plays a role. An ETS will put less pressure on sectors or companies which can do this better than others. There are no fundamental differences in this respect between an ETS and any other systems of regulation. In the long run, however, there may be a connection with the Porter hypothesis explained in the previous section. Abatement also depends on how strong the system-inherent incentives to abate emissions are. Permit solutions generally perform well in this respect. The advantages are particularly clear when compared with CaC instruments. However, as the current NAPs do not appear to be particularly demanding, the incentives under the specific design of the EU ETS may prove to be relatively modest.

From a theoretical point of view there is therefore a tendency – in comparison with a BAU scenario – to assume that energy-intensive companies or sectors at least will be subject to greater burdens with the attendant effects on the economy as a whole. This is not very surprising. On the other hand an ETS does have competitive advantages when compared with alternative regulation scenarios. These are particularly apparent when compared with CaC instruments, although the differences when compared with other market conform regulation approaches remain more modest. The advantage of the EU ETS with grandfathering is the comparatively lower costs imposed by the system[5]. At the same time, of course, this also means that it offers fewer incentives to innovate.

2.4. Selection of studies

Due to the early state of our review no empirical data is available on how emissions trading affects competitivness. Thus empirical literature in terms of econometric studies is not available. Our literature review consequently focuses on economic theory and simulation studies, the so-called “theory with numbers”.

Due to the limited number of studies we have considered all existing studies for our analysis dealing with (European) emissions trading and competitiveness. All reviewed models belong

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[5] Free allocation is often referred to as minimising the cost impact. Especially in a mid- or long-horizon view, grandfathering may offer important advantages (cp. e.g. Cramton and Carr, 2002).

to three groups of models and have different strengths and weaknesses: Computable General Equilibrium (CGE) models, partial models (which are in nearly all cases energy models) and macroeconometric models. Each model type has its advantages and disadvantges (see Table 1). With respect to our application of the models in the context of an impact assessment of the EU ETS on competitiveness, we should e.g. not expect specific insights into the market structure of single markets such as the power market from CGE models. However, CGE models give an orientation regarding the magnitude of indirect effects, which are more relevant for a simulation of the employment rather than competitiveness effects, though. E.g. energy models do not say anything on indirect effects. All models have in common that they can not reproduce Porter-like innovation effects. This shortcoming has to be borne in mind.

Table 1: Suitability of models with respect to selected criteria

	CGE Models	**Partial Models**	**Macroeconometric Models**
Range of Coverage of Measure	single-/multi-market analysis with economy-wide impacts and effects in secondary markets	single-market analysis without economy-wide impacts	single-/multi-market analysis with economy-wide impacts and effects in secondary markets
Purpose of Model Analysis	simulation (long-term)	simulation (long-term)	forecasting (short-/medium-term)
Degree of Disaggregation between Sectors or Households	potentially high	-	potentially low
Degree of Disaggregation within Sectors	potentially low	potentially high	potentially low

Generally, all studies contribute to the questions addressed in this paper. As expected, all models generate the same qualitative results, i.e. that trading systems are superior to non-trading systems, and that unrestricted trading is more efficient than restricted trading. Due to the nature of the models and the year of the study, the question of the design of NAPs is not addressed in detail. One exception is the SIMAC model which addresses the question of how allowances were allocated at the national level, and how this affects costs.

Our approach consists of looking at the results across different types of models, all based on the methodological approaches described at the beginning of each chapter, in order to draw conclusions regarding the magnitude of effects that can be expected from emissions trading.

3. Simulation studies on the EU ETS

PRIMES

A partial equilibrium model of the energy market is the PRIMES model applied by Capros and Mantzos (2000). It analyses the economic impact of variants of the EU ETS. Compliance with the Kyoto targets in each country is analysed and used as reference scenario (alternatively, within individual sectors of individual countries). The modelled scenarios are (1) an EU-wide trading system between power utilities, (2) an EU-wide trading system which includes power utilities and energy-intensive industries, (3) an EU-wide trading system which includes all sectors and industries and (4) an international trading system within all Annex B countries taking account of all sectors.

The simulations reveal that emission trading substantially reduces the costs of the Kyoto protocol. The savings are dependent on the implied scenarios and, in the case of alternative reference frameworks, are between 20.7 and 48.6 per cent. The savings increase as emission trading expands. While savings remain relatively modest when emissions are traded by power utilities, they are highest in the system with the Annex B countries. Scenarios two and three generate savings of 24 and 34 per cent respectively.

The PRIMES model consequently demonstrates that all participants gain from emissions trading. The results imply, however, that the highest marginal abatement costs borne by EU member countries are incurred in Belgium, Finland, and the Netherlands. These countries are thus among the net purchasers in the system while France and Germany are the largest seller countries. Trading also proves to be all the more beneficial the more prevalent and widespread trading is. The EU ETS actually introduced is to some extent comparable with the scenario two in the model. The results suggest that while the EU system is more beneficial than the no trading scenario, it is by no means optimal when compared with alternative scenarios including emissions reduction commitments by additional countries.

POLES

The POLES partial equilibrium model of energy systems (IPTS 2000) compares EU-wide trading with a reference scenario up to 2010 in which no trading takes place. In this reference scenario, each country or region must meet the Kyoto obligations without European-wide trading[6]. The model measures the impact of the EU ETS on the basis of an aggregated study up to the year 2010. Whether one particular country comes out better or not depends on the extent to which the country has managed to reduce its costs by trading permits compared with a non-trading scenario.

The results of the study reveal that the northern European countries bear the highest Kyoto costs as a share of their respective GDP. In the trading scenario, costs of 0.48 per cent of GDP are incurred. In comparison, the costs incurred in other regions do not exceed 0.17 per cent (Italy). However, almost all countries benefit from trading compared with the reference case. Given this view, only France remains unaffected by the EU ETS. Gains are highest in the southern European countries (savings of 62 per cent), with Germany (50 per cent) and Italy (20 per cent) also doing particularly well. The biggest net sellers are Germany and the United Kingdom.

GETS 3

The GETS 3 (ERM and Eurelectric, 2002) energy market model attempts to capture the overall costs and incidence of costs on the basis of a number of different design variants of the ETS. The study encompasses the electricity industry and another nine sectors of the manufacturing industry in 20 countries (EU 15 and five other potential trading partners). The study focuses on a pre-compliance period 2005-2007 and two compliance periods 2008-2012 and 2013-2017. The study analyses three base scenarios: a "no-trading" scenario in which no trading and no JI/CDM is licensed, the "latest guess" scenario which reflects the scope of trading proposed in the publication on the EU directive on the ETS of March 2002, and the "perfect trading" scenario. This implies unlimited trading between all the countries and sectors studied from the year 2005 onwards.

The aggregated abatement costs are lowest in the perfect trading scenario. Limited trading of the type in the latest guess scenario increases overall costs by 1.6 billion euros. Separate compliance with the reduction commitments of each single country, in other words the no trading scenario results in an increase in overall costs compared with the perfect trading scenario of 80.5 billion euros. This is mainly due to the result given that companies do not achieve their reduction goals and must consequently pay penalties.

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[6] The study encompasses six EU countries/regions – Germany, France, Italy, the United Kingdom and the remaining southern EU countries in a single group (Spain, Portugal, Greece) as well as northern EU states (Austria, Belgium, Denmark, Finland, Ireland, Luxembourg, the Netherlands, Sweden).

The findings of the study also suggest that the choice of reference year is decisive for the allocation of emission credit purchaser and seller roles. The electricity industry is particularly sensitive to variations in the reference year.

The inclusion of additional greenhouse gases (in addition to CO_2) only has a minor impact on overall costs. This is because the study only covers industrial sectors while other greenhouse gases are mainly produced in other sectors. According to the study, a sector-based allocation of reduction goals leads to substantial distributional effects and favours sectors with lower rates of growth. An allocation variant of this type has no impact on the total compliance costs of the favoured sectors, however. Auctioning of allowances on the other hand triggers redistribution between the sectors depending on the precise recycling route.

The study confirms the positive impact of an ETS on the lowering of costs if Kyoto compliance without trading is used as the reference scenario. The study also shows, though, that the existing EU ETS leaves potentials for improved competitive effects. These potentials are caused by restricting trading to a few sectors.

Smale et al.

Smale et al. (2006) use a Cournot oligopoly model to deliver a sector by sector analysis of the effects of the EU ETS on competitiveness[7]. They extensively describe two scenarios modelled: A lower price scenario based on an allowance price of 15€/tCO_2, and a higher price scenario (30€/allowance). The reference scenario, in contrast to the studies discussed thus far, is BAU.

The study investigates the cement, newsprint, petroleum, steel and aluminium sectors. Its results demonstrate that, even compared to a situation where no regulation takes place, allowance trading probably only has a minor influence on the productivity of the relevant sectors. What is interesting that the earnings of four out of the five sectors analysed rise due to the introduction of EU ETS given any scenario. The authors argue that the grandfathered allowances are more valuable for these sectors than the marginal cost rise implied. Only the aluminium sector is identified being a loser of the EU ETS. Under both scenarios, sector output and consequently earnings collapse by 100 per cent. This means that the model suggest complete relocation of the aluminium sector to outside of the EU ETS area although it is not participating in emissions trading. This is due to the projected increase in electricity prices which increases production costs as well as the intensive global competition to which the sector is subject. Smale et al. qualify, however, that aluminium smelters could associate with

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[7] The analyses undertaken by Smale et al. (2006) and by Carbon Trust (2004) are based on the same model. Due to their up-to-dateness, only the simulation results of Smale et al. are discussed in this review.

electricity generators in order to attenuate this impact. In this case, the generators would suffer from smaller earnings.

Reinaud

Reinaud (2005) also projects modest competitiveness losses of European firms in comparison with the business as usual case. Reinaud uses rising CO_2 emissions and thus the BAU according to the World Energy Outlook as the reference and models two emissions trading scenarios: The 10 per cent scenario in which the industry is allocated allowances under the EU ETS covering 90 per cent of its emission needs and the 20 per cent scenario in which the industry is allocated allowances to cover 80 per cent of its emission needs.

Loss of competitiveness is defined as loss in output – whether as a reduction in demand or the displacement of production from one country to another (leakage). Reinaud, like Smale et al. (2006), identifies the aluminium sector as the industry the most seriously affected by the scheme. As a result of a cost increase of 3.7 per cent in both scenarios and an allowance price of 10€/tCO_2 the study calculates a fall in demand, at an unchanged margin, of 2.9 per cent. The drop is more modest for the other industries analysed and does not exceed half a per cent for cement and steel, for example. Reductions in operational earnings are only predicted to be more significant if the authors make the extreme assumption of perfect competition on the observed markets.

SIMAC

Böhringer et al. (2005) use the partial model SIMAC to evaluate the actually implemented EU ETS. The model consists of marginal abatement cost curves for the European countries participating in the system. The authors analyse three different scenarios: Besides a no trading – Kyoto commitment without interstate trading – and a perfect trading scenario including all European sectors[8] and countries, the actually implemented EU ETS (scenario *NAP*) is modelled. The authors find two main conclusions: First, the hybrid emissions regulation implying that only few sectors participate in the ETS leads to substantial excess costs. Second, it induces politically delicate burden shifting between sectors participating and not participating in the ETS.

The results suggest that compliance costs under *NAP* are eight times higher than under perfect trading and still five times higher than for purely domestic – but efficient – abatement action. This is in contrast to the other studies reviewed which generally show that the actually

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[8] Among these, households and transport are the most important sectors regarding CO_2 emissions.

implemented EU ETS implies at least better competitiveness effects than domestic action. The SIMAC results are mainly due to the assumption that the generous NAPs shift abatement to sectors not participating at the ETS where, in this case, domestic action applies. Therefore, it is assumed that sectors not participating suffer from costs induced by domestic policies which are a direct consequence of the NAPs. The results provided by the SIMAC model suggest that restrictions to the EU ETS induce additional costs and therefore harm competitiveness. The actually implemented *NAP* scenario is shown to be inefficient, as it shifts the whole abatement obligation from the traded to the non-trading sectors, which is not at all intended in the theory of emission trading. Therefore, the results calculated by Böhringer el al. suggest that an extension of the EU ETS to other sectors would improve competitiveness in Europe. This is in line with the other studies reviewed here. Additionally, SIMAC produces markedly less important negative effects if JI/CDM is introduced.

DART

In contrast to the studies described so far, the DART model (Klepper and Peterson 2004) analyses competitiveness on the basis of a computable general equilibrium (CGE) model. The study analyses 16 regions[9] and twelve sectors (of which four participate in the ETS). The results relate to the year 2012. The model uses the BAU as the reference scenario.

In the competitiveness analysis the authors model the allocation of allowances on the basis of a least cost approach, abatement costs and potentials, including the sectors outside the ETS. The change in output is used as an indicator for competitiveness. Alongside the BAU use is made of a unilateral policy scenario (UNI) in which the individual regions comply with the Kyoto goals without interstate trading.

The simulation generates negative competitive effects for the EU ETS when the BAU case is taken as the reference. If all the sectors are studied in aggregate, the reduction in output of 0.3 per cent is fairly modest, however. Individual sectors suffer more dramatic drops. Compared with UNI, all sectors gain from the ETS, including sectors which do not take part in the ETS. If the drop in output in comparison with the BAU in the least cost scenario for the participating energy sector (oil products, electricity) is two per cent, it is more than double as high under UNI. The results for the remaining sectors are similar, only that part of the energy sector which does not take part in the ETS (coal, gas) has high losses in the least cost scenario (ten per cent), although these are two percentage points higher in the UNI case.

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[9] DART includes nine EU countries or groups of countries and seven regions outside Europe.

Overall, the DART model thus shows significant reductions in output to some extent and consequently loss of competitiveness if the EU ETS is compared as a least cost scenario with the BAU. If, on the other hand, one applies Kyoto measures, emissions trading generates positive competitive effects including in sectors which do not take part in emissions trading. In some sectors, this ameliorates the negative Kyoto effects by over 50 per cent.

GTAP-E

With GTAP-E, Kemfert et al. (2005) use a modified version of the general equilibrium model GTAP. The authors perform three experiments, focusing primarily on the competitive factor of marginal abatement costs. The study is based on data provided by the NAPs of the EU ETS. In experiment 1 the marginal abatement costs are estimated for a case in which every national sector is required to comply with NAP targets without engaging in trading. Experiment 2 allows national trading. Experiment 3 additionally provides for trading between EU countries. GTAP includes 17 European and four international regions. 57 different sectors can be distinguished.

In comparison with experiment 1, experiment 2 leads to major efficiency gains because, under the non-trading scenario, large differences in abatement costs are calculated with Greece, the Netherlands and Sweden gaining in particular. As of the transition to experiment 3, all countries gain although cost reductions are more moderate between the second and third experiments. Altogether, the GTAP calculates major reductions in costs via emissions trading compared to non-trading scenarios under Kyoto. The broader based a trading system is, the more countries and sectors stand to gain from it. A good example is provided by the extreme savings made by the oil refining sector in Sweden where marginal abatement costs in $/tCO$_2$ drop from 163 (experiment 1) to 8.4 (generally for Sweden, experiment 2) and finally to 2 (for the entire EU, experiment 3).

GTAP-ECAT

COWI (2004) use GTAP-ECAT (European Carbon Allowance Trading) to assess impacts of the EU ETS on competitiveness. They model two different ETS scenarios – long-term adaptation as well as sluggish shorter-term adaptation. As a reference scenario, BAU is used. GTAP-ECAT results suggest that competitiveness is affected in Europe due to the ETS introduction. It calculates a loss of productivity inducing a reduction of the overall production value of -0.36 per cent (-0.48 per cent with sluggish adaptation). These are comparable to other models like DART using BAU as a reference. The estimated allowance price is 17

€/tCO_2 (26.5 €/tCO_2). The authors stress that JI/CDM, which are taken into account in the calculations, may be an important element for cost-efficiency of EU ETS. Furthermore, it is assumed that the EU implements an optimal split between trading and non-trading sectors. A non-optimal split, however, would increase costs of the trading scheme.

4. Conclusion

This paper analyses the link between the introduction of the EU ETS and competitiveness in Europe on the basis of a literature review with a focus on simulation studies. The choice of the reference scenario was identified to be of fundamental importance for the results; in other words, whether the introduction of an EU ETS is compared with BAU or with a no trading system is crucial. Given Europe's Kyoto commitment to an 8 per cent reduction of 1990 emission levels, only comparing with alternative regulation refers to realistic options in today's political context. What is more, the results are also dependent on other assumptions, mainly the inclusion of flexible instruments and the modelling of (partial) auctioning. If these factors are identified and analysed it is possible to obtain a relatively clear picture of how the introduction of the EU ETS influences Europe's competitiveness. Table 2 provides an overview of the most important results of the studies analysed above.

An ETS as the market conform allowance solution would, theoretically, enable ecological objectives such as emission reductions to be met at minimum cost. However, there is massive room for improvement for the current EU ETS since this is far from perfect in terms of its efficiency. According to the models analysed above, heterogeneous NAPs and the limitation of emissions trading to a handful of sectors are among the major flaws[10]. Although this may be seen as a first step towards (efficient) emissions reduction, the mechanism is by no means at its optimum from an economic point of view. Improvements at significantly lower costs whilst retaining the ecological goals are possible. Evidence for this is provided by the simulation studies analysed here. GETS3, for example, estimates possible savings at 1.6 billion euros.

Highlighting the potential improvements of the instrument should not, however, obscure just how much has already been achieved with the EU ETS. If countries were required to comply with their Kyoto commitments without engaging in any trading at all, this would result in a substantial increase in costs to reach their obligatory emission reduction targets. A well designed EU ETS is a by far cheaper option. Again the GETS3 demonstrates cost savings in the EU ETS-related scenario compared with a non-trading scenario of around 79 billion euros.

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[10] The extension debate will be part of the revision of the relevant ETS Directive, scheduled for 2006 and to become binding ahead of Phase 3 (post 2012).

In this respect the otherwise very different simulation models come to fairly similar conclusions. An exception to this is the SIMAC model. This finding becomes only relevant, however, if there will be strict domestic action in the non-trading sectors across Europe. At present, this is not clear, though.

Table 2: Impacts of the EU Emissions Trading System on competitiveness in Europe – Simulation studies results

Model	**Reference Scenario**	**Effects on Competitiveness**
Reference Scenario: Business As Usual		
Smale et al. (2006)	BAU	**Positive effects:** Cement, Printing, Petroleum, Steel: Positive effect on earnings **Negative effects:** Aluminium industry: -100 % earnings
Reinaud (2005)	BAU	Most sectors: Very small and diverse effects **Negative effects:** Aluminium industry: Costs +3.7 %, demand -2,9 %
DART (2004)	BAU	**Negative effects:** Effects overall: Output -0.3 % **Negative effects:** Energy sector: Output -2 %
GTAP-ECAT (2005)	BAU	**Negative effects:** Effects overall: Output -0.36 % (-0.48 % with sluggish technology adaptation)
Reference Scenario: No Trade		
POLES (2000)	No Trade	**Positive effects:** Abatement Costs -25 % on average
PRIMES (2000)	No Trade	**Positive effects:** Abatement Costs -25 % on average
GETS 3 (2002)	No Trade	**Positive effects:** Abatement Costs -80.5 billion € (maximum)
SIMAC (2005)	No Trade	**Negative effects:** Compliance Costs +400 % (actual NAPs, costs accrue mainly in non-participating sectors)
DART (2004)	No Trade	**Positive effects:** Effects overall: Small output growth **Positive effects:** Energy sector: Output +3%
GTAP-E (2005)	No Trade	**Positive effects:** Abatement Costs -98 % (maximum)

What is interesting is that even when compared with business as usual the losses in most sectors are modest. With emission trading the EU has implemented an instrument that will have two positive effects for a relatively cheap price: it may significantly contribute to CO_2 emission reduction to tackle climate change while triggering the necessary structural change in the power sector and other industries to make Europe ready for the future. While most sectors analysed in the literature are only subject to these very modest costs, the aluminium sector is an exception from the rather positive trend, with its particular competitive situation, little options to reduce the electricity dependency of the production process and hence profits highly dependent on energy prices.

A survey conducted by the European Commission DG Environment, McKinsey and Ecofys (2005) shows that around 50 percent of the interviewed companies already build system costs into their prices. 70 percent state that this will continue to be the case in the future. The results of the same study also suggest that the EU ETS has a more powerful innovative impact than economic theory would expect given the not very demanding NAPs and lack of incentives for clean investments. While an allowance system undoubtedly offers major advantages compared with other forms of regulation such as CaC measures, the less stringent design of the current scheme and experiences with trading systems in the USA counter indicate a quick surge in innovation. Innovative progress is only likely to take place in the long term and depends on a significant devaluation in currently rather generous allocations of emission allowances as well as a global trend towards emissions reductions.

Summing up, the competitive record of the EU ETS is mixed, with emission trading coming out as the cheapest option, if we accept a reality with climate change and Kyoto compliance. However, the ETS is not designed to boost Europe's economy, its prime purpose and justification is to ensure Europe's CO_2 emissions are brought down according to comittment levels of Kyoto in 2012 at minimal costs. Thus the most important conclusion is analogous to Parry (2002) who states with regard to the double dividend hypothesis that "environmental taxes need to be justified on environmental grounds" (p. 2). This holds true for a trading scheme like the EU ETS as well. Emissions trading should be justified on environmental grounds. It is especially important that modifications to the system due to economic considerations do not undermine the environmental impacts intended with this policy instrument. It is always welcome as a side effect, but introducing environmental regulation is not designed to generally improve competitiveness. Theory contradicting this claim exists – the Porter-hypothesis is predominant in this respect. This paper shows that they cannot be applied in unqualified form to an EU ETS. In any case, this paper shows that the fears of the majority of sectors concerned about strong negative competitiveness impacts of the EU ETS are not justified.

Annex: Synopsis of the literature on ETS and competitiveness

Authors	Model	Critical Assumptions	Reference Scenario, projection period (if given)	Scenarios	Results
IPTS (2000)	POLES, a partial equilibrium model for the world energy system	certificate prices of 49 € per ton of CO_2 modelled; overestimates cost reductions, as transaction costs and market failure neglected	no-trading-scenario (national compliance to Kyoto-goals) for 2010	EU-wide emissions trading scheme	profits for all participants (highest profits for EU-south, Germany and Italy); average cost reductions of 25 per cents
Capros and Mantzos (2000)	PRIMES, a sectoral model for the energy market	burden sharing; EU reduction target of eight per cents	no-trading-scenario (national compliance or alternatively compliance within national sectors to Kyoto-goals) for 2010	(1): EU-wide ETS between energy suppliers, (2): EU-wide ETS between energy suppliers and energy-intensive branches, (3) EU-wide ETS between all sectors, (4): international ETS including Annex-B countries (all sectors)	ETS induces cost reductions (alternative reference scenario: 20.7-48.6 per cents); enlargements of ETS lead to additional cost reductions
ERM and Eurelectric (2002)	GETS 3, a partial model for the energy market	covers pre-commitment-period (2005-2007) and two commitment-periods (2008-2012, 2013-2017); approximately 50 sensitivities applied to basis scenarios	see scenarios	three basis scenarios: (1): no-trading scenario, (2): latest guess-scenario (according to EU ET directive from March 2003), (3): perfect trading-scenario (all possible participants trade fully under free market rules from 2005)	constraints increase trading costs; least abatement costs under perfect trading; latest guess (no trading) leads to cost increase of 1.6 (80.5) billion €; distributional effects if auctioning applies

Klepper and Peterson (2004)	DART, a computable general equilibrium model	no market failure; JI/CDM neglected	business as usual-scenario for 2012	(1): least-cost (LC)-scenario, (2): unilateral policy-scenario (UNI)	small competitiveness-effects: output loss of 0.3 per cents (LC); positive competitiveness-effects of LC in comparison with UNI
Smale et al. (2006)	Economic Cournot model of oligopoly behaviour	Cournot-competition (oligopoly) modelled; sectoral analysis of EU ETS	business as usual	(1): certificate price of 15 € per ton of CO_2; (2): 30 €	aluminium sector relocates completely due to EU ETS; for the other sectors concerned, earnings rise as additional burden is overcompensated by grandfathered certificate value
Reinaud (2005)	Partial model	sectoral analysis of EU ETS; competitiveness effects defined as output variation; certificate price of 10 € per ton of CO_2	business as usual: increasing CO_2-emissions according to World Energy Outlook	(1): ten per cent scenario (90 per cents of certificates needed are grandfathered); (2): twenty per cent scenario (80 per cents grandfathered)	generally modest competitiveness effects; aluminium sector looses from EU ETS: cost increase of 3.7 per cents in both scenarios (demand decrease of 2.9 per cents)
Böhringer et al. (2005)	SIMAC, a simple numerical partial equilibrium model of the EU carbon market	JI/CDM neglected; model assumes Kyoto commitment: if the NAPs/ETS are not sufficient in this regard, abatement is shifted to sectors not participating (domestic action)	see scenarios	(1): no trade scenario: EU member states meet the emissions reduction target through cost-efficient domestic action; (2): unrestricted emissions trading across all sectors and EU member states; (3): emissions as suggested by NAPs	lowest compliance costs under unrestricted trading (2.1 billion €); scenario (3) induces highest costs (17.6 vs. 3.4 billion € under scenario (1)); lower costs for (3) if JI/CDM considered; (3) induces burden shifting between sectors
Kemfert et al. (2005)	GTAP-E, a computable general equilibrium model		see scenarios	experiment 1: Kyoto-compliance within national sectors; experiment 2: national trade; experiment 3: additionally trade between EU-member states	cost reductions due to enlargements of ETS; higher efficiency gains under experiment 2 than under experiment 3
COWI (2004)	GTAP-ECAT, a computable general equilibrium model	JI/CDM included	business as usual	(1): EU ETS with long-term technology adaptation; (2): EU ETS with sluggish shorter-term adaptation	output reduction of -0.36 per cent (-0.48 per cent with sluggish adaptation); allowance price of 17 €/tCO_2 (26.5 €/tCO_2); JI/CDM has positive effect on competitiveness

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