



Essays on International Non-market Strategy and the Political Economy of Environmental Regulation

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Essays on International Non-market Strategy and the Political Economy of Environmental Regulation

A dissertation presented

by

Sanjay Patnaik

in partial fulfillment of the requirements

for the degree of

Doctor of Business Administration

Harvard University

Cambridge, Massachusetts

May 2012

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Essays on International Non-market Strategy and the Political Economy of Environmental Regulation

Abstract

This dissertation examines the interaction of companies with their non-market environment in an international context. It specifically focuses on the political economy of newly introduced climate change regulations and how these policies affect firm strategy. The empirical setting of my work is the European Union Emissions Trading Scheme (EU ETS), the largest active cap-and-trade program in the world. Introduced in 2005, the EU ETS has established a substantial market for emissions allowances by requiring companies across the EU to internalize the costs of emitting greenhouse gases. The three chapters of my dissertation are empirical studies that use novel data from the EU ETS. In the first chapter, I show through the analysis of a panel dataset of companies in the Iron and Steel sector in the EU that multinational firms are more likely to exploit arbitrage opportunities in the EU ETS. My results also indicate that multinational firms can capture more value from the EU ETS than their domestic peers. In the second chapter, we examine the sources of non-market performance differences among firms in the EU. Our findings suggest that firm-affiliation is a strong determinant of the variation in non-market performance across industrial plants in the EU ETS. We also show that industry effects are important for absolute non-market performance measures and that country effects are not as strong as firm effects. In my third dissertation chapter, I examine the political economy of the distribution of emissions allowances within the EU ETS. In my analysis of a panel dataset of industrial sectors in the EU, I find that country-specific institutional and political characteristics affect the allocation of emissions allowances to industrial sectors in the EU ETS. My dissertation is embedded within prior literature in international economics, strategy and political economy.

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Introduction

This dissertation is the product of a comprehensive research effort that combines two of my main fields of interest. The first area is the study of how companies engage with their non-market environment (e.g. regulators, politicians etc.) and how non-market actors in turn affect firm strategy and performance, particularly in an international context. The second area is how climate change and climate change regulations affect businesses and their strategies. In the following I will discuss both fields of interest in more detail in order to provide the appropriate context for my three dissertation essays.

In a variety of institutional settings, companies are engaging not only with their direct market environment (i.e. through their core business activities), but increasingly with their non-market environment to gain a competitive advantage. For example, expenditures on recorded lobbying efforts in the United States Congress have been rising steadily in the United States over the last decade (OS 2012a) and in many countries around the world non-market actors have substantial influence over the day-to-day business activities of companies. The complex processes at the intersection of business, government and society are likely to have an impact on how firms operate and which strategies they pursue. However, much of the traditional research on firm strategy has only focused on the direct market environment of firms and how they are able to improve their performance through actions that are related directly to market actors (e.g. suppliers, buyers). My dissertation is taking a more comprehensive view of strategy by examining the importance of the non-market environment for firm performance and strategy. This work is embedded within a growing body of research by business scholars that examine the importance of non-market forces for firms (e.g. Henisz et al. 2011).

As empirical context I am using the European Union Emissions Trading Scheme (EU ETS), the world's largest regulatory program for greenhouse gases. This brings me to the second area of research my dissertation is focused on, namely the issue of climate change and more specifically the setting of the EU ETS. For many years I have been strongly interested in the problem of climate change, which is expected to become one of the most important challenges for business, government and society. Since climate change inherently is a problem of global scale, addressing it will require novel and innovative solutions from the private and the public sector. The most comprehensive regulatory initiative so far is the EU ETS, which is a cap-and-trade program that covers all 27 EU member states (European Commission 2011a). It was launched in 2005 to control greenhouse gas emissions in the European Union and provides the ideal setting to examine how these regulations affect firms, their performance and strategies. Ever since I started studying the EU ETS, I have been fascinated with the unique opportunities this regulatory "experiment" presents for my research on firms and their non-market environment. The following three essays will examine different aspects of the relationship between companies and non-market actors within the context of the EU ETS. They are aimed at both expanding our knowledge in the field of international non-market strategy and at improving our knowledge of the political economy of environmental regulation.

Chapter 1

Sanjay Patnaik

Arbitraging differences in emissions permit prices

How multinational firms exploit market imperfections in the European Union Emissions Trading Scheme (EU ETS)

Introduction

Despite the growing importance of regulations for greenhouse gases¹ in countries around the world, our knowledge of how these programs affect firms and their strategic decisions is still limited. Due to the relative novelty of the markets for emissions permits² for Carbon Dioxide (CO₂)³, there is a lack of understanding of the challenges and opportunities these markets present for companies. My paper addresses this gap by examining an empirical phenomenon in the European Union Emissions Trading Scheme (EU ETS), the world's most comprehensive cap-and-trade program for greenhouse gases. The EU ETS was launched in 2005 and is the first large-scale multi-national regulatory program requiring firms to hold sufficient allowances to cover their emissions of CO₂ (European Commission 2011a). Through this mechanism, the EU ETS has established a comprehensive EU-wide market for emissions allowances, with an estimated value of more than Euro 42 billion in 2008 alone (CMD 2011, Bluenext 2011). A policy change in the EU ETS in 2008 enabled firms to use emissions credits from developing countries for compliance with the program. However, despite a persistent price differential between the cheaper developing country credits and emissions allowances⁴ issued in the EU, only some companies seize this arbitrage opportunity. In my empirical analysis I investigate why only certain firms exploit this price-spread and which firms are more likely to do so.

¹ Greenhouse gases contribute to the problem of climate change by creating a “greenhouse effect” in the atmosphere whereby more energy from the sun is kept in the earth's atmosphere. This effect is expected to lead to an increase in global temperatures. For more information on climate change and greenhouses gases, please see UNFCCC (2011a) and EPA (2011b).

² 1 emissions permit gives a firm the right to emit 1 ton of a certain pollutant (in this context CO₂).

³ CO₂ or Carbon Dioxide is one of the most important greenhouse gases. For more information on CO₂ as a greenhouse gas, please see EPA (2011a).

⁴ Emissions permits in the EU ETS are called allowances.

Utilizing a panel dataset on firms in the Iron and Steel sector in the EU, I estimate the likelihood that a company uses cheaper developing country credits for compliance with the EU ETS. A particular focus is put on the dichotomy between firms that operate emissions-producing factories in multiple EU member states⁵ versus companies that only emit in a single EU nation⁶. My findings demonstrate that multi-country firms are more likely to exploit the arbitrage opportunities in the EU ETS and that the likelihood for firms to utilize developing country credits increases over time. These results are robust to a variety of alternative specifications and econometric techniques. I then examine the implications for firm performance by analyzing the value firms can capture from the EU ETS through the use of cheaper developing country credits. I find that multi-country firms are able to extract larger rents than their single-country peers.

This paper makes several contributions to the literature on multinational companies (MNCs). It provides novel empirical evidence for the argument that MNCs are more likely to exploit arbitrage opportunities because of their presence in different countries and institutional contexts. The concept of MNCs as arbitrageurs can be traced to the early stages of the literature on multinational enterprises and has been explored by authors such as Caves (1996), Naumann-Etienne (1974) and Hodder and Senbet (1990) who mainly study the arbitraging behavior of firms on the market for capital. Other work by Aizenman (1992), Helpman (1985) and Rangan (1999) focuses on how multinational firms shift their production across plants in multiple countries to leverage exchange rate differences and differences in the cost of factor inputs. Moreover, Kogut (1983) regards the unique ability of multinational firms to recognize and exploit arbitrage opportunities as a major characteristic of these firms and Foley et al. (2009) find

⁵ From here onwards I will denote these firms as “multi-country firms”.

⁶ From here onwards I will refer to these companies as “single-country firms”.

that a certain share of Foreign Direct Investment can in fact be attributed to the arbitraging behavior of multinationals.

However, many of the existing empirical studies on the importance of arbitrage for multinational firms measure the arbitraging behavior of MNCs only indirectly. They investigate different outcomes (such as the change in production patterns as a response to exchange rate fluctuations) and then attribute the observable results to the exploitation of cross-country arbitrage by MNCs. My empirical study is distinct in that I am able to observe the exploitation of arbitrage opportunities by multinationals directly.

In addition, much of the prior research on arbitrage and MNCs is focused on traditional factor markets (e.g. for capital or labor). Due to the novelty of the market for greenhouse gas emissions permits, there is a lack of understanding of how multinational firms might exploit imperfections in those markets by acting as arbitrageurs. Given the increasing importance of climate change regulations in numerous regions around the world, the implications of imperfect emissions permit markets are of special interest to business managers and policy makers alike. The cap-and-trade program starting in 2012 in California is just one of several examples of policy choices regarding climate change that will become increasingly relevant for economic actors. My analysis addresses this empirical gap by using the unique and unprecedented setting of the EU ETS to demonstrate directly that multi-country firms are more likely to exploit arbitrage opportunities than their single-country peers. This paper therefore revisits classical arguments about the nature of MNCs in the international business and economics literature and extends the existing empirical work on MNCs as arbitrageurs onto the market for environmental permits.

Finally, my analysis contributes to the strategy literature by advancing our knowledge on how climate change regulations provide strategic opportunities for firms. The EU ETS and the market for emissions allowances were created by regulators and politicians and are still subject to rent-seeking efforts and political influence (Lütken and Michaelowa 2008). While the arbitrage opportunities exist because of imperfections in the market for allowances, non-market forces play an essential role in shaping and designing that market. However, the traditional strategy literature has mostly focused on the interactions of firms with market actors. By empirically showing how multi-country firms capture value within a regulatory program that was instituted by non-market actors, I improve our understanding of the importance of the non-market environment for corporate strategy as studied by scholars like Baron (1995) and Henisz et al. (2011).

My paper will proceed as follows. In section 2, I describe the institutional context of the EU ETS and discuss the important aspects of the regulatory program that are relevant for my analysis. In section 3, I review the related literature and derive my hypotheses. In section 4, I present my empirical analysis, including a description of the data, methods and results. Finally, I construct a measure for the value captured by firms from the EU ETS to evaluate the monetary implications of exploiting the arbitrage opportunity. I conclude my paper with a discussion of my findings and an outlook for further research.

The institutional context of the EU ETS

Cap-and-trade programs are policy tools used for the implementation of environmental regulation. The basic concept of every emissions trading program is that the regulator sets an allowance cap (= the total number of allowances) for all covered companies in order to achieve a specific emissions goal. The regulator then distributes these allowances to the affected firms

through pre-defined allocation mechanisms. For a well-functioning allowance market to develop, the overall allowance cap should be below total emissions for all firms, implying that the emissions cap is binding. To comply with the program, companies either reduce emissions and sell surplus allowances on the market or they buy additional allowances from other firms in order to cover their emissions. This strategic decision depends on the marginal abatement costs of each firm, which will vary depending on a variety of factors such as the firm's production technology, management efficiency, and the number of available alternative industrial processes. At the end of each compliance period (generally one year), all firms have to submit a sufficient number of allowances to cover their actual emissions for compliance with the cap-and-trade program. If they fail to do so, they can face strict penalties, which have to be paid to the regulators (EU Directive 2003/87/EC).

Established in 2005, the EU ETS was designed to help the EU meet its obligations under the Kyoto protocol⁷ to reduce the emissions of greenhouse gases by 8% by the end of the commitment period 2008 to 2012 (EU Directive 2003/87/EC). This makes the EU ETS a crucial component of the EU's climate change policy under the umbrella of the international Kyoto agreement (Ellerman et al. 2010). Unlike most previous cap-and-trade programs (such as the Acid Rain program in the United States), the EU ETS is not restricted to one country as it spans all 27 EU member states (European Commission 2011a). The program covers more than 11,000 installations⁸ that fall under one of ten industrial "activities" defined by the EU. These activities are Combustion, Refining, Coke Ovens, Roasting and Sintering, Cement and Lime, Glass, Bricks

⁷ The Kyoto protocol is an international environmental agreement aimed at reducing the emissions of greenhouse gases into the atmosphere. Its main goal is to mitigate the problem of climate change, caused by human economic activity that produces greenhouse gases (UNFCC 2011d). Please see (UNFCC 2011d) for more information on the details of the Kyoto protocol.

⁸ Installations in the EU ETS are individual factories/production plants.

and Ceramics, Iron and Steel, Pulp and Paper and Opt-In (CMD 2011, EU Directive 2003/87/EC).

The program can currently be divided into three distinct phases: period 1, from 2005 to 2007; period 2, from 2008 to 2012; and the period from 2013 onwards. Unless otherwise noted, my analysis will focus on period 2, which is a different and self-contained trading period. For every period, each national government had to develop a separate National Allocation Plan (NAP). The NAP contained the total number of EU allowances (EUA) distributed within a country as well as the method of how they would be allocated to individual installations (Ellerman et al. 2010). The EUAs are the most important type of emissions allowances in the EU ETS and each EUA gives a firm the right to emit 1 ton of CO₂ (EU Directive 2003/87/EC). Most of the allowances were allocated free of charge by regulators to the affected installations (EU Directive 2003/87/EC). At the end of every year, installations have to surrender sufficient emissions allowances to cover their actual verified emissions in that year as otherwise they will have to pay substantial fines⁹ (EU Directive 2003/87/EC).

The NAPs had to be submitted to the European Commission for approval ahead of time. A member state's government could implement its proposed allocation mechanism if its NAP was not rejected by the Commission or if required adjustments were made (Ellerman et al. 2010, EU Directive 2003/87/EC). This aspect of the design of the EU ETS provides national regulators with a lot of flexibility and influence on the allocation of allowances; it also leads to a high degree of decentralization in the EU ETS. The latter has been a major point of criticism, especially since it might cause an uneven initial allocation of EU allowances (Ellerman et al. 2010). As I will explain in more detail when deriving my hypotheses, this issue is particularly relevant for my analysis, because the degree of decentralization implies that firms operating in

⁹ The penalties are Euro 40/ton of CO₂ in period 1 and Euro 100/ton of CO₂ in period 2 (EU Directive 2003/87/EC).

multiple EU member countries will face a variety of different rules and approaches by national regulators whereas single-country firms only have to engage with one national regulator. Consequently, multi-country firms have to navigate multiple regulatory environments to ensure that their factories will be compliant with the EU ETS in every EU member state they are present in. For the purposes of my analysis I will justify the division of firms into multi-country and single-country by using the definition of a multinational company proposed by Caves (1996, p.1): “[...] an enterprise that controls and manages production establishments – plants – located in at least two countries.” While many of the rules within the EU ETS apply to periods 1 and 2, the start of period 2 in 2008 brought several changes to the program. One of the most important changes enabled firms to use external emissions credits from developing countries created through the Kyoto Protocol’s Clean Development Mechanism (CDM)¹⁰.

These so-called Certified Emission Reduction (CER) credits¹¹ are generated by emissions-reduction projects in developing countries and are issued after the completion of a complex review process by the United Nations. Figure 1.1 shows the whole project cycle of a CDM project from its design until the issuance of the CER credits. While technically CER credits could have already been used in period 1, no firm in the EU ETS surrendered any CER credits during the entire 1st period. The two main reasons were the scarce availability and the lack of technical infrastructure to link those credits to the EU ETS (Ellerman et al. 2010). Only the start of period 2 established a liquid market for those external permits, particularly because the IT system linking CER credits with the EU ETS market went online in 2008 (Ellerman et al.

¹⁰ The change has also enabled firms to use external credits created through the Kyoto Protocol’s Joint Implementation (JI) mechanism. However, the market for these credits is much smaller and they are governed by very different processes. They are not generated by projects in developing countries, but by joint emissions reductions projects between firms in the EU. As my analysis is focused on credits from developing countries, JI-credits are outside the scope of this paper.

¹¹ 1 CER credit covers the emissions of 1 ton of CO₂ (or equivalent).

2010). Consequently, firms started using CER credits for compliance with the EU ETS from 2008 onwards.

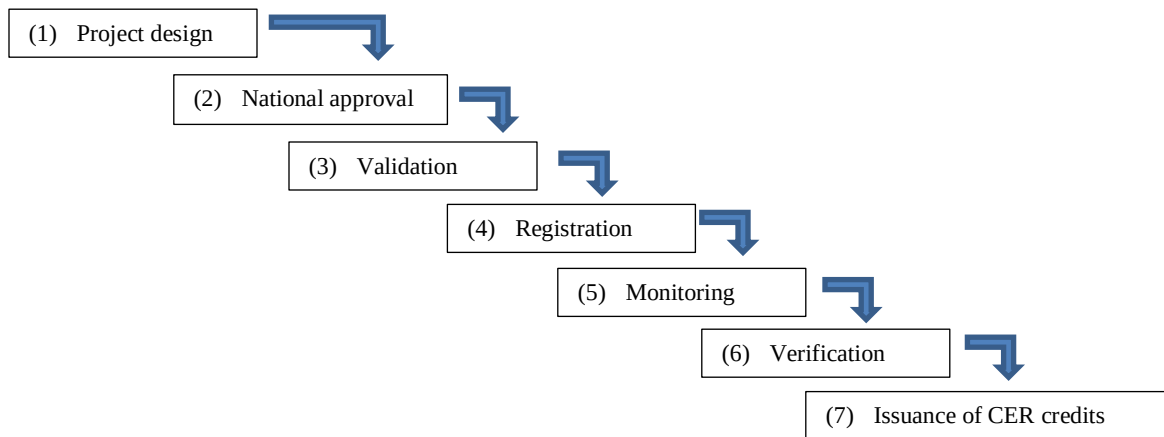


Figure 1.1: Project cycle for CER credits¹²

Installations are allowed to submit external credits up to a certain percentage of their original allocation of EU allowances for Period 2. These limits are determined on a national level and are not the same across all EU member countries, which is particularly relevant for this paper (Ellerman et al. 2010). Due to these restrictions, multi-country firms can optimize their use of CER credits across different national contexts and therefore have more flexibility than single-country firms.

The market for those permits can be divided into primary and secondary CER credits. Primary CER credits are usually sold through forward contracts to investors from developed countries that invest directly in emissions-reduction projects in developing nations. Most of these credits are bought through bilateral contracts that are not traded on a central exchange (Ellerman et al. 2010). One important characteristic of primary CER credits is that they are sold before having received UN approval. Since they are usually traded ahead of time, it might very well be the case that the UN does not approve the credits after its review or that in the end fewer than expected CER credits are actually produced. This implies that there is considerable uncertainty

¹² Source: UNFCC 2011c.

about pending UN approval and about the actual number of CER credits that will materialize (Ellerman et al. 2010, ExIn). Many of these primary CER investors are financial intermediaries that resell the CER credits to firms in the EU. However, EU ETS firms, EU countries and developing nation governments are also allowed to invest in primary CER credits themselves (Lütken and Michaelowa 2008). Table 1.1 shows a list of the top 20 primary CER investors.

Table 1.1: Top 20 investors in CDM projects (= top 20 buyers of primary CER credits)¹³

Top 20 buyers	Projects
EcoSecurities	294
Tricorona Carbon Asset Management Sweden	196
EDF Trading	157
Vitol	155
Carbon Resource Management	139
RWE	130
Mitsubishi	106
AgCert	97
CAMCO	93
Bunge Emissions Group	88
Noble Carbon	84
Danish Ministry of Climate & Energy	74
Kommunalkredit	74
Trading Emissions	67
MGM Carbon Portfolio	66
Agrinergy	64
KfW	62
ENEL	63
Marubeni	58
Cargill International	56

Once the primary CER credits have gone through all the revision steps at the United Nations, they obtain the status of “officially issued” and become secondary CER credits. The main difference between primary and secondary CER credits is that the latter have received final UN approval and can thus be considered equivalent to EU allowances (Ellerman et al. 2010, ExIn, UNFCCC 2011c). These credits are then usually sold on the spot or futures market through

¹³ Source: UNEP 2011.

designated carbon exchanges.¹⁴ From 2008 to 2011 more than 500 million CER credits were issued (UNFCC 2011b). Figure 1.2 shows a depiction of the number of issued CER credits since 2008. Since the use of CER credits in the EU ETS was enabled in 2008, a significant price spread between EU allowances and secondary CER credits has persisted. This price differential is evident both in the spot market and in futures markets. Figure 1.3 shows the spot prices of EUAs and CERs from 2008 to 2011. Figure 1.4 shows the price spread between the two credits.

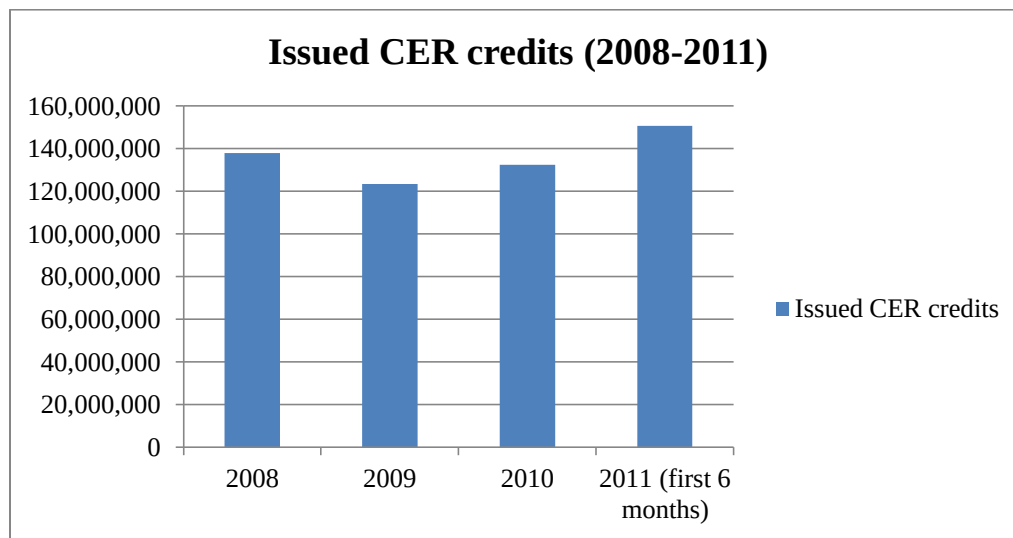


Figure 1.2: Issued CER credits from 2008 until 2011¹⁵

As Nazifi (2010) points out, economic theory would predict EUA and CER prices to converge to an equilibrium price in an efficient allowance market. However, she finds no empirical evidence that price convergence takes place during the period of her study (2008 until 2009). Mansanet-Bataller et al. (2010), Ellerman et al. (2010) and Nazifi (2010) propose that uncertainty about the supply and demand of CER credits, the percent limits on the use of CER credits, and the uncertain future of the CER markets after 2012 are possible reasons for this

¹⁴ The most important exchange for the spot market is BlueNext in Paris, which is owned by the New York Stock Exchange. For the futures market there are several exchanges, including for example ICE in London, Sendeco in Spain, BlueNext in Paris and EEX in Germany (ExIn).

¹⁵ Based on data from UNFCC 2011b.

continuing price spread. The real drivers of the price spread between CER credits and EU allowances are probably a combination of those factors. However, it is an unexplained empirical phenomenon that given the persistent price spread not all firms exploit these arbitrage opportunities and use CER credits for compliance with the program.

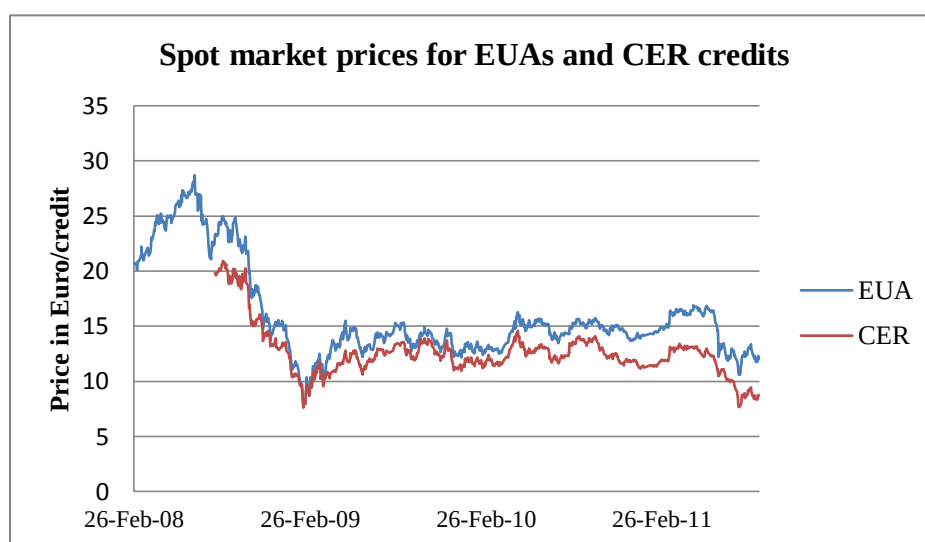


Figure 1.3: Spot market prices for EU allowances and CER credits from 2008 to 2011¹⁶

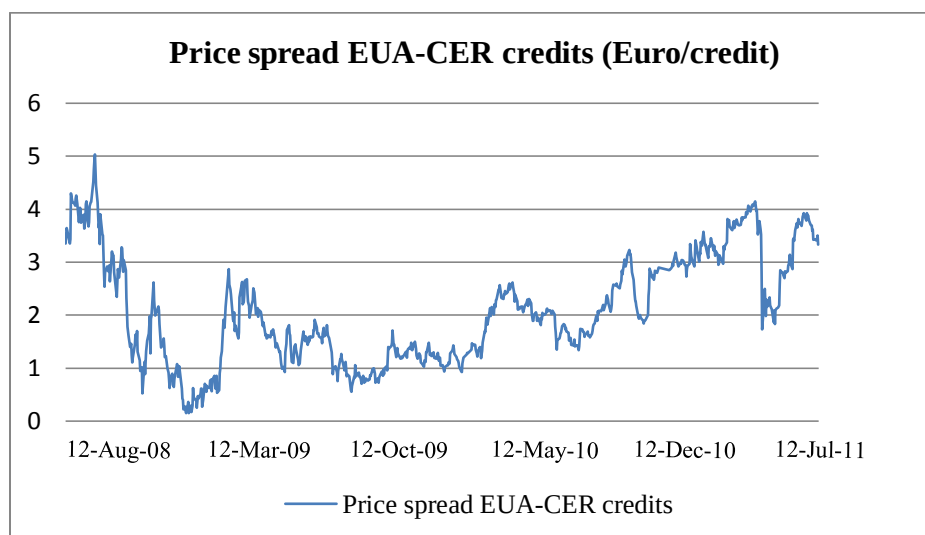


Figure 1.4: Price spread between EU allowances and CER credits on the spot market¹⁷

¹⁶ Based on data from Bluenext 2011.

Theory and Hypotheses

As Ellerman et al. (2010, p. 279) point out, the price spread between EU allowances and CER credits has attracted so-called “*compliance buyers*,” which are EU ETS firms that want to reduce their costs for compliance. In order to do so, they buy cheaper CER credits and sell the EU allowances they “swap them out for,” (Ellerman et al. 2010, p. 279) clearly indicating that they are arbitraging. The question now becomes which type of firms will be more likely to exploit these arbitrage opportunities from a theoretical point of view. A closer look at the complexities of the EU ETS allowance market and the existing literature provides essential insights.

To be able to actively engage in the use of CER credits and recognize the strategic opportunity presented to them by the CER-EUA price spread, firms need to acquire the necessary information to realize that using CER credits could help them capture additional value within the EU ETS. This requires an understanding of the characteristics of the CER credit market, particularly with regard to the difference between primary and secondary CER credits. While primary CER credits involve high transaction costs and uncertainty caused by the lengthy and complicated UN approval process, secondary CER credits are basically compliance-equivalent to EU allowances. Therefore, firms that have obtained the necessary knowledge about the CER credit market are in a better position to recognize the arbitrage opportunity caused by the price spread between EU allowances and secondary CER credits.

The decentralization of the EU ETS during periods 1 and 2 has delegated substantial powers to national regulators. Therefore, any company that operates EU ETS factories¹⁸ in

¹⁷ Based on data from Bluenext 2011.

¹⁸ I denote any factory that is required to be included in the EU ETS as an EU ETS factory.

multiple EU member states has to engage with several different national regulators¹⁹, whereas firms operating EU ETS plants in only one country are faced solely with a single regulatory agency. This decentralization has two main implications for multi-country firms, distinguishing them from single-country companies.

First, multi-country firms have more opportunities to acquire a comprehensive knowledge base on the EU ETS and learn about all possible available strategic options for compliance. Due to their multi-country presence, their information network on the EU ETS is broader as they come in contact with a more diverse base of regulators and market participants in different countries. This allows them to gain an informational advantage over single-country firms that facilitates their perception of the EU ETS as a source for strategic opportunities rather than solely a regulatory burden. That argument is strengthened by Caves (1996) who asserts that MNCs in general can gain cheaper access to information. Consequently, it is reasonable to assume that multi-country firms will recognize the arbitrage opportunity presented by the EUA-CER price spread more easily than single-country firms.

Second, the exposure to different national allocation rules increases the uncertainty about the future number of EU allowances multi-country firms will receive from regulators in the countries they are present in. While single-country firms only have to engage with one regulator, which makes any lobbying efforts for EU allowances easier, multi-country firms face a variety of different regulators that all exhibit different levels of susceptibility towards rent-seeking behavior. Due to the fact that EU allowances can be banked and used for compliance after the end of period 2 in 2012, any additional EU allowances that get “freed up” through the use of cheaper CER credits in period 2 can help to reduce some of the uncertainty surrounding the

¹⁹ Due to the complexity of the EU ETS, there are multiple occasions where regulators and companies interact regularly: during the allocation of allowances, for the monitoring of verified emissions and when firms surrender emissions allowances at the end of each year to comply with the EU ETS.

future allocation of EU allowances. This is particularly relevant, because many of the EU allowances will likely be auctioned off rather than distributed for free after 2012 (ExIn). Consequently, by exploiting the EUA-CER price spread multi-country firms are not only able to capture additional value in the year they engage in this arbitraging behavior, but they can also decrease future uncertainty about compliance with the EU ETS after 2012.

The existing literature on multinational enterprises provides further reasons for hypothesizing that multi-country firms might have an advantage over single-country firms for recognizing the strategic potential of the EUA-CER price spread. The theoretical concept of multinational firms as arbitrageurs can be traced to the capital-arbitrage hypothesis, which argues that interest rate differentials across countries can explain the activities and existence of multinational firms (Caves 2007, Hymer 1960). However, support for this theory weakened when Hymer (1960) demonstrated that several of the prevalent patterns of capital flows between countries could not be satisfactorily explained by capital-arbitrage alone. His work led to a rich stream of research in the international business literature that focused on alternative theories rather than on the role of arbitrage in the decision of firms to move outside their home markets (Caves 2007, Knickerbocker 1973). Moreover, as Caves (2007, p.32) points out, several early attempts to empirically evaluate the importance of arbitrage opportunities for multinational companies proved difficult and yielded ambiguous results.

While these developments diverted some focus of the international business literature away from arbitraging behavior by MNCs, numerous scholars continued to examine the importance of arbitrage for multinational firms (Caves 2007). Naumann-Etienne (1974) asserts that if existing imperfections in international markets are significant enough, they might allow multinationals to distinguish themselves from domestic firms by seizing those opportunities

(Naumann-Etienne 1974, p. 860, Caves 2007). In another paper, Kogut (1983, p. 246) revisits the role of MNCs as arbitrageurs by proposing that multinational companies have the unique “[...] ability to arbitrage institutional restrictions [...]” and that “[...] government intervention [...] can create unique arbitrage opportunities for the multinational company.” This argument for multinational firms as arbitrageurs is reinforced by Caves (1996, p. 160) who states that multinational companies are likely to “[...] enjoy opportunities for international arbitrage of funds [...]” and that “[...] government restrictions and transaction costs leave arbitrage possibilities open to the MNE.”

Hodder and Senbet (1990) study how the difference in tax rates across countries can provide opportunities for arbitrage for multinational companies. They assert that “Corporations can employ various mechanisms to arbitrage tax rate differences across countries.” (Hodder and Senbet 1990, p. 1504). Helpman (1985) in his theoretic analysis of multinational companies and international trade concludes that MNCs arise as a consequence of differences in factor markets across countries. Furthermore, Aizenman (1992) shows that multinational companies can exploit arbitrage opportunities in response to exchange rate fluctuations by shifting output among plants in different countries. This argument is supported by Rangan (1999) who empirically demonstrates that MNCs react to exchange rate fluctuations by changing the production levels in plants across different countries. Rangan’s findings are in line with other work that emphasizes the effect of exchange rate movements on production decisions by multinational firms (e.g. Vernon 1966, Lessard 1986, Lipsey and Kravis 1986) (Rangan 1999, p. 101). Finally, more recently, Foley et al. (2009) provide empirical evidence for the notion that a certain share of Foreign Direct Investment (FDI) can be attributed to arbitraging behavior by multinational firms.

While this review of the existing literature on multinationals as “arbitrageurs” is by no means all-encompassing, it provides important theoretical grounding for my empirical analysis. Since multi-country firms are used to arbitraging in a variety of factor markets (e.g. labor or capital), it is likely that they will be more inclined to search for arbitrage opportunities in the market for emissions allowances as well and that they will act more strategically as a consequence. The last point is particularly strengthened when considering Kogut’s (1983) argument about how government intervention can create opportunities for arbitrage for multinational firms. The EU ETS allowance market was entirely created by regulators (Lütken and Michaelowa 2008) and the market imperfections we can observe are probably at least partially attributable to the continuing influence of regulators and politicians on the EU ETS. This makes the EU ETS a prime example for the scenario Kogut describes, especially considering that the decentralized nature of the EU ETS forces firms to navigate through a variety of different regulatory contexts. Building on these arguments:

Hypothesis 1: *Firms that operate EU ETS installations in multiple EU member countries are more likely to use cheaper CER credits for compliance with the EU ETS than firms that only operate plants in a single EU nation.*

While my prior considerations emphasize the importance of information asymmetries and arbitraging behavior by multinational firms, it is reasonable to assume that these factors do not stay constant over time. The longer CER credits are available and the price spread persists, the more likely it will be that other firms learn about these strategic options and also pursue them. That is particularly the case for firms that might imitate the strategic behavior of their multinational peers. This implies that the “first-mover” advantages for the companies that used

CER credits at the beginning of period 2 will likely be reduced over time, which leads me to my second hypothesis:

Hypothesis 2: *The likelihood that firms use CER credits for compliance increases over time.*

Finally, it is important to analyze the economic value that firms can capture through the EU ETS in order to better understand what role the non-market environment plays in rent extraction by firms. The EU ETS allowance market is different from other markets in that it was created within a regulatory program that was established entirely by non-market actors (e.g. regulators and politicians). This implies that the EU ETS is shaped by a complex interaction of market as well as non-market forces. In the last section of the paper I will therefore examine the monetary implications for firms that exploit the arbitrage opportunities and investigate the differences in rents that multi-country firms capture from the EU ETS as compared to their single-country counterparts.

Research design

Data

For the analysis in this paper I have collected a comprehensive panel dataset (2005-2010) on companies in the Iron and Steel sector in the EU ETS. While the EU Commission defines ten industrial “activities” or sectors that every installation in the EU ETS is assigned to (CMD 2011 and EU Directive 2003/87/EC), I focus solely on firms in the Iron and Steel sector for several reasons.

First, one of the widely-discussed possible implications of cap-and-trade programs is that firms might be willing to relocate factories as a response to the regulatory program. This is particularly relevant in the EU ETS where the industries were treated very differently during the

allowance allocation process across EU countries (Ellerman et al. 2010). However, in the Iron and Steel sector there is a stable continuity in the location of almost all installations. Due to the high capital investments required for iron and steel plants, it is usually more difficult to relocate whole factories. In addition, most of the firms in my sample and the factories they own have existed for many years and have a tradition of producing iron and steel at those locations. This stability makes it more unlikely that strategic actions regarding the location of plants taken by companies in anticipation of the EU ETS might confound my empirical results. The latter point is especially relevant compared to other sectors in the EU ETS where capital expenditures are much lower (such as Glass).

Second, firms in the Iron and Steel sector usually produce for the international market and most of their decisions are driven by global prices for iron and steel rather than local economic conditions. By focusing on firms only in the Iron and Steel sector I am able to alleviate confounding influences that might be caused by different economic circumstances in different EU member countries. While this problem cannot be circumvented completely, my focus on the Iron and Steel sector should mitigate any confounding effects as much as possible (as compared, for example, to firms in the Cement or Combustion sector).

Third, the structure of the Iron and Steel sector covered by the EU ETS exhibits a more evenly distributed dichotomy between companies that operate in multiple EU nations and firms that operate in only a single EU country. When estimating the likelihood that a firm uses CER credits for compliance as described above, I am able to exploit that feature of the Iron and Steel sector for identification purposes. The prevalent structure of the Iron and Steel sector in the EU ETS allows me to do that, which is not the case in several of the other industrial sectors covered by the EU ETS.

Data sources

As a starting point for constructing the dataset I used the complete population of registered installations in the EU ETS that were classified by the EU Commission into the Iron and Steel sector. The exact definition of this sector as outlined in the EU Directive is: “Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour” (EU Directive 2003/87/EC). For every installation there is an entry in the national EU ETS registry of the country where it is located. Each member state has its own EU ETS registry, which is usually hosted on the respective website of the national regulator in charge of implementation of the EU ETS at the national level. Access to that registry is generally restricted, but some of the information contained in the national registries is collected by the EU and made available publicly in the so-called Community Independent Transaction Log (CITL).

This information on every installation includes the national registry it is contained in, the physical address of the installation, its emissions and allocated allowances from 2005 to 2010, its compliance status, some basic information on the account holder, if it is active or closed and information on the emissions credits that were surrendered for compliance with the EU ETS. The latter is especially important as it allows me to identify which types of credits were submitted by each installation at the end of every year (every credit has a unique identifier within the EU ETS). However, while this information is available for individual plants, it is not published on a firm level. Moreover, the information on the account holders listed for every installation often does not make it immediately apparent which company owns the installation (there are quite a few cases where, for example, a physical person working for a company is listed as the account holder of an installation).

In order to create my sample of companies based on the installation list in the Iron and Steel sector as obtained from the CITL, I proceeded as follows. The complete list of installations belonging to the Iron and Steel sector that I got from the CITL contains 256 installations in 21 countries (please see Figure 1.5 for a depiction of the distribution of these plants across different EU member states).

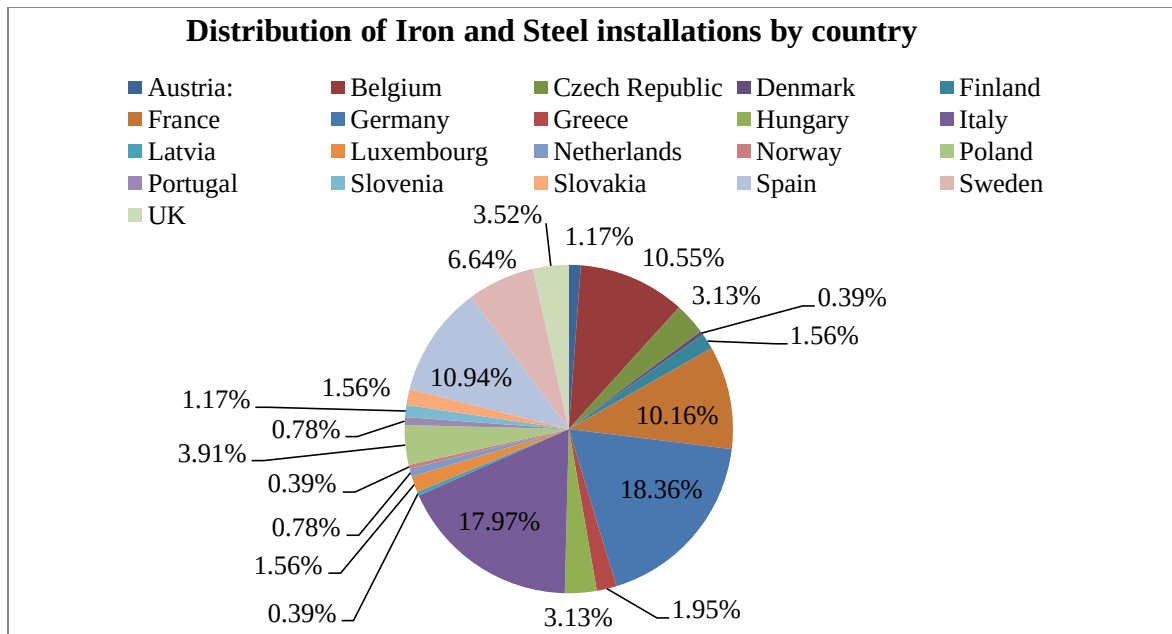


Figure 1.5: Distribution of all Iron and Steel installations by country²⁰

I then used data from a proprietary database (CMD 2011), direct company information as well as data on subsidiaries and ownership patterns from Orbis, OneSource and Amadeus to match all 256 installations to their respective parent companies (Orbis 2011, Amadeus 2011, OneSource 2011). Many of the firms in my sample are private, which is why these databases provided the best sources for my data. Anytime an installation belonged to a subsidiary of a larger company I made sure to aggregate all subsidiaries to the ultimate parent level. Through these steps I was able to identify the correct ultimate owner of every installation and assign the

²⁰ Based on data from CITL 2011.

256 plants to their parent firms²¹. In the next step I collected information on all other installations, covered under different EU ETS sectors (for example Combustion, Coke Ovens etc.), which are owned by a company. Alchemia, a Polish Steel firm, for example operates one plant labeled as Iron and Steel by the EU, but also owns several installations covered by the EU ETS that belong to Combustion. Using information from CMD (2011), direct company data (from firms' websites and annual reports) and information on ownership and subsidiaries from Orbis, Amadeus and OneSource, I then collected the complete list of EU ETS installations owned by the companies in my sample (Amadeus 2011, Orbis 2011, OneSource 2011).

Finally, I excluded several small firms from my sample, because their EU ETS installations shut down before or during 2008. I also removed two firms from the sample, whose main activity was unrelated to Iron and Steel production. Each of them just happened to own one EU ETS Iron and Steel installation as part of their conglomerate.

The final sample includes 86 firms per year, observed over a time period of five years from 2005 to 2010. The panel is not completely balanced as there were a few small firms that opened their EU ETS operations or that closed down after the program was already underway. The variables collected for every firm (on an annual basis) include the number of allocated EU emissions allowances, actual verified emissions, employees²², the types and amounts of credits used for compliance, and the origin of any of the CER credits that were utilized (with detailed information on the specific projects that created the CER credits). The information on the prices for EU allowances and CER credits was obtained directly from BlueNext (2011), which is a major spot market for CER credits. To make sure that the use of this price data does not distort

²¹ I excluded a few subsidiary firms from the sample that were owned jointly by larger parent firms.

²² Employee data was only collected for 2008 to 2010 as this is the period examined in my analysis. Employee data was collected from firms' websites, annual reports, Orbis (2011), Amadeus (2011) and OneSource (2011).

my results, I verified that the prices at other carbon exchanges are equal to the ones listed on BlueNext (2011).

Empirical analysis

Estimating the likelihood that firms use CER credits for compliance

In order to test Hypotheses 1 and 2, I estimate the likelihood that a company uses cheaper CER credits from developing countries for compliance with the EU ETS. As companies have been able to submit CER credits only since 2008, I utilize the years 2008 to 2010 from my panel for this specification.

Variables

Dependent Variable

CER

The dependent variable used in my model is a binary variable equal to 1 if a firm used CER credits for compliance with the EU ETS at the end of a given year, and 0 otherwise. For every year, firms have to submit enough emissions allowances (of any type) to the regulators to fulfill their EU ETS obligations. My variable is 1, whenever a firm utilized CER credits to cover part of its emissions in a given year.

Independent Variables

MULTICT

This is the main variable of interest, a binary variable that is equal to 1 if a company operates installations that are covered by the EU ETS, in multiple EU member countries. If a firm only has EU ETS installations in one country, the variable is set equal to 0.

Controls

The following control variables will be used in different specifications of my model. Some of them will only be utilized for robustness checks in certain variations of my model (as they capture similar information as my main controls).

Firm size

In order to ensure that any findings in my empirical analysis are not confounded by firm size, I include this control variable. Unless otherwise indicated, this variable will be the number of employees of a firm in a given year²³.

EU Allowances and Verified Emissions (used to calculate other control variables)

I use data on the EU allowances a firm received from the regulators in a given year (*Allowances*) as well as its verified CO₂ emissions at the end of a year (*Emissions*) to calculate several other important control variables, described below.

Past Change in Emissions

It is possible that a change in a firm's emissions in period 1 of the EU ETS influences its decision to buy CER credits in period 2, which is why I include this additional control variable. It might be the case that firms that increased their emissions in anticipation of the start of period 2 in 2008 would need more allowances to cover those emissions and therefore buy CER credits. This control variable will be the percentage change in emissions from 2005 to 2007 and will be denoted as $\Delta_EMISSIONS_ONE$. In addition, I will also run alternative specifications where I use the percentage change in emissions from the previous year to the current year-observation (this variable will be denoted as $\Delta_EMISSIONS_t-1$).

²³ If the number of employees was not available for a year, I extrapolated the number from a different year by using average employee change rates in the industry. I used number of employees rather than sales, because employee data could be found for all private companies as well, which was not the case for sales data.

Surplus/Shortfall in Emissions Allowances

Another possible factor that might influence a firm's decision to buy CER credits is whether it had a shortfall or surplus of EU emissions allowances in the past. The argument in my paper is based on the assumption that firms exploit the apparent imperfections in the EU ETS allowances market and seize this opportunity to capture additional value. However, it might also be reasonable to assume that firms facing an EU allowance shortfall might be more likely to use CER credits to make up for that shortfall (such a shortfall can arise, for example, due to the insufficient number of EU allowances received by regulators or due to a substantial increase in emissions). In order to control for this possibility, I include a measure for the surplus or shortfall in EU allowances over the entire period 1 of the EU ETS. This variable is binary and equal to 1 if a firm had an EU allowance surplus in period 1 and equal to 0 if it did not (the variable will be denoted as SURPLUS_ONE). For the purposes of robustness checks, I will also use the surplus/shortfall of allowances in the year immediately prior to my observation-year in several alternative specifications of my model (SURPLUS_t-1).

Empirical Specification

In order to test Hypotheses 1 and 2, I develop a base model, which is then extended with a trend component to capture any temporal change in the likelihood of companies to buy CER credits. The base model without trend component is defined as follows:

$$CER_{it} = \alpha + \beta * MULTICT_{it} + \Omega * X_{it} + \varepsilon_{it} \quad (1)$$

The extended model with trend component is defined as follows:

$$CER_{it} = \alpha + \beta * MULTICT_{it} + \gamma * Trend_t + \Omega * X_{it} + \varepsilon_{it} \quad (2)$$

The variables correspond to the ones described above for a given firm i in year t , X_{it} is a matrix of different control variables and ε_{it} is the error term. My model will be estimated through a panel probit regression with robust standard errors.

Results

Summary statistics

Table 1.2 shows the frequency table for the dependent variable CER, Table 1.3 for my main independent variable MULTICT and Table 1.4 for CER versus MULTICT. Table 1.5 shows summary statistics for several of my control variables. Table 1.6 shows summary statistics for my main variables for multi-country firms, Table 1.7 for single-country firms and Table 1.8 for multi-country firms without Arcelor Mittal (which is the largest firm in my sample). Finally, Table 1.9 shows the pairwise correlations between my variables of interest.

Table 1.2: Frequency table for binary dependent variable CER

CER	Frequency	Percent	Cumulative
0	174	67.97	67.97
1	82	32.03	100.0
Total	256	100.0	

Table 1.3: Frequency table for main independent variable MULTICT (binary)

MULTICT	Frequency	Percent	Cumulative
0	184	71.88	71.88
1	72	28.13	100.0
Total	256	100.0	

Table 1.4: Frequency table for CER versus MULTICT

CER	MULTICT		Total
	0	1	
0	143	31	174
1	41	41	82
Total	184	72	256

Table 1.5: Summary statistics for other variables in panel from 2008 to 2010

	Mean	S.D.	Max	75th	Median	25th	Min	Obs.
Allowances (tons of CO₂)	2,922,304	1.09*10 ⁷	8.95*10 ⁷	416,440	127,922	35,324	3,174	256 ²⁴
Emissions (tons of CO₂)	2,007,871	7,177,966	6.86*10 ⁷	338,000	98,396	24,810	646	256
Employees	16,737	41,068	315,867	12,075	1,998	749	35	256
# of plants	4	10	86	4	2	1	1	256

Table 1.6: Summary statistics for variables for MULTICT = 1

	Allowances	Emissions	CER credits surrendered	Nr. of plants	Employees
Mean	8,813,303	5,993,108	209,455	11	40,632
Median	1,328,136	786,930	12,246	6	11,955
Max	8.95*10 ⁷	6.86*10 ⁷	6,826,872	86	315,867
Min	117,655	64,077	0	2	979
Standard Deviation	1.91*10 ⁷	1.25*10 ⁷	867,755	17	66,608
Nr. of obs.	72	72	72	72	72

Table 1.7: Summary statistics for variables for MULTICT = 0

	Allowances	Emissions	CER credits surrendered	Nr. of plants	Employees
Mean	617,130	448,430	57,285	2	7,387
Median	66,889	47,250	0	1	1,517
Max	1.08*10 ⁷	8,960,471	3,442,500	9	134,000
Min	3,174	646	0	1	35
Standard Deviation	2,050,620	1,508,468	333,385	1	17,785
Nr. of obs.	184	184	184	184	184

Table 1.8: Summary statistics for variables for MULTICT = 1 without ArcelorMittal

	Allowances	Emissions	CER credits surrendered	Nr. of plants	Employees
Mean	5,331,940	3,786,657	217,032	8	29,884
Median	1,297,527	175,318	14,492	5	11,148
Max	3.55*10 ⁷	2.70*10 ⁷	6,826,872	19	195,826
Min	117,655	64,077	0	2	979
Standard Deviation	9,255,928	6,423,823	885,839.7	5	42,448
Nr. of obs.	69	69	69	69	69

²⁴ The number of observations is 2 short of 258, because 1 firm in my sample only started emitting in 2009 and 1 firm closed down at the end of 2009.

Table 1.9: Pairwise correlations (star indicates significance at 95% level)

	CER	Allowances	Emissions	Employees	Nr. of plants	MULTICT
CER	1.00					
Allowances	0.20*	1.00				
Emissions	0.19*	0.98*	1.00			
Employees	0.24*	0.86*	0.85*	1.00		
Nr. of plants	0.20*	0.94*	0.92*	0.83*	1.00	
MULTICT	0.33*	0.34*	0.35*	0.36*	0.43*	1.00

Regression results

Table 1.10 contains the results for the probit estimation of the likelihood that a firm uses CER credits for compliance with the EU ETS for the base model in equation 1.

Table 1.10: Results for specification of the base model (Equation 1)

	(1) Base model	(2) Year FE	(3) Firm size	(4) Firm size with year FE	(5) Incl. Δ Emissions in period 1	(6) Column 5 with year FE
Independent Variables						
MULTICT	0.9433*** (0.2737)	0.9612*** (0.2797)	0.8362*** (0.3049)	0.8544*** (0.3114)	0.8965*** (0.3124)	0.9116*** (0.3197)
Controls						
Firm Size (Nr. of Employees)			0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
Δ EMISSIONS_ONE					-0.1807 (0.1823)	-0.1705 (0.1950)
Constant	-0.7683*** (0.1435)	-0.9711*** (0.1714)	-0.7996*** (0.1428)	-1.0111*** (0.1693)	-0.8137*** (0.1506)	-1.0326*** (0.1755)
Year fixed effects	N	Y	N	Y	N	Y
p-Value	0.0006	0.0002	0.0005	0.000	0.0010	0.0001
Wald Chi²	11.88	20.18	15.20	25.11	16.22	27.15
Observations	256	256	256	256	248	248

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a panel probit estimation with robust standard errors

Columns 1 and 2 show the results for the base model defined in equation 1 that only includes MULTICT, without and with year fixed effects respectively. As we can see, the coefficient on MULTICT is positive and statistically significant at the 99% level. This finding

provides support for Hypothesis 1 and indicates that firms operating EU ETS installations in multiple countries are more likely to buy CER credits than companies that only operate in a single nation. This effect remains largely robust to the inclusion of firm size as control variable (Columns 3 and 4). The coefficient on MULTICT is slightly lower, but remains significant. This shows that even when controlling for firm size MULTICT has an effect on a company's decision to use CER credits. In Column 5 and 6 the results including the control for the change in emissions during period 1 of the EU ETS are shown. The coefficient on MULTICT remains largely robust to the inclusion of this control variable. It might be possible to assume that firms expected the policy change in 2008 and therefore adapted their emissions during period 1 of the EU ETS. However, as the results demonstrate, the coefficient on the change of emissions between 2005 and 2007 is not significant. This indicates that any change in emissions that occurred during period 1 of the EU ETS did not seem to have a significant effect on a firm's decisions to use CERs in period 2 of the program. In Columns 1 and 2 of Table 1.11, the results are shown when including the change in emissions from the previous year to the current year observation. The coefficient on MULTICT drops slightly, but remains significant at the 99% level. Similar to columns 5 and 6 of Table 1.10, the coefficient on the emissions change from the previous year is not significant. This is another indication that any past emissions changes by the companies in my sample did not seem to affect their decision to buy CER credits significantly. In Column 3 of Table 1.11, I include another important control variable, namely an indicator variable measuring if a company had a surplus of EU allowances in period 1 of the EU ETS. This variable is included in order to control for any effect the initial allocation of EUAs might have on a firm's decision to buy CERs. As the results in Column 3 show, the coefficient on MULTICT remains largely robust and the one on SURPLUS_ONE is not significant.

Table 1.11: Results for specification of the base model (Equation 1) - Continued

	(1) Incl. Δ Emissions _{t-1}	(2) Column 1 with year FE	(3) Incl. surplus in Period 1	(4) Column 3 with year FE	(5) Incl. Surplus _{t-1}	(6) Column 5 w. year FE
Independent Variables						
MULTICT	0.8479*** (0.3061)	0.8737*** (0.3142)	0.8560*** (0.3138)	0.8825*** (0.3223)	0.7930*** (0.3047)	0.8419*** (0.3113)
Controls						
Firm Size (Nr. of Employees)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
$\Delta_EMISSIONS_t-1$	-0.0162 (0.0188)	-0.0064 (0.0314)				
SURPLUS_ONE			0.0134 (0.2968)	-0.0174 (0.3003)		
SURPLUS_t-1					0.4749** (0.1944)	0.2295 (0.1852)
Constant	-0.8100*** (0.1451)	-1.0546*** (0.1763)	-0.8303*** (0.2396)	-1.0304*** (0.2625)	-1.1445*** (0.2219)	-1.1858*** (0.2233)
Year fixed effects	N	Y	N	Y	N	Y
p-Value	0.0012	0.0001	0.0015	0.001	0.0002	0.0001
Wald Chi²	15.81	27.09	15.41	25.65	20.14	26.82
Observations	254	254	248	248	254	254
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a panel probit estimation with robust standard errors						

This indicates that whether a firm had an EU allowance surplus or shortfall in period 1 of the EU ETS did not have a significant effect on its decision to purchase CER credits in period 2. This finding further strengthens my argument that firms buying CER credits do so to capture additional value rather than because they have an allowance shortfall and need the additional credits for compliance with the EU ETS.

Column 4 shows the same model with year fixed effects, confirming that the coefficient on MULTICT remains largely robust even when controlling for variation over time. Finally, Column 5 of Table 1.11 shows the results when including an indicator variable that measures if a company had an EU allowance surplus in the year prior to my current year observation. This specification is estimated to make sure that any immediate allowance surpluses or shortfalls that

arise before a given year observation are not the main drivers of my results. As is evident from Column 5 and Column 6 (with year fixed effects), the coefficient on MULTICT drops slightly as compared to the previous specifications. In the specification without year fixed effects (Column 5), the coefficient on the EU allowance surplus in year $t-1$ is positive and significant, indicating that firms which have a surplus in EU allowances are more likely to buy CER credits than firms facing an allowance shortfall. This again supports my argument that the companies which buy CER credits are actually seizing the apparent arbitrage opportunities and do not engage in this behavior out of a necessity to obtain additional allowances. However, as is shown in Column 6, the significance of the coefficient on SURPLUS_ $t-1$ disappears when including year fixed effects.

All my specifications of the base model as shown in Tables 1.10 and 1.11 strongly support Hypothesis 1 that multi-country firms are more likely to use CER credits for compliance than single-country firms. This effect remains largely robust to the inclusion of a variety of control variables that – from a theoretical point of view – could also influence the decision to buy CER credits. As my findings suggest, multi-country companies are more likely to perceive and exploit the imperfections in the emissions allowance markets within the EU ETS. In addition, as my results in Table 1.11 show, companies that have had a past shortfall in EU allowances are not more likely to buy CER credits, further supporting my argument that companies which buy CER credits are actually doing so to capture value through arbitrage.

After having estimated the base model specified in equation (1), I now examine the estimations of the extended model, which includes a trend component (equation 2). Table 1.12 shows the results for the probit estimation of the extended model with a trend component (again by including the same different control variables as before). As can be seen, the coefficient on

MULTICT remains largely the same and significant at the 99% level compared to the base model. The coefficient on the trend component is positive and statistically significant at the 99% level, clearly supporting Hypothesis 2. It seems that the longer CER credits are available, the more likely firms are to use those cheaper allowances for compliance, hinting at substantial learning and informational effects. As is shown in Columns 3 to 6 in Table 1.12, the effects of MULTICT and the trend component remain robust to the inclusion of additional control variables.

Table 1.12: Estimation of the extended model with trend component (Equation 2)

	(1) Ext. model	(2) Firm size	(3) Incl. Δ Emissions in Period 1	(4) Incl. Δ Emissions _{t-1}	(5) Incl. Surplus in Period 1	(6) Incl. Surplus _{t-1}
Independent Variables						
MULTICT	0.9606*** (0.2793)	0.8528*** (0.3108)	0.9096*** (0.3191)	0.8751*** (0.3139)	0.8777*** (0.3213)	0.8379*** (0.3108)
TREND	0.2387*** (0.0823)	0.2456*** (0.0831)	0.2592*** (0.0819)	0.2690*** (0.0832)	0.2567*** (0.0816)	0.2227** (0.0801)
Controls						
Firm Size (Nr. of Employees)		0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
Δ _EMISSIONS_ONE			-0.1699 (0.1940)			
Δ _EMISSIONS_t-1				0.0101 (0.0241)		
SURPLUS_ONE					-0.0058 (0.2995)	
SURPLUS_t-1						0.2521 (0.1795)
Constant	-1.2567*** (0.2300)	-1.3019*** (0.2289)	-1.3401*** (0.2351)	-1.3679*** (0.2357)	-1.3413*** (0.3021)	-1.4457*** (0.2600)
p-Value	0.0001	0.000	0.000	0.000	0.000	0.000
Wald Chi²	19.07	24.42	26.55	26.68	25.12	26.33
Observations	256	256	248	254	248	254

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a panel probit estimation with robust standard errors

The coefficients on almost all controls are insignificant, similar to the estimation of the base model. The findings in this part of my analysis strongly support Hypotheses 1 and 2, namely that multi-country firms have a higher likelihood to exploit the imperfections in the emissions allowance market. In addition, my results show that there seem to be learning and informational effects as the likelihood of firms to use CER credits increases over time. These effects remain largely robust when estimating a variety of alternative specifications. In the following I will discuss further considerations of robustness and address possible sources of endogeneity to provide stronger support for my empirical findings.

Further considerations of robustness

Primary CER investments

As discussed in my description of the EU ETS and the market for CER credits, it is possible that firms invest in CDM projects themselves to obtain primary CER credits. If they own production facilities in a developing country that hosts CER projects, they could even produce these CER credits themselves at one of their plants. Therefore, it would be reasonable to argue that my results might also be driven by firms that operate factories in developing countries rather than by multi-country firms within the EU ETS. However, this possibility can be ruled out as only one firm of all the companies in my sample used direct primary CER credits from one of their own projects for compliance with the EU ETS. However, in order to also demonstrate empirically that firms which own production plants in developing countries do not drive my results, I run an alternative specification of the extended model. I include DEVPROD, which is binary variable equal to 1 if a firm has at least one production facility in one of the developing countries that host CER projects. The results are shown in Column 1 of Table 1.13. The coefficient on DEVPROD is not significant and the results for MULTICT and the trend

component remain largely robust. This makes the alternative explanation that the firms using CER credits for compliance are the ones investing in primary CER projects themselves unlikely.

Table 1.13: Further robustness checks

	(1) Plants in developing countries	(2) Public vs. private firms	(3) Nr. of plants	(4) Nr. plants and employees	(5) Nr. of countries	(6) MULTICT and nr. of countries
<i>Dependent variable</i>	CER	CER	CER	CER	CER	CER
<i>Independent Variables</i>						
MULTICT	0.8520*** (0.3125)	0.8439*** (0.3077)	0.8840*** (0.3095)	0.8867*** (0.3089)		0.8835** (0.3928)
TREND	0.2456*** (0.0832)	0.2448*** (0.0834)	0.2402*** (0.0827)	0.2470*** (0.0832)	0.2388*** (0.0757)	0.2456*** (0.0832)
Nr. of countries					0.2650 (0.1647)	-0.0206 (0.1827)
<i>Controls</i>						
Firm Size (Nr. of Employees)	0.0000 (0.0000)	0.0000 (0.0000)		0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
DEVPROD	0.0073 (0.3302)					
PUBLIC		0.2214 (0.2796)				
Nr. of plants			0.0079 (0.0091)	-0.1000 (0.0157)		
Constant	-1.3034*** (0.2268)	-1.3604*** (0.2560)	-1.2741*** (0.2295)	-1.3048*** (0.2302)	-1.4125*** (0.2988)	-1.2834*** (0.2856)
p-Value	0.0001	0.000	0.000	0.000	0.0042	0.000
Wald Chi²	24.92	25.01	23.76	28.89	13.21	25.14
Observations	256	256	256	256	256	256
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a panel probit estimation with robust standard errors						

Public companies versus private firms

Another possible factor that might influence the likelihood that a firm uses CER credits for compliance is whether it is publicly listed or not. In Table 1.13 – Column 2, I show the results for the estimation of the extended model including a dummy variable PUBLIC indicating if a firm is publicly listed. However, as the findings demonstrate, the coefficient on public is not significant and the coefficients on MULTICT and the trend component remain largely robust and

significant. This indicates that even when controlling for the ownership status of a firm the results for MULTICT hold.

Firm size – number of plants

In the previous specifications I used the number of employees rather than the number of EU ETS plants to control for firm size. The justification behind that approach is that the number of employees reflects the size of the entire company and not only the factories that are covered by the EU ETS. It is therefore a more accurate number to use when controlling for total firm size. However, in order to provide robustness to my results, I will also estimate the extended model with the number of plants as control for firm size. From a theoretical point of view, it might be possible that a firm with more EU ETS plants has to devote more attention and resources to its compliance behavior, therefore increasing its awareness of the EAU-CER price spread as strategic opportunity. Column 3 in Table 1.13 shows the results for the extended model with the number of plants instead of employees as the control for size. The results are similar to the ones obtained when using number of employees (Table 1.12 – Column 2). Both, MULTICT and the trend component remain positive and significant at the 1% level (the magnitude of the coefficient on MULTICT is slightly larger). As with number of employees, the coefficient on number of plants is not significant. In Column 4 of Table 1.13, I included the number of employees as well as the number of plants. While I show these results for the sake of completeness, it is important to note that naturally the correlation between both variables is relatively high. This might affect my findings through the problem of multicollinearity. As can be seen in Column 4 the findings remain largely robust and both measures of firm size are not significant. This indicates that the number of EU ETS plants a firm owns does not seem to affect my findings.

Number of countries a firm has plants in

My analysis is strongly focused on the dichotomy between multi-country and single-country firms. However, it might be possible that the number of countries a firm has EU ETS plants in affects my results as well. In order to control for this possibility, I conduct two additional robustness checks, which are shown in Columns 5 and 6 of Table 1.13. In Column 5 I use the number of countries a firm has EU ETS plants in instead of the binary variable MULTICT and in Column 6 I include both variables. The number of countries is not significant in any of the specifications, while the coefficient on MULTICT remains largely robust to the inclusion of the number of countries. This seems to indicate that the presence in multiple countries, but not the number of countries is the driving factor behind my findings.

Sample excluding ArcelorMittal

Since ArcelorMittal is the largest firm in my sample with more than 80 factories, I also run my estimation without ArcelorMittal to make sure that this outlier does not drive my results. In Table 1.14 – Column 1, I show the results for the estimation of the extended model on the sample excluding ArcelorMittal. The coefficient on MULTICT remains largely robust and significant, but it drops slightly and the coefficient on the trend component remains largely unchanged. This indicates that even with the restricted sample my results hold.

Continuous dependent variable – Tobit Regression

In all specifications so far I have used the binary variable CER as the dependent variable to estimate the likelihood that a firm submits CER credits for compliance. However, to further check the robustness of my findings I also use the actual number of CER credits surrendered by firms as the dependent variable. This variable is denoted as CERS. Since the distribution of that variable is left-censored (there is no firm that can have a negative number of CER credits), I use a tobit regression to account for this. The results are shown in Column 2 of Table 1.14. The

coefficient on MULTICT is positive and significant at the 95% level, providing support for Hypothesis 1. In this specification the number of employees is also positive and significant (as expected, since my dependent variable is the total number of CER credits a firm surrendered).

Table 1.14: Further robustness checks (continued)

	(1) Excl. ArcelorMittal	(2) Continuous DV - Tobit	(3) Coarsened exact matching – Probit on matched sample I	(4) Coarsened exact matching – Probit on matched sample II	(5) Insulation from reputational risk
<i>Dependent variable</i>	CER	CERS	CER	CER	CER
<i>Independent Variables</i>					
MULTICT	0.7787** (0.3142)	532,661** (253,792)	0.8539** (0.3717)	0.7644** (0.3629)	0.7222** (0.3252)
TREND	0.2334*** (0.0839)	125,442 (88,980)	0.2349*** (0.0879)	0.1999** (0.0819)	0.2346*** (0.0838)
<i>Controls</i>					
Firm Size (Nr. of Employees)	9.23*10 ⁻⁶ ** (4.58*10 ⁻⁶)	7.2138*** (2.5402)	0.0000 (0.0000)	0.0000 (0.0000)	9.61*10 ⁻⁶ ** (4.68*10 ⁻⁶)
Reputational risk					-0.1894 (0.2901)
Constant	-1.3251*** (0.2296)	-1,341,233*** (268,788)	-1.5151*** (0.2474)	-1.3546*** (0.2299)	-1.2099*** (0.3026)
p-Value	0.0000	0.0002	0.0007	0.0021	0.0000
Wald Chi²	26.45	19.43	17.10	14.65	26.96
Observations	253	256	218	235	253

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a panel probit estimation with robust standard errors

Coarsened Exact Matching

To further check the robustness of my results, I apply a matching algorithm on my sample, which is a statistical technique aimed at “[...] controlling for some or all of the confounding influence of pretreatment control variables in observational data” (King et al. 2009). I use coarsened exact matching to match firms from my treatment group to similar firms from my control group by selecting appropriate pre-treatment variables that can explain why a firm would be present in multiple EU members states in the first place (i.e. why MULTICT = 1 for a

given firm). After completing the matching algorithm, I then run the probit estimation for my extended model on the matched sample. For more details on the coarsened exact matching algorithm, please see (King et al. 2009).

From a theoretical point of view there are two main possible reasons why an Iron and Steel firm might decide to open plants in several EU member countries. First, the number of years a firm's home country has been a member of the EU is likely to play a major role in that firm's decision to open a plant abroad. Whenever a country joins the EU, the resulting economic integration with the rest of the EU makes it much easier for companies to engage in cross-border economic activity, including building production plants in other EU nations. I therefore run the matching algorithm with the number of years the home country²⁵ of a firm had been in the EU at the beginning of the EU ETS in 2005 as a relevant pre-treatment variable. Data on EU accession dates was collected from EU (2011). I also include firm size and then use coarsened exact matching on my sample to match multi-country firms to appropriate single-country companies. I then utilize the weights obtained with the matching algorithm to estimate my extended probit model (equation 2) with the inclusion of those weights. Results are shown in Table 1.14 – Column 3. As we can see, the coefficients on MULTICT and my trend variable remain significant at the 99% and 95% level respectively, providing further support for Hypotheses 1 and 2.

In a second application of coarsened exact matching, I include an additional pre-treatment variable in the algorithm: the number of years a firm's home country had been in the NATO at the start of the EU ETS in 2005. The Iron and Steel sector has historically been closely involved with the defense industry; thus, one indicator for how integrated suppliers for defense

²⁵ As home country I define here the EU country where the majority of EU ETS plants is located in.

contractors (such as Iron and Steel firms) might be across countries is a home country's membership in a military alliance. Data on NATO accession dates was collected from NATO (2012). The results for the second stage probit estimation on my matched sample are shown in Table 1.14 – Column 4. The results remain largely robust.

Addressing additional concerns of endogeneity

As in all empirical studies, there is always the possibility that the problem of endogeneity might lead to spurious results and therefore undermine the findings obtained in the econometric analysis. However, in the following I will address possible sources of endogeneity in my empirical specification in order to demonstrate the steps I have taken to alleviate any problems caused by them.

Reverse causality

One possible source for endogeneity in panel data like the one I am using is the problem of reverse causality. However, this issue can definitely be ruled out in my analysis as it is implausible that the decision to buy CER credits actually influences whether a firm operates EU ETS installations in multiple countries or not. This is because almost all installations that I am examining from 2008 to 2010 already belonged to the same firms in my sample in period 1 of the EU ETS (2005-2007). Therefore, it is not plausible that companies decided to operate new plants in different countries in period 2, because of their decision to buy CER credits.

Relocation of factories in anticipation of the policy change

Another possible concern in my specification is that firms would have expected the change from period 1 to period 2 in 2008 (since it was widely known that this policy change would happen). Therefore they could have relocated plants to different countries or extended their presence across new EU members by opening new plants in anticipation of the policy change in 2008. They might have perceived it to be more beneficial to operate in more than one

country because of the %-restrictions on how many CER credits can be used maximally per installation in different countries. However, this scenario is highly unlikely as well. As mentioned before, one characteristic of the Iron and Steel sector is that it requires large capital investments and that many of the factories and companies have a long historical tradition of steel production in Europe. Most of the installations in my sample were not relocated by the firms they belong to and only few new plants were opened during the period 2005 to 2010. This indicates that companies did not move their factories in anticipation of the policy change at least during the relevant time period I am examining. Moreover, given the capital intensity of steel production, it is highly unlikely that decisions on where to locate plants would only be made in expectation of the policy change in the EU ETS. Due to the large commitment a new Steel plant involves, location decisions in that sector usually involve a variety of considerations. Consequently, I am highly confident that the issue of preemptive relocations by companies should not be of concern for my empirical analysis.

Adjusting CO₂ emissions in expectation of the CER policy change

Another possible source of endogeneity in my empirical analysis might be that firms would increase their emissions starting in 2005 in anticipation of the policy change that would allow them to use cheaper CERs from 2008 onwards. However, as Table 1.10 (Columns 5 and 6) and Table 1.12 (Column 3) show, the inclusion of the change in emissions from 2005 to 2007 alters the coefficient on MULTICT or on my trend component only marginally. Moreover, the coefficient on $\Delta_EMISSIONS_ONE$ is not statistically significant, indicating that a change in emissions in period 1 does not seem to be a main factor influencing a firm's decision to buy CERs. From a theoretical point of view, this result is also intuitive, because firms could not completely anticipate the persistent price differential between CER credits and EUAs due to uncertainty about prices. While some level of price differential might have been expected, it

would have been hard for companies to predict these price movements so many years in advance. This argument is supported by my empirical findings that $\Delta_EMISSIONS_ONE$ does not have an effect on the probability to buy CER credits.

Endogeneity of MULTICT

Finally, the last possible issue of endogeneity that I would like to address is that multi-country firms might inherently have unobservable qualities that allowed them to set up foreign plants in the first place. If those unobservable qualities (rather than their presence in multiple countries) also play a role in their decision to use CER credits, my analysis would lead to spurious results. However, there are several aspects of my analysis which address this issue. First, as mentioned before most of the plants and firms in my sample have a long history of producing iron and steel at those locations. Therefore, for most firms, the decision to set up installations in multiple countries was made a long time before the EU ETS was even considered by policy makers. Any unobservable qualities such as better managerial performance or stronger financial performance at the time when a firm went abroad need not necessarily have persisted until the start of the EU ETS, when compliance decisions became relevant. Moreover, some unobservable qualities that led firms to establish foreign production plants might not have an influence on the decision about whether to use CER credits or not. Even if superior managerial quality relevant for recognizing foreign opportunities caused a firm to go abroad, compliance with a rather novel and unique regulatory program such as the EU ETS might require very different skills and managerial abilities. Finally, as discussed in the previous section I used coarsened exact matching to check the robustness of my results. While the matching algorithm does not control for unobservable heterogeneity directly, it “[...] improves the estimation of causal effects [...]” (King 2009, p. 1) by matching observations from the treatment group (multi-country) to comparable observations from the control group (single-country). The fact that my

empirical support for Hypotheses 1 and 2 is even stronger on the matched sample leads me to believe that a possible endogeneity problem of being MULTICT is mitigated.

Additional alternative mechanisms

Reputational effects

In my theoretical and empirical analysis so far I have proposed the argument that multinational firms are exploiting the EUA-CER arbitrage opportunity because of their presence in multiple countries. In addition, I am arguing that they are more accustomed to this type of strategic behavior in different markets and are therefore more likely to pursue such opportunities in the market for emissions allowances. However, there are several alternative mechanisms that could drive my empirical results, which I would like to address here. One possibility is the issue of reputational concerns for firms with regard to compliance with the EU ETS. In the past, the Clean Development Mechanism and the use of CER credits has been the target of increased criticism (NYT 2010). As a consequence it might be conceivable that certain firms do not want to use CER credits in order to avoid being exposed to damaging news reports or criticism by environmental activists. Assuming that such considerations do in fact play a role in a firm's decision on whether to use CER credits or not, multinational firms might have an advantage by being more insulated from negative localized domestic activism and news coverage. However, there are several reasons which make it unlikely that reputational effects are driving my results.

First, during the allowance allocation process for the period after 2012, the European Steel Association (EUROFER) sued at the European Court of Justice in order to obtain a more generous allowance allocation for the Iron and Steel sector from 2013 onwards (ECJ 2011). While the European Court of Justice struck EUROFER's challenge down, the fact that Iron and Steel companies would engage in such a public lawsuit seems to indicate that their concerns as an industry group about reputational damage is limited. Otherwise they could have tried to come

to a mutually acceptable agreement with the EU Commission during the negotiation of the allocation rules, just as some other sectors did (ExIn). It is important to acknowledge, however, that this argument only extends to reputation effects for the industry group EUROFER as a whole. It is conceivable that some firms would only engage in behavior that poses a reputation risk under the shield of EUROFER. Their behavior could change when faced with firm-specific decisions where the risk is apparent directly to the firm. Nevertheless, EUROFER's lawsuit is an indication that the industry itself is willing to challenge EU ETS rules if they are not considered beneficial for their members.

A second argument against reputational effects as main driver of my results relates to the available data. For a firm to be vulnerable to negative news report and activist action, it has to be publicly known which credits it used for compliance. However, the public information on compliance is released by the EU only on a plant-level and not on a firm-level. For any reporter or activist to identify the number of CER credits a firm submitted for compliance, he/she would have to collect a dataset on all the installations that are owned by a firm and then aggregate to the parent level (similar to what was done in this analysis to create the dataset). This task is further complicated by the fact that in several cases (which is dependent on the country an installation is located in) the publicly released information does not allow identification of the owner of an installation right away. Under the assumption that journalists and activist groups do not conduct such extensive background research that would allow them to gather the firm-level information quickly, it seems rather unlikely that a large number of firms would be subjected to scrutiny about their compliance by news agencies or environmental activists.

Finally, in order to test for the reputational alternative explanation empirically as well, I conducted an additional robustness check which is shown in Column 5 of Table 1.14. I

constructed a variable that measures how insulated every ultimate parent firm is from reputational risk within the EU ETS. For every firm I calculated the percentage of installations for which the ultimate parent firm is directly inferable²⁶ from the publicly available EU ETS information released by the EU. As is evident in Column 5, the results remain robust in that both the coefficient on MULTICT and the trend component continue to be positive and significant (at 95% and 99% respectively). At the same time, however, the coefficient on the reputation control is not significant, indicating that the insulation from reputational risk as measured above does not seem to drive my results. It is important to note that this measure has its limitations as it only captures the direct visibility of the ultimate parent firms of an EU ETS plant. Therefore, reporters or activists who put more effort in identifying the ultimate parent firm of a plant would still be able to attack a firm on reputational grounds. However, the limitations of this empirical measure for reputational salience will be addressed further through more comprehensive field interviews and additional data collection efforts, which will be the subject of another of my forthcoming research projects.

Hidden transaction costs – size of the arbitrage rents

While I will talk in more detail about the monetary implications for firms that seize the arbitrage opportunity in the next section, I will briefly discuss another possible alternative mechanism that could be influencing my results. One part of my argument for why multinationals are more likely to capitalize on the EUA-CER price spread is the easier and cheaper access to information that MNCs enjoy. This implies that MNCs face lower information costs if we examine that issue through the lens of a transaction cost approach. In addition, there could be some unobservable transaction costs in the allowance market, which make the use of

²⁶ Inferable in this context means that either the name of the installation or the name of the account holder contain information about the ultimate parent firm that owns an installation.

CER credits less feasible for some firms, particularly as CER credits can only be used up to a certain limit. It might therefore be possible to argue that only the firms for which the expected value of exploiting the arbitrage is greater than the transaction costs associated with using CER credits will surrender CER credits for compliance. However, there are several reasons that weaken the argument for this alternative explanation. First, as Ellerman et al. (2010) point out, a detailed survey of Irish firms covered by the EU ETS conducted by Jaraite et al. (2009) found no evidence that transaction costs were a deterrent for engaging in trading on the EUA market in period 1 (Ellerman et al. 2010, p. 254). The study found that there were differences in the initial start-up costs for having to comply with the EU ETS and in the continuous monitoring, verification and reporting costs across firms of different sizes. However, none of the companies cited transaction costs on the allowance market as a reason not to trade (Ellerman et al. 2010, Jaraite et al. 2009). While this survey was conducted in a limited setting (only Irish firms were included) and restricted to processes in Period 1 of the EU ETS (where CERs were not used for compliance yet), it seems to indicate that limited market access or too high transaction costs related to the trading of allowances was not an issue.

Another reason for why the size of rents that can be captured is unlikely to affect a firm's decision to engage in this arbitrage opportunity is the fact that submitting CER credits for compliance up to the permitted limit would minimize compliance costs for every firm. Therefore, every firm should have the motivation to use CER credits if it wanted to fulfill EU ETS obligations with the lowest costs possible. Furthermore, given that the rules of the EU ETS stipulate that only plants which meet certain minimum size requirements are covered by the EU ETS, every firm that is included in my sample owns plants that are sufficiently large to yield reasonable rents if the EUA-CER spread were exploited. In particular, the inclusion of firm size

as control in my analysis demonstrates clearly that size (which is directly related to the size of rents that can be captured through arbitrage) does not drive my findings. All in all, this leads me to believe that possessing information about the price spread is more important than the size of rents that can be captured or hidden transaction costs that cannot be observed.

Monetary implications of exploiting the arbitrage opportunity

How much money is at stake?

Before discussing the direct monetary value that was captured by firms in my sample through engaging in EUA-CER arbitrage, it is important to take a look at the size of the total allowance market. Early a-priori estimates by Ellerman et al. (2007) for period 1 of the EU ETS assert that the value of EU allowances alone ranges between Euro 20 and 40 billion annually, depending on the prevalent allowance price. Using data from CMD (2011) and Bluenext (2011), I calculate the value of all EU allowances issued in 2008. Based on the average spot market price for EUAs during that year of about Euro 22/ton of CO₂, the total value of EU allowances was Euro 42.9 billion, demonstrating that the EU ETS permit markets are of considerable size. Furthermore, in 2008 about 82.9 million CER credits were surrendered for compliance with the EU ETS. The average price spread between EU allowances and CER credits on the spot market in 2008 was about Euro 5.3/ton, which means that the total arbitrage value captured by all installations that used CER credits stood at roughly Euro 439 million. These numbers show that the monetary value at stake in the EU ETS is substantial and that the arbitrage rents this paper focuses on are not negligible. While most firms do not disclose their trading activities and compliance choices, there is also some direct evidence from companies, indicating that exploiting the arbitrage opportunity allows them to capture sizeable rents. Rautaruuki for example mentioned in its annual report for 2008 that the firm was able to make about Euro 5

million through the sales of surplus EUAs and through the use of CERs, thereby capitalizing on the EUA-CER spread (Rautaruuki 2008). Examples like these demonstrate that some companies are indeed aware of the strategic opportunities presented to them by the price spread and are able to seize them for their benefit. In the following I will examine the rents that firms in my sample were able to capture, both derived from allowance surpluses and arbitraging behavior.

Constructing rent measures

In order to evaluate the economic rents captured by firms in EU ETS, I construct a value measure based on the number of EU allowances a firm originally received, its actual verified emissions, the number of CER credits used as well as price information for these different types of emissions credits. My value function is defined as follows:

$$Value_{it} = [(EUA_{it} - Emissions_{it}) * p_{EUA_t}] + [CER_{it} * (p_{EUA_t} - p_{CER_t})] \quad (i)$$

Where:

- $Value_{it}$ is the economic value captured by firm i in year t
- EUA_{it} is the number of European Union emissions allowances received by firm i in year t
- $Emissions_{it}$ is the amount of verified CO₂ emissions actually released by firm i in year t, reported at the end of year t
- CER_{it} is the number of CER credits firm i submitted at the end of year t for compliance with the EU ETS
- p_{EUA_t} is the average spot market price of European Union emissions allowances during year t in Euro/ton of CO₂
- p_{CER_t} is the average spot market price of CER credits during year t in Euro/ton of CO₂

This measure captures any surplus value firms were able to obtain through the EU ETS, by having received more EU allowances than needed (part 1 of my value function) and by having bought cheaper CER credits (part 2 of my value function).

Since the previous specification of my rent function measures the value firms are capturing through two different avenues, I will also estimate the following function. It expresses the counterfactual value if a firm only had used EU allowances for compliance with the EU ETS (and no CER credits):

$$ValueEUA_{it} = [(EUA_{it} - Emissions_{it}) * p_{EUA_{it}}] \quad (ii)$$

Comparison of rents captured through the EU ETS

Table 1.15 shows the summary statistics for the arbitrage value captured by firms that used CER credits (the variable examined here corresponds to part 2 of the value function defined in (i), which only measures the direct CER arbitrage rent). As can be seen, the average value captured stands at almost Euro 1 million. This implies that firms which exploited the arbitrage opportunity were able to increase their average rents by about Euro 1 million through that arbitraging behavior. The largest rent appropriated comes to close Euro 4 million and firms even used CER credits if the captured value was relatively small. This provides further support that the size of the expected CER rents does not seem to play an important role for a firm's decision about whether to surrender CER credits for compliance or not. Table 1.16 shows the summary statistics for the total rent measure as defined in (i) for the entire sample.

Table 1.15: Summary statistics for CER arbitrage rents captured by firms that used CER credits

	Mean	S.D.	Max	75th	Median	25th	Min	Obs.
CER arbitrage rents (in Euro)	976,954	4,176,445	3.59*10 ⁷	357,855	54,129	12,442	1.24	82

Table 1.16: Summary statistics for total rents as defined in (i) (across all firm-year pairs)

	Mean	S.D.	Max	75th	Median	25th	Min	Obs.
Total EU ETS rents (in Euro)	1.44*10 ⁷	6.12*10 ⁷	5.75*10 ⁸	1,635,310	344,016	46,247	-2.95*10 ⁷	256

As can be seen, on average all firms exhibited an allowance surplus (= positive rent), with the average value captured about Euro 14 million. Of the 256 firm-year observations, 210 showed positive rents, clearly indicating that on average the Iron and Steel sector was able to capture value from the EU ETS. Any firm that had a negative rent (cost) was required to buy additional allowances to make up for the shortfall.

Tables 1.17 and 1.18 show the summary statistics for the rent measures defined in (i) and (ii) for multinational and domestic firms respectively. In addition, they also show the average rent measure as defined in (i) per employee. As can be seen in those tables, multinational firms were able to capture more value than domestic firms for all rent measures shown. The average EU ETS rents per employee (which is a measure that controls for firm size) are almost twice as high for multinational firms than for single-country companies.

Table 1.17: Summary statistics for three measures of rents captured by multi-country firms

	Mean	S.D.	Max	75th	Median	25th	Min	Obs.
Total rents (i)	4.43*10 ⁷	1.09*10 ⁸	5.75*10 ⁸	1.91*10 ⁷	3,939,882	672,745	-2.95*10 ⁷	72
EUA rents (ii)	4.34*10 ⁷	1.08*10 ⁸	5.75*10 ⁸	1.91*10 ⁷	3,939,882	649,659	-2.95*10 ⁷	72
Total rents (i) per employee	1,109	1,458	5,881	1,971	594	61	-690	72

Table 1.18: Summary statistics for three measures of rents captured by single-country firms

	Mean	S.D.	Max	75th	Median	25th	Min	Obs.
Total rents (i)	2,763,916	1.10*10 ⁷	7.26*10 ⁷	608,715	204,917	19,786	-2,918,367	184
EUA rents (ii)	2,650,756	1.07*10 ⁷	7.26*10 ⁷	597,063	199,643	19,786	-4,934,477	184
Total rents (i) per employee	670	2,049	18,044	440	149	13	-2,706	184

Formal t-tests for a difference in means, shown in Tables 1.19, 1.20 and 1.21 for all three rent measures, demonstrate that the difference in average rents captured by multinationals and

single-country firms is significantly different from 0. All three tests clearly show that multi-country firms on average were able to capture more value than their single-country counterparts. While the value that was captured can be attributed to a large part to a surplus in EUAs²⁷, multi-country firms were on average able to increase their rents by about Euro 900,000 through the use of CER credits (as compared to the counterfactual EUA rent measure). These findings indicate that multi-country firms could benefit economically more from the EU ETS than their single-country peers, both through having received a larger allowance surplus and through exploiting the EUA-CER arbitrage opportunity.

Table 1.19: Results of the t-test for the difference in means for total rent measure as defined in (i)

Group	Obs	Mean	Std.Err.	Std.Dev	[95% Conf. Interval]	
Single-Ctr.	184	2,763,916	809,083	$1.10 \cdot 10^7$	1,167,587	4,360,246
Multi-Ctr.	72	$4.43 \cdot 10^7$	$1.29 \cdot 10^7$	$1.09 \cdot 10^8$	$1.86 \cdot 10^7$	$6.99 \cdot 10^7$
Combined	256	$1.44 \cdot 10^7$	3,827,468	$6.12 \cdot 10^7$	6,894,405	$2.20 \cdot 10^7$
Diff		$-4.15 \cdot 10^7$	$1.29 \cdot 10^7$		$-6.72 \cdot 10^7$	$-1.58 \cdot 10^7$

Diff = mean (period 1) – mean (period 2) t = -3.2200

H₀: diff = 0 Satterthwaite's degrees of freedom = 71.5629

H_a: diff < 0 H_a: diff != 0 H_a: diff > 0

Pr(T < t) = 0.0010 Pr(|T| > |t|) = 0.0019 Pr(T > t) = 0.9990

Table 1.20: Results of the t-test for the difference in means for EUA rent measure as defined in (ii)

Group	Obs	Mean	Std.Err.	Std.Dev	[95% Conf. Interval]	
Single-Ctr.	184	2,650,756	787,226	$1.07 \cdot 10^7$	1,097,551	4,203,962
Multi-Ctr.	72	$4.34 \cdot 10^7$	$1.28 \cdot 10^7$	$1.08 \cdot 10^8$	$1.80 \cdot 10^7$	$6.88 \cdot 10^7$
Combined	256	$1.41 \cdot 10^7$	3,790,556	$6.06 \cdot 10^7$	6,654,169	$2.16 \cdot 10^7$
Diff		$-4.08 \cdot 10^7$	$1.28 \cdot 10^7$		$-6.62 \cdot 10^7$	$-1.53 \cdot 10^7$

Diff = mean (period 1) – mean (period 2) t = -3.1920

H₀: diff = 0 Satterthwaite's degrees of freedom = 71.5419

H_a: diff < 0 H_a: diff != 0 H_a: diff > 0

Pr(T < t) = 0.0011 Pr(|T| > |t|) = 0.0021 Pr(T > t) = 0.9989

²⁷ The processes that might have led to such a surplus in EU allowances are outside the scope of this paper, but are the subject of another working paper by the author.

Table 1.21: Results of the t-test for the difference in means for total rent measure (i) per employee

Group	Obs	Mean	Std.Err.	Std.Dev	[95% Conf. Interval]	
Single-Ctr.	184	670	151	2,049	372	968
Multi-Ctr.	72	1,109	172	1,458	766	1,452
Combined	256	793	119	1,909	558	1,028
Diff		-439	229		-890	12
Diff = mean (period 1) – mean (period 2)				t = -1.9196		
H ₀ : diff = 0				Satterthwaite's degrees of freedom = 181.221		
H _a : diff < 0		H _a : diff != 0		H _a : diff > 0		
Pr(T < t) = 0.0282		Pr(T > t) = 0.0565		Pr(T > t) = 0.9718		

One question related to the average arbitrage value that can be captured in the EU ETS through exploiting the EUA-CER price spread is how it compares to arbitrage profits in other settings. The average arbitrage value of Euro 1 million is likely to be lower than arbitrage savings that could for example be achieved by arbitraging labor cost differentials (e.g. Hansen 2005). However, in order to realize labor arbitrage profits, a firm's strategy and organizational structure usually would have to change substantially (e.g. by relocating plants, outsourcing certain firm functions). The EUA-CER arbitrage can be exploited relatively easy and effortlessly as compared to many other forms of arbitrage. In light of the fact that Iron and Steel plants require large capital requirements and firms in my sample do not seem to relocate plants easily, the gains that can be materialized through using CER credits are much more feasible. Another possible arbitrage area I can compare my findings to is tax arbitrage, which Erickson et al. (2002) examine within the United States. They find that the average annual profits from arbitraging in the market for municipal bonds are estimated to be between \$0.3 and \$8 million. While my estimates are still at the lower end of that range, they do suggest that firms even engage in other types of arbitrage that yield lower profits than exploiting the EUA-CER price spread would.

Before turning to the conclusion of my paper, I would like to discuss another possible alternative explanation mechanism behind my results, which is also directly related to the arbitrage rents that can be captured in the EU ETS. One might argue that buying CER credits for use with compliance is just another investment opportunity available to a company. If managers perceive CER credits that way (rather than as an instrument to minimize compliance costs and capture value through the EU ETS), it might be that only firms which don't have other attractive investment opportunities pursue CER credits. While this mechanism is certainly a possibility, the fact that multinational companies are more likely to use CER credits runs counter to the investment-argument. Since multinationals are present in more markets than domestic firms, they are likely to have a larger set of investment opportunities than a single-country firm. If they invested in CER credits out of a lack of other opportunities, this effect would probably be stronger for domestic companies, which have even fewer alternatives at their disposal. Consequently, I would regard the investment-mechanism as a less likely alternative explanation. Nevertheless, this issue will be explored further during more comprehensive field interviews.

Discussion and outlook

My analysis in this paper has demonstrated that the EU ETS as a comprehensive regulatory program for greenhouse gas emissions has opened up opportunities for firms to capture value and exploit market imperfections. I find strong support for Hypothesis 1 and 2, providing novel and direct empirical evidence for the argument that multinational firms are more likely to act as arbitrageurs. In addition, my analysis demonstrates that multi-country firms on average benefitted economically more from the EU ETS than their single-country counterparts.

First, I have shown that firms operating EU ETS factories in multiple EU member countries have a much higher likelihood to use cheaper CER credits from developing countries

for compliance with the EU ETS. This implies that they are more likely to exploit arbitrage opportunities in environmental permit markets than their single-country counterparts. My findings indicate that through their operations in multiple EU countries, they are better equipped to overcome informational asymmetries about the use of CER credits than their single-country peers. This in turn allows them to recognize the price spread as a strategic opportunity more easily, which they can exploit. In addition, multi-country firms can reduce the increased risk of a future shortfall of EU allowances by using CER credits now and freeing up EU allowances that can be banked for later.

The argument about informational asymmetries is further strengthened by the fact that my analysis supports Hypothesis 2, namely that the likelihood of firms to use CER credits for compliance increases over time. As period 2 of the EU ETS progresses, more firms are buying CER credits as they learn about these arbitrage opportunities and can gather more information about the CER credit markets. This also indicates that the “first-mover” advantage enjoyed by multi-country firms through their early use of CER credits will likely be reduced over time.

Finally, my analysis also shows that multi-country firms could capture more value from the EU ETS than their single-country counterparts. The additional value multi-country firms could appropriate consists of rents they received through a surplus in EU allowances as well as their strategic choice to use CER credits for compliance. This provides evidence for the argument that the non-market environment of firms can be a major influence on the ability of firms to capture value and recognize strategic opportunities.

Due to the complexity of the EU ETS, the possibilities for future research on this large regulatory program are numerous. My paper is part of a broader research stream aimed at advancing our knowledge on how climate change regulations will affect firms and their

strategies. Since those types of regulations are becoming increasingly salient in countries around the world, this paper is one step in my comprehensive research agenda on this underexplored issue.

Chapter 2

Sanjay Patnaik and Tarun Khanna

Analyzing the sources of non-market rents

Are country-, industry- or firm-effects more important for capturing value from the non-market environment?

Introduction

There is a rich body of work in the strategy literature that analyzes the sources of performance differences among firms. Early debates mostly focused on the role of industry versus firm effects (e.g. Schmalensee 1985, Rumelt 1991, McGahan and Porter 1997). More recent research has also investigated the importance of country effects in explaining differences in the financial performance of international companies (e.g. Makino et al. 2004). While these studies vary in terms of the econometric methodologies used as well as their conclusions, they all focus on purely traditional measures of financial performance and examine how firms capture value from their market environment. This research stream has substantially advanced our knowledge about whether country-, industry- or firm-effects are more important for competitive advantage derived through market-based mechanisms.

However, the sole focus on how companies capture value from their market environment might neglect possible, important sources of competitive advantage that stem from the non-market environment (e.g. regulators, politicians, NGO activists, etc.)²⁸. Scholars like Baron (1995), Henisz et al. (2011), Siegel (2007) and De Figureido and Silverman (2006) have provided strong theoretical and empirical evidence for the argument that the non-market environment can have significant effects on firm strategy and performance. Baron (1995) proposes that engaging with non-market actors can be an essential part of firm strategy. This assertion is further supported by findings in Fisman (2001) and Henisz et al. (2011). In light of this increasing salience of the importance of non-market forces in firm strategy, we examine the question of whether previous empirical findings about the role of country-, industry- and firm-

²⁸ In this paper non-market environment refers to any actors/players that are not governed by the same processes that prevail in a regular market environment (e.g. politicians operate under different objective functions than companies do).

effects are equally valid when using measures of firm performance in the non-market environment.

In our study we use a novel dataset on industrial plants covered by the European Union Emissions Trading Scheme (EU ETS) to evaluate if country-, industry- or firm-effects are more important for the ability of plants to capture economic rents from the non-market environment. Our database consists of a cross-section of 3,697 plants, owned by 538 firms in 10 industries and located in all 27 EU member countries (for the year 2010). We construct several unique non-market performance measures, based on the number of emissions allowances allocated to individual plants by regulators in the EU ETS. Since these emissions allowances represent economic rents that are created and distributed by regulators who are non-market actors, this empirical setting is ideally suited for our analysis. Moreover, the EU ETS is the first large-scale multinational emissions trading program for greenhouse gases and is expected to be in place at least until 2020 (EU Commission 2011a). This further emphasizes the novelty and continuing relevance of this research setting for the study of firm strategy in a multinational setting.

Our analysis finds that firm-affiliation is a strong factor determining the variance in the non-market performance across plants in our sample, a result that is robust to the use of different performance measures. The industry effects are the strongest for performance measures that express the absolute monetary rents plants can capture within the EU ETS. For relative performance measures, however, industry-affiliation loses importance. Finally, we also find that country-affiliation has a significant effect on non-market performance, but to a lesser degree than firm-affiliation.

Our paper is structured as follows. We will first provide an overview of the relevant literature. Second, we will discuss the empirical setting and theoretical foundation. Third, we

describe the data, performance measures and empirical methods. Finally, we conclude with a presentation of our results and a discussion of the implications, particularly with regard to further research opportunities.

Literature review and the importance of non-market rents

Studies of the sources of persistent performance differences among firms have strongly shaped the strategy literature. In this research stream, scholars generally use standard financial performance measures such as return on assets (ROA) or return on sales (ROS) to examine how much country-, industry- and firm-affiliation affects firm performance.

In his study of the profitability of business units in 1975, Schmalensee (1985) for example asserts that industry effects can explain most of the variation in firm profitability and that there is no statistical evidence for firm effects. Rumelt (1991) extends this research focus by including business unit effects in his study of Federal Trade Commission Line of Business data (FTC LB) from 1974 to 1977. He confirms Schmalensee's results that there is hardly an effect of firm-affiliation on profitability, but his results suggest that business unit effects are much stronger than industry effects.

In another contribution to that debate, McGahan and Porter (1997) utilize a much more comprehensive dataset (Computstat's Business Segment Reports) from 1981 until 1994, which includes all economic sectors. They find evidence that is more strongly in line with Schmalensee's original conjecture that industry is an important factor in the profitability of businesses. Khanna and Rivkin (2001) expand this line of research by looking at the effect of affiliation with a business group. They conduct an analysis of the profitability of international business groups in emerging markets and find that business-group effects are as strong as industry effects. Makino et al. (2004) further advance the international focus by studying the

performance of affiliates of Japanese multinationals. Their findings indicate that country effects are as strong as industry effects. Other similar work has either confirmed previous findings or extended it by looking at different firm attributes (Hawawini et al. 2003, Walker et al. 2002, Christmann et al. 1999).

While this brief review of relevant work is by no means exhaustive, the commonality among all these studies is that they focus on the direct market environment of companies and therefore use traditional financial performance measures as outcome variables. Table 2.1 shows an overview of prior work in that field and the corresponding performance measures the authors used.

Table 2.1: Comparison of outcome variables in prior literature on the importance of various firm attributes for traditional financial performance measures

<i>Performance Measure</i>	Study
Return on Assets (ROA)	Schmalensee 1985, Rumelt 1991, Roquebert et al. 1996, McGahan and Porter 1997, Khanna and Rivkin 2001, Walker et al. 2002, Hawawini et al. 2003
Return on Sales (ROS)	Walker et al. 2002, Makino et al. 2004
Return on Invested Capital (ROIC)	Chang and Hong 2002
Return on Investment (ROI)	Yip 1991
Tobin's Q	McGahan 1998
Economic Profit/Capital Employed	Hawawini et al. 2003
Total Market Value/Capital Employed	Hawawini et al. 2003
Gross Margin (in % of Revenues)	Christmann et al. 1999

Consequently, we have a lack of understanding about how these findings would translate when examining how well firms perform in capturing rents from their non-market environment²⁹. As Baron (1995) points out, engaging with non-market actors can be a substantial part of firm strategy. A former senior executive of a large brewing company for example asserted during a conversation for this research study: *“For our company, dealing with the government,*

²⁹ We will denote such rents from now on as non-market rents.

with regulators and with politicians was an essential part of our strategy. We were put out of business for many years during the time of Prohibition³⁰ and recognized that it was indispensable for our company to devote a large part of our strategy to engaging with regulators and governments. Our corporate strategy team knew it could not separate market from non-market elements and ignore one or the other. If we had done that we would have run the risk of being surprised by federal or state regulations that could have substantially impacted our business.³¹”

Companies can engage with their non-market environment in several ways, which provide them with opportunities to capture additional value that cannot be secured through their interactions with traditional market actors (e.g. suppliers, buyers, competitors). There are numerous examples for such non-market rents and firms have multiple strategic tools available to them to try to capture those rents or prevent their competitors from doing the same. The first type of rents, which we will denote as *indirect non-market rents*, arises due to changes in the traditional financial performance of firms as a result of their interaction with non-market actors. Fisman (2001) for example finds in a study of Indonesian companies, that political connections with the Suharto regime had direct impact on the stock market valuation of the respective firms. More recently, Henisz et al. (2011) find in their comprehensive stakeholder analysis in the gold mining industry that cooperative engagements with stakeholders through the media have a significant positive effect on companies’ stock market valuation.

The second type of non-market rents, which we will denote as *direct non-market rents*, are economic rents that can be directly captured by firms from their non-market environment. In

³⁰ Prohibition was a period in the early 20th century where the “[...] manufacture, sale and transportation [...]” of alcohol was not allowed in the United States (USM 2012).

³¹ Statement was paraphrased for this paper.

our study we focus on this category of rents as their significance for firm strategy is not well understood.

Examples for such rents can be found in numerous settings. De Figureido and Silverman (2006) in their study of lobbying for academic earmarks find that some universities could experience large returns on their lobbying efforts. These universities were able to benefit from their lobbying activities if they were represented by the respective Appropriations Committees in the US House and Senate. Another classic example for direct non-market rents arises when a home government awards trade protection to firms or groups of firms that lobby for it. As Grossman and Helpman (1994) demonstrate in their theoretical analysis of industries' rent-seeking behavior, in equilibrium, trade protection can be "bought" through monetary contributions and support for the politicians who are willing to implement trade protection. Empirically, Brooks et al. (1998) show that sugar producers in the US for years made campaign contributions to politicians sympathetic to maintaining a domestic support price and import quotas for sugar. These efforts helped to keep sugar prices in the US artificially high and allowed them to reap additional rents created through the higher domestic sugar prices. As is evident from the authors' analysis, these rents were appropriated by the sugar growers through non-market actors (e.g. the politicians responsible for maintaining the tariff legislation) and captured from consumers and companies that use sugar in their products. The latter two groups lost economic value as they had to pay higher prices than they would have had absent the support price and quotas. According to the authors' estimates, these welfare losses caused by the higher sugar prices amounted to \$2.1 billion annually between 1982 and 1993 (Brooks et al 1998, p. 442).

The pursuit of subsidies, in particular agricultural subsidies such as the sugar support price described above, demonstrates how important the non-market environment can be for firms to gain a competitive advantage. Governments in both the US and Europe provide large subsidies to their farmers and in many instances to their companies, allowing them to improve their competitive position. Just recently, the World Trade organization (WTO) ruled against Boeing in a case that was brought up by the European Union and Airbus, acknowledging that Boeing received substantial subsidies from the US government that were illegal under WTO rules (BBC 2012). Examples such as these are plentiful and many of these rents are awarded through processes that are governed by non-market forces such as the prevalent political system. Beghin and Kherallah (1994) and Thies and Porche (2007) for example find in their studies that the characteristics of the political system in a country have a significant effect on the extent of agricultural protection.

Other examples of non-market rents that firms try to capture are emissions allowances, tax breaks, specific pieces of legislation that would benefit certain firms or industries, the reduction of regulations that would otherwise incur costs for the affected firms (e.g. environmental regulation), gaining influence with specific regulatory bodies to expedite product approval, using home governments to gain an advantage over international rivals through diplomatic pressure (Maurer 2011) or lucrative long-term government contracts, particularly in defense and science (Mueller 2003). While this list of examples is by no means all-encompassing, the relative frequency of firms seeking these rents warrants a deeper analysis of the specific role of non-market factors in firm strategy.

There is increasing evidence that in fact many firms engage in targeted strategic behavior to obtain such rents. The amount of money spent on lobbying in the United States Congress by

companies and other organizations has increased from \$1.44 billion in 1998 to \$3.3 billion in 2011 (OS 2012a). This sharp rise is a clear indication that a growing number of firms seem to recognize the potential of capturing non-market rents to gain a competitive advantage. In 2010 alone for example, General Electric spent \$39 million on lobbying efforts, FedEx \$26 million and ConocoPhillips \$20 million (OS 2012b). A closer look at more detailed lobbying data in the US also reveals that the US federal budget appropriation process, defense expenditures, health care spending and taxes were the items that companies lobbied on the most from 1998 to 2011 (OS 2012c). All of these areas provide the opportunity to capture non-market rents as defined above.

In order to better understand how applicable our traditional knowledge in corporate strategy is to the non-market environment, we will study the distribution of emissions allowance rents in the European Union cap-and-trade program in this paper.

Emissions allowance rents and institutional setting

To examine the importance of country-, industry- and firm-effects for the performance of firms in the non-market environment, we focus on emissions permit (allowance) rents that are a central part of every cap-and-trade program. In recent years, emissions trading schemes have become increasingly salient as policy tools to control greenhouse gases, because of their introduction in countries around the world. An emissions permit gives its owner the right to emit a certain amount of a pollutant and it therefore constitutes a property right for producing emissions. These emissions allowances are usually awarded for free by regulators or political authorities to the affected firms, based on industry benchmarks, historic emissions or projected production (Ellerman et al. 2010). As the allowances generally have a non-trivial market price, they represent economic rents that are being allocated by non-market actors (e.g. regulators) to

the affected firms. Consequently, cap-and-trade programs and the allocation of emissions allowances that occurs within these schemes provide the ideal empirical setting for our study.

Due to its unprecedented scale and reach across 27 countries, the European Union Emissions Trading Scheme (EU ETS) is the most comprehensive cap-and-trade program ever implemented (European Commission 2011a). Introduced in 2005, it is currently set to continue well beyond 2013 (European Commission 2011a) and because of its novelty, there is relatively little scholarly work on the EU ETS. The fact that it covers 10 industries and hundreds of companies in 27 countries allows us to exploit this variation for our empirical analysis. In addition, the emissions allowance rents that are being created and distributed by regulators in the EU ETS could be valued at more than 42 billion Euros in 2008 alone³². This implies that the non-market rents that can be captured by firms in the EU ETS are quite substantial, highlighting the importance of studying the possible sources of non-market performance differences among firms.

The European Union Emissions Trading Scheme (EU ETS)

In the EU ETS, 1 emissions allowance gives the owner the right to emit 1 ton of CO₂. The EU Directive governing the program stipulates that every industrial plant which meets certain output and size criteria and belongs to any of several industrial activities defined by the EU has to be covered by the program (EU Directive 2003/87/EC). These industrial sectors are: Bricks&Ceramics, Cement&Lime, Coke Ovens, Combustion, Glass, Iron&Steel, Pulp&Paper, Refining and Roasting&Sintering. In addition, there is a separate category for installations from other sectors that are included on initiative from specific national regulators or that opted in voluntarily. We will refer to this category as “Opt-In” for this paper (EU Directive 2003/87/EC).

³² Derived by the authors from data found in CMD (2012).

As is evident from the breadth of industries included in the EU ETS, the program affects large parts of the economy of EU member countries.

Every plant (or installation as they are called within the EU ETS) receives a pre-determined number of emissions allowances for a given year. These allowances are allocated to installations by national regulators in a so-called National Allocation Plan (NAP), which has to specify the method by which allowances will be distributed in every trading period. Countries like Austria for example used complex allocation formulas that allowed regulators to adapt allowance allocations to installations dependent on their industry- and firm-affiliation (NAP Austria 2004). Currently, the EU ETS is divided into three periods: Phase I (2005-2007), Phase II (2008-2012) and Phase III (from 2013 onwards) (Ellerman et al. 2010). Allowances are allocated ahead of time as the respective NAPs had to be submitted by 2004 for Period 1 and by 2006 for Period 2 (EU Directive 2003/87/EC, European Commission 2011a). At the end of every year, an installation has to submit enough allowances to cover its actual emissions in order to comply with the program. Failure to do so results in fines that can go up to 100 Euros/ton of CO₂ (EU Directive 2003/87/EC).

The entire allocation process is supervised by the EU Commission, who has the right not to approve a specific proposal for a NAP by a member state (Ellerman et al. 2010). Nevertheless, the decentralized nature of the allowance allocation makes the location of an installation a salient factor for the size of allowance rents it will receive. In addition, there is substantial variation in how many allowances are awarded across different industries as many countries treated industries differently during the allocation process. They did so by introducing industry-adjustment factors during the allocation process, which can vary across sectors and are aimed at capturing different emissions reduction potentials across industries (NAP Austria 2004, EU

Directive 2003/87/EC). Finally, while the number of allowances is allocated on a plant-level, firms are optimizing their compliance and use of allowances across all their plants within their company. This in conjunction with anecdotal evidence that firms are regularly engaging with regulators in the EU ETS to affect the process of allowance allocation warrants the examination of firm-affiliation as third element in our analysis (ExIn).

Country-, Industry- and Firm-effects

As the above description of the specific mechanisms governing the allowance allocation in the EU ETS shows, country-, industry- and firm-affiliation all have to be considered in our study. Using the definition of those three effects as applied in Makino et al. (2004) as a baseline, we derive each effect as follows:

- Country effects stem from differences in the average non-market rents individual plants can capture within each of the 27 EU members states
- Industry effects stem from the differences in the average non-market rents individual plants can capture within each of the 10 industries covered by the EU ETS
- Firm effects stem from the differences in the average non-market rents individual plants can capture within each of the parent firms

Research design

Data

In order to test which role country-, industry- or firm-effects play in performance differences in the non-market environment we are using data on industrial plants covered by the EU ETS in 27 EU member countries in 2010. For every installation, we collected data from EU sources and a proprietary database (CMD 2012) on verified emissions, allocated allowances,

type and number of surrendered allowances, the country it is located in, the industry it is classified under, information on the firm that owns the plant and the percent of ownership (CMD 2012 and CITL 2012). The data that is published by EU sources is purely released on a plant-level and the listed account holders are not always equivalent with the parent firm that owns the plant (in many cases for example the account holder listed for a plant is the name of an employee working at the firm which owns the plant). For the installations where it was possible to identify their corporate owner, we used information from CMD (2012) on firm affiliation (which is available for the year 2010) and publicly available firm data to assign installations to their ultimate parent firms. We always aggregated any parent-subsidary relationship to the highest level, which means that for every plant we assigned the ultimate parent firm as corporate owner. Finally, we dropped all plants that were co-owned by multiple firms and only included installations that had full ownership by their parent firms. This allows us to eliminate possible confounding effects caused by joint ownership of a plant by several firms. We also eliminated plants that did not receive any allowances in 2010, either because they were about to close down or because they opened without having received an initial allowance allocation. The final cross-sectional dataset for the year 2010 includes 3,697 installations³³ in 10 industrial categories, owned by 538 firms and located in all 27 EU member countries.

Variables

Dependent variables

We are constructing several different alternative outcome variables to measure the performance of firms in their non-market environment. The defining factors in all of these measures are the number of allowances an installation received and whether a plant had a surplus

³³ Depending on which dependent variable we use in alternative model specifications, that number might be lower.

in emissions allowances (i.e. the difference between allocated allowances and verified emissions is positive) or a shortfall in allowances (i.e. the difference between allowances and emissions is negative). The number of allowances, valued at the prevalent allowance price is an absolute measure of the direct rents that an installation received through the EU ETS (similar to a subsidy).

However, since installations have to submit enough allowances to cover their verified emissions in a given year, we also construct measures that relate allocated allowances to emissions. The magnitude of this allowance surplus/shortfall is a direct expression of the size of allowance rents that can be kept by a firm. Any unused surplus of allowances can be sold on the market at prevailing spot market prices, while any shortfall will require a firm to buy additional allowances on the market. In order to provide robustness to our empirical results, we will run different specifications of our model that include the following direct non-market performance-measures as dependent variables:

- 1) **Performance Measure 1 (PM1)** is the logarithm of absolute monetary allowance rents calculated as:

$$\pi = \log(Allowances * p_{spotallow})$$

Allowances is the number of allowances a plant received in 2010 and $p_{spotallow}$ is the average spot market price of allowances in the same year. As every emissions allowance can be sold at the prevalent allowance price on the market, this measure reflects the total value of the allowance rents received by a plant from regulators. This measure is an absolute value that does not account for the fact that in order to comply with the regulatory program, installations have to surrender allowances to cover their emissions. Strictly speaking, however, this rent measure captures the exact monetary value of the direct rents that are being distributed by regulators (ExIn).

2) **Performance Measure 2 (PM2)** captures whether an installation had a surplus in allowances or a shortfall. We define the following function for this rent measure:

$$\pi = f(allow, em)$$

$$f(allow, em) = \begin{cases} 1, & (Allowances - Emissions) > 0 \\ 0, & (Allowances - Emissions) \leq 0 \end{cases}$$

This rent measure is 1 if the difference between *Allowances* and *Emissions* for a plant is positive (surplus), and 0 otherwise (shortfall). This measure will allow us to answer the question of how much country-, industry- and firm-affiliation influence whether an installation has an allowance surplus or shortfall. Since a surplus means that parent firms can sell their additional allowances on the market and a shortfall implies increased costs incurred by required allowances purchases, this variable expresses whether a plant yields financial benefits or causes additional costs for its parent firm.

For the following two non-market performance measures (PM3 and PM4), we will solely concentrate on plants that had an allowance surplus (i.e. whose performance measure 2 is equal to 1). By using this subsample for PM3 and PM4, we are answering the following question: given that an installation is benefitting from the EU ETS (i.e. has an allowance surplus), how much do country-, industry- and firm-affiliation affect the size of rents that can be captured by that installation? By focusing only on plants that actually received positive rents (when taking their verified emissions into account), we are able to examine how much of the value captured by plants in the EU ETS can be attributed to those effects (since installations with a shortfall are not capturing any value).

3) **Performance Measure 3 (PM3)** is also based on the difference between allowances and emissions:

$$\pi = \log((Allowances - Emissions) * p_{spot_{allow}})$$

4) **Performance Measure 4 (PM4)** is what we denote as “Return on Emissions” (ROEm). This relative measure captures the surplus/shortfall in allowances, normalized by the amount of verified emissions.

$$ROEm = \log \left(\frac{(Allowances - Emissions)}{Emissions} \right)$$

Independent variables

As independent variables we are using categorical variables that reflect the respective differences among countries, industries and firms. The country effects are determined by the variation in the non-market rents awarded to installations among all 27 EU member countries in our sample. While there is some degree of homogeneity among EU member states because of their shared European cultural heritage and geographic proximity, the institutional, political and legal environments in these countries are sufficiently distinct to provide enough variation for our analysis. This diversity is particularly salient in the EU ETS as there is substantial variation in their regulatory approaches and in how countries implemented their national allocation plans (NAPs) (Ellerman et al. 2010). Most of this diversity can be attributed to different legal systems (La Porta et al. 1997, La Porta et al. 1998), different political systems and institutions that evolved differently in those countries. All of these factors might play a role in the susceptibility of non-market actors to efforts by firms to capture non-market rents (as Beghin and Kherallah 1994 and Thies and Porche 2007 have shown for agricultural protection).

Our industry effects reflect the differences among all 10 industrial activities as defined in the EU Directive 2003/87/EC. The variation among those industries is rooted in the differential treatment of industrial sectors by governments in their NAPs. Many countries introduced so-called industry-adjustment factors that would distribute the number of emissions allowances differently across those industrial sectors (e.g. NAP Austria 2004). While the rationale behind these adjustment factors stems from considerations of public policy and political reality, the differential treatment of industries by national regulators might make industry a factor in the ability of firms to capture non-market rents (Ellerman et al. 2010, NAP Austria 2004). Consequently, for our analysis it is crucial to include industry-affiliation as a possible source of performance differences in the non-market environment.

The firm effects are derived from the differences in non-market performance across all firms in our sample. These firms include domestic as well as multinational firms. Since industry- and country-affiliation are determined by the EU at a plant level, one firm can have installations in multiple industries as well as numerous countries and therefore the industry-affiliation is not measured at the firm level, but at the installation level. For robustness checks, we will also include an interaction term of country-industry, accounting for the differential treatment of industries across countries.

Empirical analysis

We use a components of variance analysis to determine the extent to which country-, industry- and firm-affiliation affect the non-market performance of installations. This approach is similar to the methodologies applied in previous studies (e.g. McGahan and Porter 1997, Khanna and Rivkin 2001, Makino et al. 2004). One advantage of using the EU ETS as empirical setting is that the country-, industry- and firm-effects examined are not nested within each other. Since

country- and industry-affiliation are assigned at a plant-level, firm is not nested within industry, which is in turn also not nested within country. A firm can have plants in multiple industries as well as in multiple countries. We will be able to exploit that data structure for our estimation.

Following Makino et al. 2004, our model is specified as:

$$\pi_{klji} = \alpha + \delta_k + \gamma_l + \beta_j + \varepsilon_{klji}$$

whereby π_{klji} is the respective non-market performance measure of *installation i*, owned by *firm j*, affiliated with *industry l* and located in *country k*. δ_k is the country effect for *country k*, γ_l is the industry effect for *industry l* and β_j is the firm effect for *firm j*. The country-, industry- and firm-effects as well as the error term are all modeled as random effects. In order to conduct robustness checks, we will also include an interaction term between country and industry, denoted as $\delta\gamma_{kl}$ which is also modeled as a random effect. Consistent with Makino et al. 2004, the variance of the non-market performance at the installation level is defined as:

$$\sigma_{\pi}^2 = \sigma_{\delta}^2 + \sigma_{\gamma}^2 + \sigma_{\beta}^2 + \sigma_{\varepsilon}^2$$

For the continuous non-market performance measures (PM1, PM3 and PM4) we estimated the model through the MIXED procedure in SAS. For the purpose of robustness checks, we used both a maximum likelihood estimation as well as a restricted maximum likelihood estimation. For the binary outcome variable PM2, we used xtlogit in Stata, which estimates a mixed-effects logistic regression.

Results

Table 2.2 shows the summary statistics for the entire sample, including the number of allowances, emissions, the difference between allowances and emissions, non-market performance measure 1 and non-market performance measure 2.

Table 2.2: Summary statistics for entire sample

Variable	Allowances (t CO₂)	Emissions (t CO₂)	Allowances – emissions (t CO₂)	Performance measure 1	Performance measure 2
Mean	377,929	365,112	12,817	13.61	0.70
Median	54,411	39,824	5,212	13.57	1
Max	2.69*10 ⁷	2.97*10 ⁷	1.09*10 ⁷	19.77	1
Min	2	1	-1.32*10 ⁷	3.35	0
Standard Deviation	1,166,826	1,325,644	593,818	2.13	0.46
Nr. of obs.	3,697	3,697	3,697	3,697	3,697

As is evident in Table 2.2 there is variation in the number of allowances installations received as well as the verified emissions they produced in 2010. This can be partially attributed to the breadth and scope of the EU ETS as it covers so many different industrial sectors. As can be seen in Table 2.3, which shows the frequency table for Performance Measure 2, 1,094 installations exhibited an allowance shortfall, implying that they were required to buy additional allowances to be able to comply with the EU ETS regulations.

Table 2.3: Frequency table for performance measure 2

	Frequency	Percent	Cumulative
0	1,094	29.59	29.59
1	2,603	70.41	100.0
Total	3,697	100.0	

In Table 2.4, the summary statistics are shown for the subsample of plants that only had an allowance surplus. Since Performance Measures 3 and 4 are only valid for plants that had an allowance surplus, they are included in Table 2.4. For reference we show the correlations among our performance measures and the variables we used to construct them (allowances and emissions) in Tables 2.5 and 2.6.

Table 2.4: Summary statistics for installations that exhibited allowance surplus

<i>Variable</i>	<i>Allowances (t CO₂)</i>	<i>Emissions (t CO₂)</i>	<i>Allowances – emissions (t CO₂)</i>	<i>Performance measure 1</i>	<i>Performance measure 3</i>	<i>Performance measure 4</i>
Mean	330,757	231,567	99,190	13.74	12.27	-0.84
Median	58,441	35,171	15,110	13.64	12.29	-0.95
Max	1.96*10 ⁷	1.07*10 ⁷	1.09*10 ⁷	19.46	18.87	9.56
Min	7	1	4	4.61	4.05	-9.75
Std. Dev.	983,868	678,733	412,314	1.91	2.04	1.81
Nr. obs.	2,603	2,603	2,603	2,603	2,603	2,603

Table 2.5: Correlations among alternative non-market performance measures for the entire sample (star indicates significance at 95% level)

	Allowances (A)	Emissions (E)	A - E	P.Measure 1	P.Measure 2
Allowances (A)	1.00				
Emissions (E)	0.89*	1.00			
A - E	-0.03	-0.48*	1.00		
P.Measure 1	0.52*	0.44*	0.03	1.00	
P.Measure 2	-0.06*	-0.16*	0.22*	0.09*	1.00

Table 2.6: Correlations among alternative non-market performance measures for subsample of installations that only had an allowance surplus (star indicates significance at 95% level)

	Allowances (A)	Emissions (E)	A - E	P.Measure 1	P.Measure 3	P.Measure 4
Allowances (A)	1.00					
Emissions (E)	0.94*	1.00				
A - E	0.83*	0.60*	1.00			
P.Measure 1	0.54*	0.54*	0.39*	1.00		
P.Measure 3	0.48*	0.43*	0.43*	0.85*	1.00	
P.Measure 4	-0.06*	-0.15*	0.11*	-0.17*	0.31*	1.00

Table 2.7 shows the results of our components of variance estimation for Performance Measure 1. Columns (1) and (3) are estimations without the interaction term, columns (2) and (4) include the interaction. As can be seen in Column (1), industry is the most important factor, contributing about 33% to the total variation in absolute allowance rents received by installations. Firm-affiliation can explain about 18% of the variance and country-affiliation roughly 4%.

Table 2.7: Components of variance estimation for non-market performance measure 1

Dep. Var.	Performance measure 1											
	(1) Restricted Maximum Likelihood (REML)			(2) REML with country*industry interaction			(3) Maximum Likelihood (ML)			(4) ML with country*industry interaction		
Model	Est.	%	Sig.	Est.	%	Sig.	Est.	%	Sig.	Est.	%	Sig.
Country	0.25	3.94%	***	0.09	1.54%		0.25	4.09%	***	0.09	1.59%	
Industry	2.11	33.28%	**	1.60	27.44%	**	1.90	30.99%	**	1.43	25.26%	**
Firm	1.13	17.82%	***	1.05	18.01%	***	1.13	18.43%	***	1.05	18.55%	***
Ctry*Industry	-	-	-	0.32	5.49%	***	-	-	-	0.32	5.65%	***
Residual	2.85	44.95%	***	2.77	47.51%	***	2.85	46.49%	***	2.77	48.94%	***
Total	6.34	100%		5.83	100%		6.13	100%		5.66	100%	
Observations	3,697			3,697			3,697			3,697		

*Numbers shown are rounded. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level*

While it is important to keep in mind that Performance Measure 1 is based on the absolute value of the allowance rents received by an installation³⁴, the magnitude of the industry effect is much larger than found in previous studies (e.g. Schmalensee 1985³⁵: 19.6% and McGahan and Porter 1997³⁶: 19%). The strength of the industry effects demonstrates that for the absolute rents captured by plants, industry-affiliation is very important. This finding indicates that coordinated rent-seeking efforts on an industry-level seem to play a major role in securing larger absolute allowance rents. The country-effect is comparable to the findings in Makino et al. 2004³⁷ (5.5%) and the firm effect is higher than in previous studies as well. All three effects are significant, at least at the 95% level. As is evident from Column (3), the difference between the restricted maximum likelihood estimation and the maximum likelihood (ML) estimation is marginal. In Column (2), we include the country-industry interaction term, which is significant

³⁴ This absolute value does not account for the verified emissions an installation had or its size.

³⁵ Numbers for Schmalensee (1985) out of Makino et al. 2004: 1036.

³⁶ Numbers from McGahan and Porter (1997), Table 2.

³⁷ From now onwards when referring to findings in Makino et al. (2004), we will always discuss their results in Table 2, p. 1036 – Model 1 of their paper.

and explains about 5.5% of the variance in Performance Measure 1. As expected, the industry effect is lower than in the specification without the interaction term at about 27%. The country effect loses its significance and the firm-effect is similar to the result found in Column (1). The ML estimation in Column (4) yields similar results. Since our analysis is cross-sectional, we cannot explicitly include plant effects. Therefore, any variation in the performance measure that can be attributed to installation effects or other confounding factors is captured in the residual. That residual variation of about 45% is close to the residuals in McGahan and Porter (1997) as well as Makino et al. (2004). The results in Table 2.7 are in line with design features of the EU ETS, which make industry a prominent factor in the allocation of emissions allowances.

After examining the absolute total value of rents as expressed in Performance Measure 1, for PM3 we now also take into account the actual emissions an installation produced. The analysis for PM3 only includes installations that exhibited an allowance surplus. The results for the components of variance estimation for PM3 are shown in Table 2.8.

Table 2.8: Components of variance estimation for non-market performance measure 3

<i>Dep. Var.</i>	Performance measure 3											
Model	(1) Restricted Maximum Likelihood (REML)			(2) REML with country*industry interaction			(3) Maximum Likelihood (ML)			(4) ML with country*industry interaction		
	Est.	%	Sig.	Est.	%	Sig.	Est.	%	Sig.	Est.	%	Sig.
Country	0.20	3.88%	**	0.16	3.11%	**	0.20	3.98%	**	0.16	3.20%	**
Industry	1.35	26.16%	**	1.31	25.49%	**	1.20	23.90%	**	1.17	23.40%	**
Firm	0.81	15.70%	***	0.78	15.18%	***	0.81	16.14%	***	0.78	15.60%	***
Ctry*Indstry	-	-	-	0.14	2.72%	**	-	-	-	0.14	2.80%	**
Residual	2.80	54.26%	***	2.75	53.50%	***	2.81	55.98%	***	2.75	55.00%	***
Total	5.16	100%		5.14	100%		5.02	100%		5.00	100%	
Observations	2,603			2,603			2,603			2,603		

*Numbers shown are rounded. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level*

As is evident in Column (1), the restricted maximum likelihood estimation yields similar results as for PM1. Industry-affiliation explains 26% of the variance of PM3, firm-affiliation

about 16% and country-affiliation about 4%. All three effects are significant and remain similar when estimating the components of variance through a maximum likelihood approach (Column 3). This time, the results stay largely robust to the inclusion of the country-industry interaction term (Columns 2 and 4). The interaction term, however only explains less than 3% of the variation. The findings for PM3 are for the most part similar to the results obtained when using PM1. This implies that when examining the absolute monetary value captured by installations, industry- and firm-affiliation are the most important. Therefore, the differential treatment of industries by national regulators is confirmed by the results in Table 2.7 and 2.8, as the combined effects of industry-affiliation and the interaction term can explain about 1/3 of the variation of allowance rents received by installations. The relative strength of the firm effect is also in line with anecdotal evidence which suggests that many firms engaged in lobbying behavior to obtain a larger surplus of allowances (ExIn).

As next step, we now turn to estimating the components of variance approach for Performance Measure 2. This measure expresses whether an installation had an allowance surplus or shortfall. The sample for that measure is again the entire dataset, as was the case for PM1. Table 2.9 shows the results for our estimation through the use of a mixed-effects logistic regression (as PM2 is a binary variable). As is evident in Column (1), the firm-effect of 15% is similar to the results obtained in Table 2.7 and 2.8, implying that firm-affiliation exerts a strong influence on whether an installation has an allowance surplus or shortfall. The country-effect is higher than for PM1 and PM3 at 9% and the industry-effect is much weaker at about 7%. These results closely match the findings in Makino et al. (2004), which are based on a relative performance measure, namely Return on Sales (their results ascribe 10.8% to corporate-, 5.5% to country- and 6.9% to industry effects). Comparing the outcome for PM2 with the results for PM1

and PM3, we can see that firm-affiliation plays a large role in the variation of all three performance measures (about 15% to 18%).

Table 2.9: Components of variance estimation for non-market performance measure 2

<i>Dep Var</i>	Performance measure 2					
Model	(1) Mixed-effects logistic regression			(2) Mixed-effects logistic regression with interaction		
	Estimate	%	Sign.	Estimate	%	Sign.
Country	0.28	8.95%	**	0.32	9.47%	**
Industry	0.23	7.35%	**	0.25	7.40%	*
Firm	0.47	15.02%	***	0.43	12.72%	***
Ctry*Industry	-	-	-	0.23	6.80%	**
Residual	2.15	68.69%	***	2.15	63.61%	***
Total	3.13	100%		3.38	100%	
Observations	3,697			3,697		

*Numbers shown are rounded. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level*

Finally, for our last estimation, we use Performance Measure 4, which is a relative non-market rent measure as it captures the allowance surplus of installations as a percentage of their total verified emissions. Since we want to focus on plants that actually were able to capture positive value, we again will only use the sub-sample of installations that exhibited an allowance surplus (as in the case of PM3). Table 2.10 shows the results for the components of variance analysis for PM4. As can be seen in Column (1), which uses a restricted maximum likelihood estimation, country-effects account for about 5% of the performance variance and firm-effects for about 6%. Industry-affiliation is not significant in this specification. These findings remain largely the same when using the maximum likelihood estimation (Column 3). Finally, when including the country-industry interaction term (Columns 2 and 4), the results remain robust, with the industry effect and interaction term not significant.

Table 2.10: Components of variance estimation for non-market performance measure 4

<i>Dep Var</i>	Performance measure 4											
Model	Restricted Maximum Likelihood (REML)			REML with country*industry interaction			Maximum Likelihood (ML)			ML with country*industry interaction		
	Est.	%	Sig.	Est.	%	Sig.	Est.	%	Sig.	Est.	%	Sig.
Country	0.15	4.46%	**	0.15	4.46%	**	0.15	4.48%	***	0.15	4.48%	**
Industry	0.08	2.38%		0.07	2.08%		0.07	2.09%		0.06	1.79%	
Firm	0.20	5.95%	***	0.20	5.95%	***	0.20	5.97%	***	0.20	5.97%	***
Ctry*Indstry	-	-		0.03	0.98%		-	-		0.03	0.90%	
Residual	2.93	87.20%	***	2.91	86.61%	***	2.93	87.46%	***	2.91	86.87%	***
Total	3.36	100%		3.36	100%		3.35	100%		3.35	100%	
Observations	2,603			2,603			2,603			2,603		

*Numbers shown are rounded. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level*

The magnitude of the country effect of about 5% is comparable to the findings in Makino et al. (2004) (5.5% for country-affiliation), while the corporate effect of about 6% is slightly more than McGahan and Porter (1997) found (4.33%) and slightly lower than Makino et al. (2004) estimated (10.8%). Due to the fact that PM4 is a relative rent measure and the estimation is conducted on a cross-sectional sample, the residual variation is higher for PM4 than for any of the other measures (about 86%). However, part of that residual is likely to be attributed to plant effects (which in Makino et al. 2004 are equivalent to affiliate effects that explain about 31% in performance variation, three times more than the next largest effect). Adding their residual and affiliate effect yields about 77% for all other factors, excluding country-, industry- and firm-effects. Our study is therefore in line with prior research in terms of explanatory power of the three effects we are examining.

Interpretation of Industry- vs. Firm-effects

The results presented above provide several insights into the relative importance of industry- and firm-effects for non-market performance. In the traditional strategy literature, focused on pure financial performance of firms, the debate has often been framed as to whether

the industry environment (e.g. McGahan and Porter 1997) or firm-specific capabilities (e.g. Peteraf 1993) are more relevant for firm profitability. The findings in my analysis indicate that both factors appear to be complementary when examining non-market performance. First, for the absolute allowance rents received by plants, industry-affiliation seems to be a much stronger influence than any of the industry-effects found in the previous literature that uses financial performance. Industry-wide rent-seeking efforts, which can be coordinated among firms within the same industry, seem to have been successful in securing larger absolute allowance rents for certain industries within the EU ETS. Consequently, coordinated industry efforts can have a substantial effect on the non-market performance of plants. However, this does not mean that firm-specific capabilities have a less important role. As my analysis indicates, firm-affiliation also has a strong influence on the non-market rents captured by EU ETS installations. For relative performance measures (PM2 and PM4), firm-effects are even stronger than industry-effects. This indicates that firms which go beyond any industry-level efforts to capture more value can significantly improve their non-market performance by using firm-specific capabilities (e.g. political ties, social connections). Rather than contrasting the importance of industry- and firm-affiliation, a comprehensive view on how these two effects can jointly explain firm performance seems a more appropriate approach in the context of the non-market environment.

Discussion

Our paper extends the focus of previous work about the sources of performance differences among firms onto the non-market environment. In light of the growing expenditures of firms on efforts to influence non-market actors (e.g. through lobbying), our study contributes to our understanding of the sources of non-market rents within the context of the European Union. This analysis advances an increasingly salient research agenda highlighting the

importance of the non-market environment for firm performance and strategy (e.g. Henisz et al. 2011). The findings obtained through our components of variance analysis have multiple implications.

First, the results for all four non-market performance measures we construct show that firm-affiliation has a strong influence on the non-market rents captured by EU ETS installations. For PM1 and PM3, firm effects account for about 15 to 18% of the variance in the non-market performance among installations, making it the second strongest influence after industry-affiliation for those measures. For PM2 and PM4, which are relative non-market rent measures, firm-affiliation is even stronger than country- and industry-affiliation in determining the variance in non-market performance among installations. The prominent role firm-affiliation plays in the appropriation of non-market rents is not only robust to how we construct our different outcome variables, but also seems intuitive from a theoretical point of view. How to engage with non-market actors and how to capture value through the non-market environment will likely require certain firm capabilities (e.g. the connections to the Suharto regime as discussed in Fisman 2001). Such abilities might for example be shaped by historic events (e.g. Prohibition in case of the brewery company we mentioned at the beginning of our study), social connections that a firm can benefit from or other idiosyncratic elements that provide certain firms with an advantage in the non-market environment. The empirical results from our analysis therefore provide evidence for the argument that when following a strategy that includes non-market components, firm-specific assets and abilities should not be neglected.

The second implication of our analysis concerns the importance of industry-affiliation for capturing value from the non-market environment. While the evidence in our study is mixed with regard to the magnitude of industry-effects, the findings do suggest that industry-affiliation plays

a role, particularly for the absolute non-market performance measures. As our results for PM1 and PM3 show, industry effects and the interaction of industry with country can jointly explain up to 1/3 of the variance in the non-market performance of plants. Parts of this very large effect can likely be attributed to differences in the size of plants across industries. However, given that the size of installations differs within industries as well, considerations of size are likely not the only factors at work here. In fact, our results confirm empirically that certain design features of the EU ETS make industry-affiliation a salient characteristic when it comes to the absolute monetary values installations can capture through the EU ETS. By introducing industry-adjustment factors, national regulators consciously treated industries differently during allowance allocation, which is reflected in the significance of industry effects empirically in our analysis. Moreover, the fact that the interaction terms are all significant for PM1, PM2 and PM3, demonstrates that different national regulators seemed to have treated industries differently as well. These empirical findings are also in line with reports that industry associations, such as the European Iron and Steel Federation (EUROFER), have engaged in targeted efforts to influence regulators with regard to the allocation of allowances (ECJ 2011).

Our analysis also yields similar results for PM2, albeit the magnitude of the industry-effect is much lower. For PM2, the industry-effect is about 7% and the interaction term about 7%, both are significant at least at the 10% level. This means that 14% of the variance in whether a plant had an allowance surplus or shortfall can be explained by these two effects. Since PM2 is a binary performance measure, this finding also supports the argument that the ability of installations to capture value from the non-market environment is influenced by industry-affiliation, regardless of the absolute monetary value received. Finally, the industry-effect and interaction term are not significant for PM4, which is a relative performance measure. The

implications of this finding are that when it comes to the absolute rents that can be captured within the EU ETS, industry-affiliation matters, but when looking at a relative non-market performance measure, firm-affiliation is much more important.

Third, our findings with regard to the importance of country-affiliation indicate that country does matter, but not as much as firm-affiliation. The magnitude of the country-effect ranges from 4% to 9% (depending on the performance measure used) and is therefore close to the results presented in Makino et al. (2004), albeit lower. Our empirical findings demonstrate that the decentralization in the EU ETS does have an effect on the value plants can capture.

Last but not least, our analysis has several additional implications for the study of corporate strategy and for subsequent research in that field. First, when firms want to capture value through their non-market environment, there is a role for coordinated efforts within an industry to engage with non-market actors. Our study shows that industry can be a factor that influences the size of rents a group of entities receives within an industry. This finding for non-market rents within the EU ETS is in line with prior work that has demonstrated how industrial sectors lobby as a group for other non-market rents such as trade protection. Second, our analysis clearly demonstrates the importance of corporate effects for the ability of plants to capture additional non-market rents. This result, which is robust to the use of all our alternative performance measures, indicates that firm-specific capabilities can play a major role in capturing value from the non-market environment. Companies that recognize the opportunities presented to them by engaging with non-market actors can therefore build capabilities that will allow them to capture additional value and improve their competitive position. Rather than focus solely on the competitive landscape within its industry, firms can pursue a targeted “integrated approach” (Baron 1995) to strategy by building the necessary capabilities that will allow them to pursue

opportunities in their non-market environment. Given the considerable size of possible non-market rents that firms are increasingly trying to capture (not only within emissions trading programs), such firm-specific capabilities might be crucial for gaining or sustaining a competitive advantage.

Before concluding our paper, we would like to discuss possible future research opportunities based on this study. One limitation of our analysis is that the sample only includes plants from countries within the European Union. While the countries in our sample differ sufficiently in terms of their institutional, political and legal environments, there is still some degree of homogeneity among European nations. A future extension of our study might expand our analysis onto other countries/regions in the world that are introducing similar cap-and-trade programs (e.g. California and Australia) once data for these schemes becomes available. By including other countries (or in case of California another state within a country), the general validity of our results will be enhanced.

Another possible extension of the study concerns the inclusion of 2011 EU ETS data once it becomes available, which will allow us to account for variation across time in our analysis. Furthermore, it would enable us to estimate installation-effects, which are now encompassed by the residual variation of our model. Finally, our study might also be expanded by examining the importance of country-, industry- and firm-affiliation for capturing additional non-market rents in another context than the EU ETS (e.g. different regulatory programs, lobbying in the U.S. etc.). There are numerous possible research opportunities facilitated by increasingly available datasets on lobbying and by the use of insights from other disciplines such as political science.

Chapter 3

Sanjay Patnaik

The political economy of climate change regulation

Rent-seeking in the European Union Emissions Trading Scheme (EU ETS)

Introduction

The political science and political economy literature has a long tradition of examining how different country-specific institutional and political characteristics affect rent-seeking efforts by economic actors. The ability to obtain rents such as trade protection, agricultural support or protection against foreign investments has been found to be influenced by the structure of the prevalent political system and idiosyncratic institutional factors (e.g. Mueller 2003, Mitchell and Munger 1991, Grossman and Helpman 1994, Milner 2002, Chase 2003, Jensen 2003, Li and Resnick 2003, Thies and Porche 2007, Davis 2004, and Beghin and Kherallah 1994). This rich body of research has greatly advanced our knowledge on how rent-seeking efforts are either facilitated or dispersed by certain political configurations and institutions. Most of this work has focused on traditional rents such as trade protection or agricultural support as they are more easily measured empirically and have had central, historic roles in the economies of many countries. However, there is a lack of understanding about the processes that influence rent-seeking efforts related to environmental regulation, a public policy area that is becoming increasingly important. The rising salience of climate change and the accompanying introduction of greenhouse gas regulations in countries and regions around the world (e.g. the European Union, Australia, California), has led to intensified rent-seeking efforts by interest groups to influence emissions legislation to their benefit (ECJ 2011). This issue is particularly exacerbated by the fact that most of the newly introduced regulations are based on cap-and-trade programs, where the distribution of emissions allowances³⁸ by governments provides ample opportunities for rent-seeking behavior.

³⁸ 1 allowance is the right to emit 1 ton of CO₂

My study addresses the research gap on rent-seeking related to environmental regulation by examining the question of how the distribution of emissions allowances to industrial sectors is affected by country-specific political and institutional characteristics. At a non-trivial allowance price, these emissions allowances represent economic rents that are being distributed by government regulators to the affected industries, firms and plants. As empirical setting for my analysis I am using the European Union Emissions Trading Scheme (EU ETS), which is the world's largest cap-and-trade program for greenhouse gas emissions. Introduced in 2005, it covers plants in 10 industrial sectors across all 27 EU member countries (Ellerman et al. 2010, EU Directive 2003/87/EC). Although the EU ETS is governed by EU regulations (EU Directive 2003/87/EC) and supervised by the European Commission, the distribution of emissions allowances has been largely delegated to national governments (Ellerman et al. 2010). I am able to exploit the resulting variation in the number of emissions allowances distributed across countries and industrial sectors for my empirical analysis. Due to its unprecedented scope and reach, the EU ETS is an ideal and novel empirical setting to study rent-seeking within environmental regulation.

Using a panel dataset on industrial sectors in the EU ETS from 2005 to 2009, I first examine whether these sectors were treated differently by governments during the allowance distribution process. I find that some industries did in fact exhibit significantly different allowance rent allocations than the other sectors. My results also indicate that industries with a smaller number of factories were more successful in their rent-seeking efforts than sectors with a larger number of plants. This result is in line with theoretical and empirical evidence on the collective action problem related to rent-seeking (Mitchell and Munger 1991). I then examine how certain political characteristics of the home country of an industrial sector influence the

magnitude of allowance rents it receives. First, my results demonstrate that governments in countries with a legal tradition rooted in Germanic law seem less vulnerable to rent-seeking efforts than governments in countries that have a Common, French or Scandinavian legal system. This indicates that the legal system seems to affect how rent-seeking efforts can be channeled within a country. Second, I find that the ideology of the executive branch in a country during the time of allowance allocation significantly influences the size of rents awarded to domestic industries. More left-leaning governments tend to award larger allowance rents than centrist or right-leaning governments. Third, I find that countries with a more stable political environment are awarding lower allowance rents to their industries than countries with a higher frequency of political upheavals. This result shows that the durability of political institutions influences how resilient they are against rent-seeking efforts by interest groups.

The paper is structured as follows. In the first section I will describe the theoretical background and relevant literature for my empirical analysis. This part will also encompass a brief description of the institutional background of the EU ETS. In the next section I will discuss the data, empirical approach and results. Finally, the paper concludes with a discussion of my findings and an outlook on future research.

Theory and relevant literature

As Mueller (2003) asserts “The monopoly rents that the government can help provide are a prize worth pursuing and the pursuit of these rents has been given the name of rent seeking.” (Mueller 2003, p. 333). The monopoly rents described by Mueller encompass a variety of rents that can be awarded by the government and that are being sought out by organized interest groups such as industry associations (Mueller 2003). Those groups attempt to influence the government and politicians in numerous ways in order to secure larger rents for themselves,

usually to the detriment of less organized or more dispersed groups such as consumers (Mitchell and Munger 1991, Olson 1965). Most schools of thought that exist on rent seeking consider this behavior socially inefficient as it diverts resources away from more productive uses (Mitchell and Munger 1991, Mueller 2003). Examples for such rents are plentiful and include government regulations, tariffs, quotas, voluntary export restraints, agricultural subsidies or tax breaks (Mueller 2003, Thies and Porche 2007), many of which have been studied by scholars from a variety of disciplines.

In recent years, as the problem of climate change has become more salient in political and public policy circles, another type of government rent has been gaining importance. Due to the introduction of cap-and-trade programs aimed at controlling greenhouse gas emissions, the emissions allowances allocated by government regulators have increasingly become the object of rent-seeking efforts by industries and firms (ECJ 2011, ExIn, Ellerman et al. 2010). In an emissions trading scheme, every allowance gives its owner the right to emit a certain amount of a pollutant. In general these allowances are allocated for free by government regulators to the industries, firms and plants that are included in the cap-and-trade program, based on historic emissions, projected output or benchmarks (Ellerman et al. 2010). As these allowances can be traded on designated carbon exchanges and are priced at prevalent market prices, they represent economic rents that are directly distributed among affected interest groups. The relative novelty of cap-and-trade programs that cover broad parts of the economy and span multiple countries is a major reason why there has been little research up to date on rent-seeking efforts during the allocation of emissions allowances.

The European Union Emissions Trading Scheme (EU ETS) is the most comprehensive cap-and-trade program ever implemented so far, posing substantial challenges to policy makers

and political institutions that are in charge of the program (Ellerman et al. 2010). The EU ETS covers any industrial plant if it belongs to any of the following 10 pre-defined industrial sectors and meets certain criteria: Combustion, Refining, Coke Ovens, Roasting and Sintering, Cement and Lime, Glass, Bricks and Ceramics, Iron and Steel, Pulp and Paper and Opt-In (EU Directive 2003/87/EC). The allocation of allowances to these plants is conducted by national regulators under the supervision of the EU Commission. This distribution of emissions allowances is conducted ahead of time. For Period 1 of the EU ETS (2005-2007) allowances were allocated in 2004 and for Period 2 (2008-2012) they were distributed in 2006 (Ellerman et al. 2010). At the end of every year, a plant has to surrender sufficient allowances to regulators to cover its emissions, otherwise it faces steep fines (EU Directive 2003/87/EC). Consequently, economic actors covered by the EU ETS have the incentive to try and obtain more allowances from regulators than needed in order to avoid the costs of reducing emissions or buying additional allowances on the market.

Every country has an overall emissions reduction goal assigned by the EU and that goal has to be achieved through the sectors that are covered by the EU ETS and through reductions outside the EU ETS in other sectors (such as transportation or private households). For the EU ETS sectors, national regulators determine the total number of allowances that are to be distributed within their own respective countries, but that number has to be approved by the EU Commission (Ellerman et al. 2010). Hence, the total allowance cap for one country establishes how much of the required emissions reductions for that country will come from the industries covered by the EU ETS and how much from the sectors not covered by cap-and-trade. This implies that if a government provides more generous allowance rents to their EU ETS industries, emissions reductions (and the ensuing costs) will have to be borne by other groups in the

economy. In fact there is evidence that national governments tried to engage in this behavior as the EU Commission had to force many member states to adjust their total allowance caps downwards (Ellerman et al. 2010).

The method for allowance allocation is mostly specified by national governments as well and the categorization into different industries has developed as a salient factor during the allocation process (Ellerman et al. 2010, NAP Austria 2004). Governments have introduced industry-adjustment factors that are aimed at capturing the emissions reducing potential of different industries, thereby allowing them to treat industries distinctly when allocating allowances (EU Directive 2003/87/EC, NAP Austria 2004, Ellerman et al. 2010). This design feature has invited efforts by interest groups, in this case mostly industry organizations, to influence governments to receive a larger number of emissions allowances than other groups (ECJ 2011). From a theoretical point of view, the rationale behind trying to receive more allowances is clear. On the one hand, any interest group that can secure more allowances than needed (i.e. has an allowance surplus) will not only have enough allowances to cover emissions, but can even reap additional profits by selling off the surplus emissions allowances. On the other hand, any interest group that receives too few allowances will have to either reduce emissions or buy additional allowances. The allowance rents sought by industries in the EU ETS are therefore comparable to other more traditional rents like trade protection or agricultural support. Instead of seeking protection against foreign imports or seeking subsidies, interest groups in the EU ETS try to maximize their protection against costly environmental regulation and at the same time reap additional allowance rents. This process occurs to the detriment of other groups within the EU ETS or even the larger economy. Given that all allowances distributed in 2008 alone were valued at Euro 42 billion (CMD 2011), the rents that can be pursued are significant.

From the literature on trade protection and agricultural support, we know that different industries are able to gain advantages over their rival interest groups by successfully obtaining higher degrees of trade protection or agricultural support (e.g. Grossman and Helpman 1994, Brooks et al. 1998). It is to be expected then, that different industries within the EU ETS would also exhibit heterogeneity in their rent-seeking efforts during allowance allocation, resulting in an unequal outcome across industries. My first hypothesis for my analysis therefore is:

Hypothesis 1a: *Within the EU ETS, some industries receive larger allowance rents than others. Hence, rent-seeking within environmental regulatory programs is similar to rent-seeking within trade or agricultural policy.*

Another defining characteristic of traditional rent-seeking processes is that they are facilitated by the problem of collective action (Mitchell and Munger 1991, Olson 1965). A major prediction of Olsen's theory on rent-seeking by interest groups is that "[...] rent seeking (defined below) is most likely in industries with a high degree of concentration [...]" (Mitchell and Munger 1991, p. 515). A larger number of players within an industry will exacerbate collective action problems, while more concentrated industries will be able to organize more effectively for their rent-seeking efforts. Brooks et al. (1998) demonstrate this phenomenon elegantly in their analysis of agricultural protection for sugar growers in the United States. The more concentrated group of sugar farmers has been able to successfully sustain support prices and import restrictions for sugar through targeted contributions to politicians. While their opposing interest groups (consumers and companies that use sugar in their products) also engaged in efforts to influence sugar legislation, their attempts were more dispersed and therefore less successful than the ones by the sugar growers.

My next hypothesis is therefore:

Hypothesis 1b: *Within the EU ETS, industries that have a smaller number of plants receive larger allowance rents than industries with many plants.*

It is important to note that I am using the number of plants rather than the number of firms in formulating this hypothesis. One reason is that the EU Commission considers an industrial plant one of the most important units of analysis in the EU ETS, which is why public information is released on a plant level. In addition, the number of plants rather than the number of firms largely determines the size of an industry for the allocation of allowances. An industry that has 100 installations belonging to 10 firms will be more salient during the allowance allocation process than an industry with 10 plants that are owned by 10 firms. Consequently, I use the number plants as a measure of the number of players in my analysis. However, there are limitations to this measure as it cannot capture the concentration of an industry as for example expressed through the Herfindahl-index. The relevant firm-level information is unfortunately not available for the time period I am examining in my analysis.

As discussed above, one important aspect of rent-seeking is the possible heterogeneity among different interest groups in their ability to secure government rents. Another essential factor is how the prevalent institutional and political environment in a country affects the rent-seeking efforts by interest groups. In a variety of settings, scholars have found that the type and structure of the institutional and political system influence how rent-seeking efforts can either be facilitated or dispersed. As Mueller (2003) asserts, the composition of legislative bodies plays an important role in the success of rent-seeking efforts by interest groups (Mueller 2003). He cites a study by McCormick and Tollison (1981) as an example, which finds that the “[...] number of seats and the ratio of seats in the two houses, are significantly related to the degree of economic and occupational regulation across the states, [...]” (Mueller 2003, p. 347).

In another paper, Beghin and Kherallah (1994) find that more pluralistic political systems lead to higher levels of agricultural protection, but in a non-linear fashion. After agricultural protection peaks for dominant party systems, it starts diminishing as political systems get more democratic. In a related study, Thies and Porche (2007) examine agricultural protection in the OECD countries between 1986 and 2001. They find that a more federalist system, larger party fragmentation and the timing of elections lead to higher degrees of agricultural protection (Thies and Porche 2007). Based on their empirical results, the authors assert that generally it seems that patterns of agricultural protection are similar to those for trade protection. Trade policy is another classical example of where institutions and political systems have been found to affect levels of trade protection (Milner 2002.). In another study, on foreign direct investment, Jensen (2003) finds that more democratic countries attract higher levels of FDI, which runs counter to the argument that democratic institutions constrain politicians more severely and make them susceptible to domestic industries asking for protection (Li and Resnick 2003). This brief overview of relevant work related to the political and institutional influences on rent-seeking efforts demonstrates how important these factors can be for interest groups when they pursue government rents. While the emissions allowances distributed in the EU ETS do not fall into any of the categories of previously studied government rents, it is very likely that their allocation will also be affected by political and institutional characteristics. In the following, I will focus on three elements of the institutional and political environment in a country, which might influence allowance allocation: the prevalent legal system in a country, the stability of political institutions and the ideology of the executive branch.

The EU ETS like most other regulations in the European Union is governed by an EU Directive (EU Directive 2003/87/EC), which is translated into national law by the respective

member states (EU Commission 2011b). The legal tradition that is dominant within each member country not only governs how the Directives are implemented nationally, but also provides different avenues for interest groups to challenge legislation through the court system. Moreover, the legal system in a country also shapes the way the legislative body operates and how it might be influenced by interest groups. As defined in La Porta et al. (1997) and La Porta et al. (1998), European countries can be divided into four different legal families: Common law, German Law, French civil law and Scandinavian law. Following their categorization, I will use these four families to classify EU member countries and formulate the following hypothesis:

Hypothesis 2: The prevalent legal family in an EU member country influences the allocation of allowance rents to industrial sectors within that country.

Another important characteristic of the political environment that might affect the distribution of allowance rents is the ideological orientation of the executive branch. While the EU ETS was designed and is being supervised by the EU Commission, the allowance allocation in Periods 1 and 2 of the EU ETS was conducted by national regulatory authorities. These regulators are usually part of government ministries that report directly to the executive branch of the respective governments, allowing them to yield considerable influence on the rules governing the allocation process. The politicians in the executive branch like other politicians are concerned with gaining the maximum support from voters and constituents. If we assume that the politicians in the EU ETS follow an objective function as defined by Grossman and Helpman (1994), then it would be in the interest of the politicians in the executive branch to garner as much support from the affected EU ETS industries as possible. In return they would be expected to distribute larger allowance rents to many of the heavy industries included in the EU ETS, to the detriment of other interests groups that will have to make up the required emissions cuts for

the country (e.g. consumers). In that context, the ideological orientation of these politicians is likely to play a role. Prior to the introduction of the EU ETS, many critics voiced concerns about firms possibly relocating to countries outside the EU, thereby shutting down plants and shedding employees. This “leakage” argument was used as a potent tool by industry groups to bargain for higher allowance rents (ExIn). Through that threat, the interests of workers in the affected industries got aligned with the interests of factory owners. Given that any relocations would have affected employees more than employers and many of the affected workers are unionized, it is likely that these organizations used their political influence during allowance allocation. As most of the unions historically have a strong affiliation with parties and politicians on the left of the political spectrum, I propose the following hypothesis:

Hypothesis 3a: *Industries receive larger allowance rents during the allocation process, if the politicians in power in the executive branch can be characterized as being ideologically on the left. Countries where politicians from the right were in power during allowance allocation will award fewer allowance rents.*

Another characteristic of the political environment that is likely to play a role during the allowance allocation process is the stability of political institutions. As Acemoglu et al. (2001) demonstrate, the quality of institutions (in their case restraints on the executive branch) affects economic growth positively and well-functioning institutions take a long time to develop. Although the authors’ analysis is focused slightly differently on economic development, the durability of institutions might also be relevant for many other economic and political processes, including rent-seeking. While many EU member states are somewhat homogenous when it comes to their forms of government, there is considerable variation in the longevity of political institutions. The longer such institutions exist without facing a severe political upheaval, the

better they can develop. This should in turn make them more resilient to rent-seeking efforts as compared to relatively novel institutions that are more prone to be subjected to influences by interest groups. My next hypothesis is therefore as follows:

Hypothesis 3b: *Governments in countries with a well-developed and stable institutional environment will allocate smaller rents to their industries than countries with a less stable institutional environment.*

Finally, the last aspect of the political environment that is relevant for the process of allowance allocation is the electoral cycle. The argument for how elections could influence the distribution of allowance rents has two sides. On the one hand, as Thies and Porche (2007) demonstrate, elections are associated with a higher degree of agricultural protection as politicians cater to the demands of interest groups in order to get re-elected. Such a behavior would correspond to the model developed by Grossman and Helpman (1994) and to findings obtained by Magee, Brock and Young (1989). From a theoretical point of view, elections could have the same effect in the EU ETS. If there is an election taking place in the year allowances are allocated, then politicians might be tempted to gain support by promising the affected industry groups larger allowance rents. However, on the other hand, the argument could also be made that in an election year politicians will have to broaden their appeal as much as possible and do not want to be associated with being influenced by special interest groups. Consequently, they might be less inclined to give in to rent-seeking efforts by EU ETS industries. In either case, I am proposing that the election cycle will have a significant effect on the distribution of allowance rents. My last hypothesis is therefore:

Hypothesis 3c: *In countries where an election is held during the years allowance rents are allocated, the distributed allowance rents will be significantly different from those in countries where no election took place in the same period.*

After discussing the theoretical foundation of my analysis, I now turn to the empirical specification.

Research design

Data

In order to test my hypotheses, I constructed a panel dataset of industrial sectors covering 24 EU member states (I excluded Romania and Bulgaria as they joined while the EU ETS was well underway and Malta because it only has two installations included in the EU ETS). There are ten different industry categories as defined by the EU Commission (CMD 2010 and EU Directive 2003/87/EC): Bricks&Ceramics, Cement&Lime, Coke ovens, Combustion, Glass, Iron&Steel, Paper, Refining, Roasting&Sintering and “Opt-In”. I eliminated the sector “Opt-In” from my sample because of some missing data and multiple cases where that category did not have any allowance or emissions data. In the ideal case, I therefore have nine observations for a country each year, in total for five years (2005-2009). However, since there are some countries that do not have installations in all sectors, the number of observations in my sample is 835³⁹. The unit of analysis is a country-industry pair. The data on emissions, allowances, installations and categorization into industries was collected from CMD (2010), which compiles the data from the EU Community Transaction Logs (CITL 2011), National Allocation Plans and EU Commission documents. The data on the institutional stability for each country comes from the Polity IV database, a comprehensive collection of several important characteristics of political

³⁹ Instead of the $45 \times 24 = 1080$ for the case that all industries were to be found in each country.

systems in countries around the world (Polity IV 2010). Information about the legal system of each nation was compiled from La Porta et al. (1998) and supplemented with more recent data on former Soviet countries from the CIA world fact book (CIA 2010). The data on the ideology of the executive branch and the electoral cycle comes from the World Bank's political indicators database (WB 2011). Any data about the accession of each member state to the EU and important deadlines regarding the EU ETS were compiled from official EU sources and documents by the EU Commission (European Union 2011). Data on GDP growth were collected from the Economist Intelligence Unit country database (EIU 2011).

Variables

Dependent variable

In order to measure the magnitude of allowance rents different industries received within the EU ETS, I construct a relative rent measure that relates allocated allowances to verified emissions. This variable captures the relative surplus/shortfall in emissions allowances an industry had, normalized by the original number of allowances received. By utilizing a relative rent measure, I am pursuing a similar approach as used in the rent-seeking literature on trade or agricultural protection (e.g. Thies and Porche 2007).

My dependent variable is defined as follows:

$$AG_{ijt} = \frac{Allowances_{ijt} - Emissions_{ijt}}{Allowances_{ijt}}$$

AG_{ijt} is my measure of allowance surplus/shortfall as a percentage of the original allowance cap for industry i in country j in year t , which I will denote as "Allowance Rent Gap" from here onwards. $Allowances_{ijt}$ is the number of allowances received by industry i in country j in year t and $Emissions_{ijt}$ represents the verified emissions of industry i in country j in year t . If AG_{ijt} is equal to 0, the industry received exactly as many allowances as needed to cover all emissions, if

the number is positive, the industry had an allowance surplus (over-allocation or positive rent) and if it is negative, it exhibited an allowance shortfall (under-allocation or negative rent). This variable can be interpreted as a measure of the “protection from environmental regulation costs”, similar to other protection measures used in the rent-seeking literature (e.g. the Average Nominal Protection Coefficient as used in Thies and Porche 2007). The magnitude and direction of the variable determine whether an industry will receive a net gain (positive rent) or incur a net loss (negative rent) from the EU ETS. Therefore, it can be seen as a measure of how much an industry is protected from the cost burden put by the EU ETS (either through having to reduce emissions or through having to buy additional allowances on the market). Since this normalized relative rent measure captures the surplus/shortfall as a percentage of the original allowance allocation, it is possible to use it to compare industries of different sizes and allowance shares.

Independent variables⁴⁰

Legal system of the home country of an industry (Hypothesis 2)

This indicator variable captures the origin of the legal family in the home country of an industry. Corresponding to the classification used in La Porta et al. (1998), I assign each country to one of the four following families: Common law, French civil law, German civil law and Scandinavian civil law.

Ideological orientation of the executive branch (Hypothesis 3a)

This categorical variable captures the ideological orientation of the executive branch of the government in power. The data was obtained from the World Bank’s Database on Political Institutions (WB 2011). The variable can take five values: 0 if there is no information, 1 if the ideology is right, 2 if it is at the political center, 3 if it is left and NA if there is no executive branch.

⁴⁰ Unless noted otherwise I will assign values for every variable to each observation for the time allowances were allocated.

Durability score (stability of institutions – Hypothesis 3b)

This variable captures the stability of the political system, which I use as a measure for the continuity of the institutional environment. The durability score for a country, obtained from the Polity IV database, is “equal to the number of years since the most recent regime change or since the end of transition period defined as lack of stable political institutions” (Polity IV 2010). In the polity framework, a regime change is defined as “a three-point change in the polity score over a period of three years or less” (Polity IV 2010). This score is intended to capture the continuity and stability of the political institutional environment in a home country of an industry. Nations that just recently had a regime change will have less well-functioning and stable institutions than countries that could develop without radical regime changes for a longer period of time.

Election year indicator (Hypothesis 3c)

This variable is an indicator, equal to 1 if either an election of the executive branch or an election of the legislative branch was held during the years allowances were awarded for the respective EU ETS years. The data on election cycles was collected from the World Bank’s Database on Political Institutions (WB 2011).

Number of installations (Hypothesis 1b)

Another variable that will be included in my model is the number of installations covered by the EU ETS for each industry. For the purposes of my analysis I assign to each industry the number of installations it had at the end of the period 2005-2009. Since regulators had to distribute allowances ahead of time and many of the expected new plants are factored into the allocation decision beforehand, I can use this number as a reasonable measure of the size of an industry under the EU ETS.

Control variables

In order to account for possible confounding factors, I will include several important control variables in my model. First, since industries in many of the new EU member countries might exhibit unobservable characteristics that are rooted in their affiliation to the former Soviet bloc (outdated technology, inefficient use of energy etc.), I include a dummy variable to control for such factors. Second, it is reasonable to assume that GDP growth in the home country of an industry might affect its allowance gap through the influence on emissions. Thus, I will use GDP growth as another control variable.

Empirical analysis

My model is specified as follows (equation 1):

$$AG_{ijt} = \alpha + \beta_1 * Legal_{ijtAll} + \beta_2 * ExecId_{ijtAll} + \beta_3 * Durable_{ijtAll} + \beta_4 * Elec_{ijtAll} + \beta_5 * NrInst_i + \delta_t + X_{ijt} + \varepsilon_{ijt}$$

AG_{ijt} is the allowance rent gap of industry i in country j in year t , $Legal_{ijtAll}$ is a set of dummies capturing the legal family in home country j of industry i in the respective year the allowances were allocated for the current year. $Durable_{ijtAll}$ is the durability score of the home country j of industry i in the year allowances were allocated and $Elec_{ijtAll}$ is the indicator capturing whether there was an election in home country j of industry i in the year allowances were allocated. $NrInst_i$ is the number of installations belonging to industry i and δ_t are year effects. X_{ijt} are the control variables mentioned above and ε_{ijt} is the error term. The model will be estimated through a random-effects generalized least squares panel regression.

Results

Descriptive statistics and industry effects

Table 3.1 shows the summary statistics for several of my variables across all observations in the panel. As is evident, the average allowance gap is +14.7%, reflecting an overall allowance surplus from 2005-2009. Table 3.2 shows the pairwise correlations among my dependent variables and multiple independent variables.

Table 3.1: Summary statistics for variables from 2005 to 2009

	Mean	S.D.	Max	75th	Median	25 th	Min	Obs.
Allowances (t of CO₂)	1.19*10 ⁷	3.53*10 ⁷	3.85*10 ⁸	7,240,420	1,990,544	335,436	6,297	835
Emissions (t of CO₂)	1.18*10 ⁷	3.81*10 ⁷	3.80*10 ⁸	6,497,675	1,549,903	277,872	21	835
AG	0.147	0.226	0.100	0.276	0.112	0.016	-1.295	835
Nr. of plants	70	170	1,297	52	10	3	1	835

Table 3.2: Pairwise correlations across the entire panel (star indicates significance at 95% level)

	AG	Nr. plants	Ideology	Durability	Elect.	New memb.	GDP growth
AG	1.00						
Nr. of plants	-0.2696*	1.00					
Ideology	-0.0663	0.0487	1.00				
Durability	-0.1546*	0.0538	0.1630*	1.00			
Election	0.0316	-0.0922*	-0.0681*	-0.1903*	1.00		
New member	0.1956*	-0.1369*	0.0115	-0.6509*	0.1981*	1.00	
GDP growth	-0.0924*	-0.0428	0.0086	-0.1708*	-0.1358*	0.1611*	1.00

In order to examine the variation in the allowance gap across industries and countries in more detail, I calculate the average allowance gap for each year and industry across countries. The plot of these industry averages is shown in Figure 3.1 and Table 3.3 contains the values depicted in Figure 3.1 together with the corresponding standard deviations.

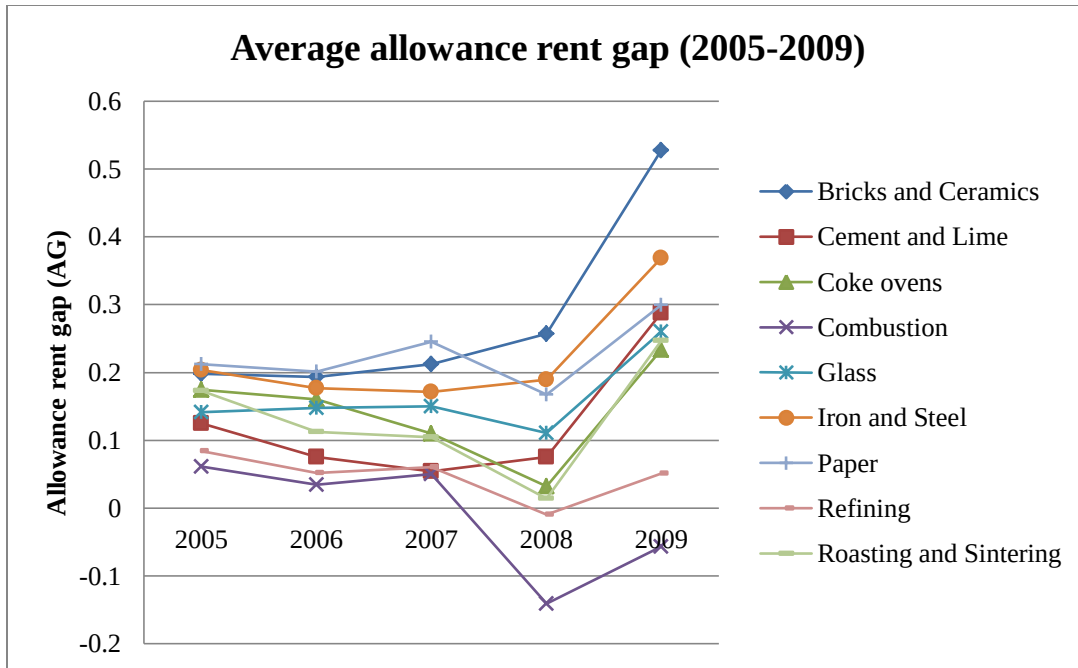


Figure 3.1: Average allowance rent gap by industry (2005-2009)

Table 3.3: Average allowance gap by industry and year

	2005	2006	2007	2008	2009
Bricks and Ceramics	0.1978 (0.1472)	0.1934 (0.1732)	0.2123 (0.2162)	0.2574 (0.1639)	0.5274 (0.2262)
Cement and Lime	0.1249 (0.1336)	0.0752 (0.1260)	0.0543 (0.1401)	0.0753 (0.1129)	0.2879 (0.1291)
Coke ovens	0.1744 (0.1620)	0.1603 (0.2088)	0.1101 (0.2547)	0.0320 (0.3228)	0.2334 (0.3811)
Combustion	0.0608 (0.2190)	0.0343 (0.2106)	0.0501 (0.2054)	-0.1412 (0.2955)	-0.0572 (0.3048)
Glass	0.1418 (0.1521)	0.1480 (0.2177)	0.1500 (0.2344)	0.1108 (0.1178)	0.2602 (0.2020)
Iron and Steel	0.2035 (0.2052)	0.1771 (0.2167)	0.1714 (0.2346)	0.1894 (0.1798)	0.3687 (0.2281)
Paper	0.2119 (0.1937)	0.2012 (0.2104)	0.2454 (0.2348)	0.1677 (0.1652)	0.2993 (0.2392)
Refining	0.0843 (0.1097)	0.0515 (0.0991)	0.0604 (0.1334)	-0.0098 (0.0828)	0.0510 (0.1337)
Roasting and Sintering	0.1727 (0.2263)	0.1123 (0.2146)	0.1048 (0.2732)	0.0139 (0.1677)	0.2467 (0.1351)

Standard errors in parentheses; Numbers shown are rounded;

There is substantial variation in AG across industries and this variation is increasing over time. While in 2005, the allowance gap ranges from 6% (Combustion) to 21% (Paper), in 2009 it ranges from -6% (Combustion) to 53% (Bricks&Ceramics). The fact that the average allowance gap varies across industries seems to indicate that industries differ in their ability to capture economic rents from regulators. A multivariate test for the equality of means of all 9 industry groups confirms that the means are not equal across all industries. Table 3.4 shows the results for the multivariate test of means assuming homogenous variances. Tables 3.5 and 3.6 show the findings, assuming heterogeneous variances (calculated through a Wald-test and Likelihood-ratio test respectively). In all three cases the null hypothesis that the means are equal is rejected.

Table 3.4: Test for equality of group means of all 9 industry groups

	Statistics	F(df1,	df2)	= F	Prob>F
Wilks' lambda	0.8311	8.0	826.0	20.99	0.0000 e
Pillai's trace	0.1689	8.0	826.0	20.99	0.0000 e
Lawley-Hotelling trace	0.2033	8.0	826.0	20.99	0.0000 e
Roy's largest root	0.2033	8.0	826.0	20.99	0.0000 e
e = exact, a = approximate, u = upper bound on F					

Table 3.5: Test for equality of group means of all 9 industry groups, allowing for heterogeneity

Wald chi2(8)	=	175.01	8.0
Prob > chi2	=	0.0000	(chi-squared approx.)
Prob > chi2	=	0.0000	(James' approx.)

Table 3.6: Alternative test for equality of group means of all 9 industry groups, allowing for heterogeneity

LR chi2(8)	=	150.63
Prob > chi2	=	0.0000

Finally, Table 3.7 shows the results of the estimation of industry effects through a Panel GLS regression (Combustion is the omitted variable).

Table 3.7: Estimation of industry effects

	(1) Model 1	(2) Model 2
Bricks and Ceramics	0.2883*** (0.0523)	0.2883*** (0.0524)
Cement and Lime	0.1342*** (0.0472)	0.1342*** (0.0474)
Coke Ovens	0.1527** (0.0817)	0.1527** (0.0819)
Combustion	Omitted	Omitted
Glass	0.1728*** (0.0540)	0.1728*** (0.0541)
Iron and Steel	0.2327 *** (0.059)	0.2327*** (0.0593)
Paper	0.2357*** (0.0572)	0.2357*** (0.0573)
Refining	0.0581 (0.0465)	0.0581 (0.0467)
Roasting and Sintering	0.1407** (0.0686)	0.1407** (0.0688)
Constant	-0.0106 (0.04350)	-0.0104 (0.0436)
<i>Year effects</i>	N	Y
p-Value	0.000	0.000
Wald Chi²	73.81	323.81
Observations	835	835
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a random effects GLS panel regression with robust standard errors		

As can be seen, all sectors apart from Refining exhibit significantly larger allowance surpluses than Combustion. The ranking in terms of size of coefficients on AG is as follows: Bricks and Ceramics, Paper, Iron and Steel, Glass, Coke Ovens, Roasting and Sintering, Cement and Lime, and Combustion. When including year fixed effects as shown in Column 2 of Table 3.7, the results remain robust. The findings in Tables 3.4 to 3.7 provide strong support for Hypothesis 1a, namely that the ability to extract allowance rents from governments differs significantly from industry to industry.

Main results

For estimating the full model as specified in equation (1) I eliminated Luxembourg from the sample as not all relevant variables for that country were available. The results without year effects are shown in Column 1 of Table 3.8.

Table 3.8: Estimation of different specifications of model defined in equation 1

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Common Law	0.1400* (0.0797)	0.1342* (0.0794)	0.1551* (0.0877)	0.1295 (0.0811)
French Civil Law	0.0937*** (0.0334)	0.0903*** (0.0332)	0.0943*** (0.0358)	0.0747* (0.0430)
Scandinavian Law	0.0969** (0.0421)	0.0990** (0.0417)	0.0813* (0.0450)	0.0882* (0.0458)
German Law	Omitted	Omitted	Omitted	Omitted
Number of Plants	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0004*** (0.0001)	-0.0003*** (0.0001)
Ideology of Executive Branch	0.0280** (0.0125)	0.0294** (0.0123)	0.0258** (0.0124)	0.0288** (0.0123)
Stability of Political Institutions	-0.0017* (0.0009)	-0.0016* (0.0009)	-0.0014 (0.0010)	-0.0013 (0.0010)
Election Year	-0.0359 (0.0230)	-0.0278 (0.0222)	-0.0341 (0.0227)	-0.0281 (0.0223)
GDP Growth	-0.0092*** (0.0022)	-0.0014 (0.0039)	-0.0010 (0.0040)	-0.0017 (0.0039)
New EU Member	0.0621 (0.0418)	0.05224 (0.0426)	0.0543 (0.0463)	0.0111 (0.0701)
Δ Emissions _{t-1}			-0.0262*** (0.0068)	
GDP per Capita				0.0000 (0.0000)
Constant	-0.0106** (0.0435)	0.1005* (0.0597)	0.0830 (0.0663)	0.1995 (0.1576)
Year effects	N	Y	Y	Y
p-Value	0.000	0.0000	0.0000	0.0000
Wald Chi²	74.24	324	282.71	324.99
Observations	815	815	652	815

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a random effects GLS panel regression with robust standard errors

The coefficient on the number of plants is negative and significant at the 1%-level, providing strong support for Hypothesis 1b. This indicates, that the more installations an industry has, the lower the allowance rents are it receives. This result is consistent with the predictions of

Olson's theory on collective action (Mitchell and Munger 1991). The coefficients on the Common law, French civil law and Scandinavian legal family are positive and significant at least at the 10-% level (the German legal family is omitted). This provides strong support for Hypothesis 2, namely that the legal tradition in the home country of an industry affects the allocation of allowance rents. The findings show that on average Common law countries seem to award the most generous allowance rents to their industries, followed by countries with Scandinavian law and French Civil law nations (holding all else constant). Countries that have a German legal tradition seem to be the least susceptible to the rent-seeking efforts of interest groups. The ideology of the executive branch also has a positive and significant coefficient, providing strong support for Hypothesis 3a. This seems to imply that more left-leaning governments correlate with larger allowance rents during the allocation process. The coefficient on the political stability score is negative and significant at the 10% level, which provides support for hypothesis 3b. This finding indicates that political institutions that have had more time to develop without political upheaval seem to be more resilient against rent-seeking efforts. The coefficient on the election dummy is not significant in this specification, implying that there is no evidence for Hypothesis 3c. Finally, the control for being a new member state is not significant, while the coefficient on GDP growth is. The direction of the coefficient is negative, because emissions usually rise with economic growth, which in turn affects my allowance rent measure. As can be seen in Column 2 of Table 3.8, the results remain largely robust to the inclusion of year effects.

When controlling for year effects the coefficient on GDP growth loses its significance. This indicates that cross-sectional variation in GDP growth does not influence the allowance gap through its effect on emissions when controlling for temporal variation. This point is further

highlighted in Column 3 of Table 8 where I include the %-change in emissions for an industry from the previous year as additional control. While the coefficient on the Δ in emissions is significant and negative (implying that an increase in emissions leads to a decrease in the allowance gap), the coefficients on my variables of interest remain largely robust (apart from the coefficient on the political stability variable, which loses significance).

Robustness

In order to provide robustness to my results, I would like to address several issues that could pose problems for the validity of my empirical findings. First, I will discuss the mechanisms which can lead to an allowance surplus or shortfall as defined through my rent measure. In my analysis I am assuming that an allowance surplus (a positive AG measure) is the result of an over-allocation on part of the regulator rather than a disproportionate reduction of emissions by the respective industrial sectors. I am arguing that this over-allocation is in turn what allows industries to capture the allowance rents created within the EU ETS. This view is rooted in a strong rent-seeking perspective as postulated by Grossman and Helpman (1994). One main reason for this direction of my argument is that existing evidence in the literature (Ellerman et al. 2010) and interviews with experts on the EU ETS (ExIn) indicate that regulators did in fact over-allocate allowance rents during the allocation process.

However, there is a flip-side to my argument, namely that if my AG measure is positive, it might also be the result of a substantial emissions decrease rather than an over-allocation of allowances. If that were true, then it would imply that the EU ETS actually worked well as a policy tool and led to larger than expected emissions reductions by certain sectors. There are a few factors which make this an unlikely scenario. As can be seen in Table 3.1, there was an allowance surplus across all sectors and countries from 2005 to 2009. A closer look also reveals that average yearly emissions across all industries and countries for 2005 to 2009 were as

follows: 12 million tons of CO₂ (2005), 12.2 million tons of CO₂ (2006), 12.3 million tons of CO₂ (2007), 11.9 million tons of CO₂ (2008) and 10.6 million tons of CO₂ (2009). This indicates that from 2005 to 2007 average emissions even increased across all sectors and across all countries and only started to fall slightly in 2008 and 2009 (very likely because of the recession).

If the EU ETS as a policy tool had achieved substantial emissions reductions across sectors and countries, emissions should have fallen steadily since 2005. Furthermore, the fact that the coefficient on GDP growth loses significance when year effects are included indicates that cross-country differences in economic growth do not seem to drive the observed variation in my allowance rent measure. Since GDP growth affects emissions directly, this finding provides support for the mechanism I am focusing on in my analysis, namely that differences in the allocation of allowances by national regulators rather than differences in emissions among countries seem to be responsible for the variation in the allowance gap across different political systems. In addition, the over-allocation argument seems to be more probable from a theoretical point of view as well. Let us assume that a sector has a positive AG rent measure as a result of reducing emissions for the entire sector below the allowance cap rather than because of over-allocation. In that case, it would imply that on average all firms and installations in this sector must have had lower marginal abatement costs than the prevalent allowance price. Otherwise it would not have been optimal for them to reduce emissions below their allocated cap. Given the large heterogeneity of firms and production technologies even within the same industrial sector, this scenario is improbable. All in all, the empirical and theoretical arguments described above, lead me to believe that an over-allocation rather than an emissions-reduction interpretation is more likely.

Another issue I would like to address is the problem of unobserved heterogeneity within my analysis. One advantage of the independent variables I chose is that most of them are given exogenously. The electoral cycle, the stability of the political institutions and the prevalent legal tradition are all determined by factors independent of the EU ETS. However, in order to address possible issues of unobserved heterogeneity, I also estimate a limited model of equation 1, by including country-industry fixed effects and by only examining those variables from my model that change over time. The inclusion of fixed effects controls for unobservable characteristics of my country-industry pairs. This specification will allow me to examine the robustness of my findings for time-variant variables⁴¹. The results are shown in Table 3.9.

Table 3.9: Estimation of fixed-effects model

	(1) Model 1	(2) Model 2
Ideology of Executive Branch	0.0503*** (0.0148)	0.0473*** (0.0149)
Stability of Political Institutions	-0.0108 (0.0095)	-0.0069 (0.0099)
Election Year	-0.0412* (0.0238)	-0.0482** (0.0239)
GDP Growth	-0.0111*** (0.0028)	-0.0107*** (0.0028)
$\Delta \text{Emissions}_{t-1}$		-0.0352*** (0.0071)
Constant	0.5261 (0.3827)	0.3763 (0.3986)
p-Value	0.0000	0.0000
F	9.58	16.26
Observations	815	652
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level; Standard errors in parentheses; Numbers shown are rounded; Results obtained through a fixed-effects panel regression with robust standard errors		

Column 1 shows the fixed effects model including my measures for the ideology of the executive branch, the political stability and the election cycle. In Column 2 the change in emissions is added as additional control and GDP growth is included in both models. As can be

⁴¹ This robustness check will not, however, allow me to validate my results for the variables that are absorbed by the country-industry fixed effects (i.e. the time invariant variables).

seen in Table 3.9, the ideology remains positive and significant, with the coefficient slightly larger than in the random effects specification. The measure of political stability is not significant, which can be attributed to how that variable is constructed. It measures the number of years between the last major political upheaval in a country and the year allowances were allocated. Since the inclusion of fixed effects takes out the variation across countries, it is to be expected that the coefficient will lose its significance. Interestingly, when controlling for all cross-sectional variation, the election year indicator is negative and significant, indicating that during an election year allowance rents were lower than during non-election years. This seems to imply that rent-seeking demands on politicians might be more dispersed during an election year, making them less likely to cater to the rent-seeking demands by specific interest groups. While the fixed effects model has obvious limitations, it confirms that the ideology of the executive seems to have played a role in the allowance allocation process.

Another issue that I would like to address is that the prevalent legal tradition in a country and the stability of political institutions could be related to the GDP per capita of a country. Richer countries might have a better developed political institutional environment. In order to test for this possibility, I include the GDP per capita during the allowance allocation as additional control variable for my original random effects model (shown in Table 3.8 - Column 4). The coefficient on GDP per capita is not significant, indicating that the economic performance of a country did not have an impact on my rent measure. The countries with French and Scandinavian legal families still show significantly different rents from nations with the German legal tradition. The coefficient on the ideology of the executive remains positive and significant, but the coefficient on the stability of political institutions loses significance. The election year indicator is not significant, similar to previous random effects specifications.

Discussion and outlook

This study examines rent-seeking efforts related to environmental regulation in order to investigate whether they follow similar patterns as described in the literature on trade protection or agricultural support. Using the unique and novel empirical setting of the European Union Emissions Trading Scheme (EU ETS), I analyze the influence of country-specific political characteristics on the allowance rents received by industries in the European Union. First, I find strong support for Hypothesis 1a, namely that there are significant differences in the allocation of allowance rents to different industrial sectors. Some sectors were able to obtain larger allowance rents than others, demonstrating that industries in the EU ETS were treated differently by governments during the allocation process. This finding confirms that rent-seeking efforts by interest groups within climate change regulations seem similar to rent-seeking processes related to trade protection or agricultural support.

Second, I find strong support for Hypothesis 1b that the number of plants within an industry influences the allowance rents received by that industry negatively. This is a clear empirical validation of Olson's collective action theory for rent-seeking by interest groups, which predicts that more concentrated industries will overcome collective action problems more easily and therefore be more successful in their rent-seeking efforts (Mitchell and Munger 1991). Finally, the empirical evidence related to the influence of institutional and political characteristics is mixed. I find strong support for Hypothesis 2 that the legal tradition within a country influences the distribution of allowance rents in the EU ETS. Countries that follow a German law tradition provide lower allowance rents to their industries than countries with Common, French civil, or Scandinavian legal tradition respectively. This finding is robust to the inclusion of several additional control variables. The strong result for the Germanic legal family

seems to indicate that there is something inherent to the legal system of those countries, which makes regulators less susceptible to rent-seeking efforts. It could be the structure of the legal system or the way Germanic law channels rent-seeking efforts by different groups. Another possible explanation might be that there is something in the German culture itself that drives my results. Future research efforts will be focused on identifying the underlying mechanisms in more detail.

I also find strong support for Hypothesis 3a. Left-leaning governments are more likely to be susceptible to rent-seeking efforts by industries during allowance allocation than centrist or right-leaning governments. This result is robust when including additional control variables and when estimating a fixed-effects model. For Hypothesis 3b I only find weak support. Stable political institutions in a country might lead to lower allowance rents as these institutions seem to be less susceptible to rent-seeking efforts. However, this result is not robust to the inclusion of additional control variables. Finally, in the main specification of my model, I do not find evidence for Hypothesis 3c that the electoral cycle influenced the distribution of emissions allowances. A theoretical explanation for this result might be that during an election, politicians need to gather a support base that is as broad as possible and they do not want to be seen as catering to interest groups. This finding is different from evidence in the literature on agricultural support where elections do seem to matter (Thies and Porche 2007), possibly explained by the fact that environmental regulation is an issue that is usually more broadly visible in the public sphere.

The empirical results obtained in my paper have several implications. First, rent-seeking efforts do seem to play a role in the distribution of emissions allowances in cap-and-trade programs. The uneven allocation of allowances across industries and the influence of political

characteristics on the allowance rents to industries show that climate change regulation creates additional “rents” that are pursued by interest groups (as proposed by Mueller 2003). The traditional focus of the rent-seeking literature on trade protection and agricultural support might therefore be expanded onto environmental regulations as those programs become more important.

Second, in light of the fact that more countries are planning to implement similar trading schemes, these rent-seeking processes should be taken into consideration during the distribution of allowances to avoid undermining the effectiveness of these policies. One of the main theoretical arguments for using cap-and-trade as a policy tool (as compared to a carbon tax, for example) is that it provides the most cost-effective and efficient emissions reductions. However, these theoretical models usually do not account for rent-seeking efforts which can cause additional welfare losses for society (Mueller 2003). Hence, for policy makers wanting to regulate the emissions of greenhouse gases, a more thorough understanding is required of how socially wasteful rent-seeking efforts and the ensuing skewed allowance allocation outcome might affect the economic impacts of the cap-and-trade programs. This is particularly relevant when it comes to the choice of awarding allowances for free or auctioning them off. Through the use of auctioning, many of the rent-seeking efforts could be easily neutralized.

Finally, the novelty and unprecedented scope of the EU ETS make it an ideal setting for future research efforts on the political economy of climate change regulations, especially as more data from the program becomes available. This provides exciting avenues for possible future research in that subject area.

References

- Acemoglu, Daron, Simon Johnson and James A. Robinson. 2001. "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review* v91, n5 (December): 1369-1401.
- Aizenman, Joshua. 1992. "Exchange Rate Flexibility, Volatility and the Patterns of Domestic and Foreign Direct Investment." *Working Paper No. 3953*. National Bureau of Economic Research.
- Amadeus. 2011. Data provided through the Amadeus database, an online business information product of Bureau van Dijk. ("Amadeus"), accessed July-December 2011.
- Baron, David P. 1995. "Integrated Strategy: Market and Nonmarket Components." *California Management Review* 37 (2): 47-65.
- BBC News. 2012. "WTO confirms Boeing subsidies illegal." British Broadcasting Corporation News Web site. <http://www.bbc.co.uk/news/business-17345903>, accessed April 2012.
- Beghin, John C. and Mylene Kherallah. 1994. "Political Institutions and International Patterns of Agricultural Protection." *Review of Economics and Statistics* 76: 482-489.
- Bluenext. 2011. "Statistics." Bluenext Web site. <http://www.bluenext.eu/statistics>, accessed August 2011.
- Brooks, Jonathan C., A. Colin Cameron, and Colin A. Carter. 1998. "Political Action Committee Contributions and U.S. Congressional Voting on Sugar Legislation." *American Journal of Agricultural Economics* 80: 441-454.
- Carbon Market Data (CMD). 2010. *EU ETS World Database*, accessed November 2010.
- Carbon Market Data (CMD). 2011. *EU ETS Installation and Company Database*, accessed April-December 2011.
- Carbon Market Data (CMD). 2012. *EU ETS Installation and Company Database*, accessed January-May 2012.
- Caves, Richard. 1996. *Multinational Enterprise and Economic Analysis*. Second Edition. New York: Cambridge University Press.
- Caves, Richard. 2007. *Multinational Enterprise and Economic Analysis*. Third Edition. New York: Cambridge University Press.
- Chang, Sea Jin and Jaebum Hong. 2002. "How much does the business group matter in South Korea." *Strategic Management Journal* 23 (3): 265-274.

- Chase, Kerry. 2003. "Economic Interests and Regional Trading Arrangements: The Case of NAFTA." *International Organization* 57: 1 (Winter), pp. 137-74.
- Christmann, Petra, Diana Day and George S. Yip. 1999. "The relative influence of country conditions, industry structure, and business strategy on multinational corporation subsidiary performance." *Journal of International Management* 5: 241-265.
- CIA World factbook. 2010. "The World Factbook." Central Intelligence Agency Web site. <https://www.cia.gov/library/publications/the-world-factbook/index.html>, accessed December 2010.
- Community Independent Transaction Log (CITL). 2011. "Community transaction log." European Commission Web site. <http://ec.europa.eu/environment/ets/welcome.do?languageCode=en>, accessed May-December 2011.
- Community Independent Transaction Log (CITL). 2012. "Community transaction log." European Commission Web site. <http://ec.europa.eu/environment/ets/welcome.do?languageCode=en>, accessed January-May 2012.
- Davis, Christina. 2004. "International Institutions and Issue Linkage: Building Support for Agricultural Trade Liberalization." *American Political Science Review* 98:153-169.
- De Figueiredo, John M. and Brian S. Silverman. 2006. "Academic Earmarks and the Returns to Lobbying." *Journal of Law and Economics* 49 (2), (October): 597-626.
- EIU. 2011. Economist Intelligence Unit Database. www.eiu.com. accessed January to July 2011.
- Ellerman, Denny A., Barbara K. Buchner and Carlo Carraro (eds.). 2007. *Allocation in the European Emissions Trading Scheme – Rights, Rents and Fairness*. New York: Cambridge University Press.
- Ellerman, Denny A., Frank J. Convery and Christian de Perthuis. 2010. *Pricing Carbon – The European Union Emissions Trading Scheme*. New York: Cambridge University Press.
- Environmental Protection Agency (EPA). 2011a. "Carbon Dioxide." EPA Web site. <http://www.epa.gov/climatechange/emissions/co2.html>, accessed September 2011.
- Environmental Protection Agency (EPA). 2011b. "Climate Change." EPA Web site. <http://www.epa.gov/climatechange/index.html>, accessed September 2011.
- Erickson, Merle, Austan Goolsbee and Edward Maydew. 2002. "How prevalent is tax arbitrage? - Evidence from the market for municipal bonds." *NBER Working Paper Series*, no 9105, August.

- European Commission. 2011a. "Emissions Trading System (EU ETS) – Policy." "European Commission Web site. http://ec.europa.eu/clima/policies/ets/index_en.htm, accessed September 2011.
- European Commission. 2011b. "What are EU Directives?" "European Commission Web site. http://ec.europa.eu/eu_law/introduction/what_directive_en.htm, accessed September 2011.
- European Court of Justice Ruling (ECJ). 2011. *Vorläufiger Rechtsschutz – Umwelt – Kostenlose Zuteilung von Treibhausgasemissionszertifikaten aufgrund der Richtlinie 2003/87/EG – Festlegung der zuteilungsrelevanten Produkt-Benchmarks durch Beschluss der Kommission – Antrag auf einstweilige Anordnung – Zulässigkeit – Dringlichkeit*. European Court of Justice Web site. <http://curia.europa.eu/juris/document/document.jsf?text=&docid=109641&pageIndex=0&doclang=DE&mode=doc&dir=&occ=first&part=1&cid=315054>, accessed April 2012.
- European Union Directive 2003/87/EC. *Directive 2003/87/EC of the European Parliament and of the Council*. Official Journal of the European Union, October 2003.
- European Union. 2011. "Key dates in the history of European Integration." European Union Web site. http://europa.eu/abc/12lessons/key_dates/index_en.htm, accessed January 2011.
- Expert Interviews (ExIn). Interviews with experts, regulators and market participants within the EU ETS. Conducted in 2011 and 2012.
- Fisman, Raymond. 2001. "Estimating the Value of Political Connections." *American Economic Review* 91: 1095-1102.
- Foley, C. Fritz, Malcolm Baker and Jeffrey Wurgler. 2009. "Multinationals as Arbitrageurs? The Effect of Stock Market Valuations on Foreign Direct Investment." *Review of Financial Studies*, 22, no. 1: pp. 337-369.
- Grossman, Gene and Elhanan Helpman. 1994. "Protection for Sale." *American Economic Review* 84 : 833-850.
- Hansen, Fay. 2005. "Global labor arbitrage resets wages." *Business Finance* 11 (4): 7-10.
- Hawawini, Gabriel, Venkat Subramanian and Paul Verdin. 2003. "Is performance driven by industry- or firm-specific factors? A new look at the evidence." *Strategic Management Journal* 24 (1): 1-16.
- Henisz, Witold J., Sinziana Dorobantu and Lite Nartey. 2011. "Spinning Gold: The Financial and Operational Returns to External Stakeholder Engagement". *Working Paper*.
- Helpman, Elhanan. 1985. "Multinational Corporations and Trade Structure." *The Review of Economic Studies*, Vol. 52, No. 3 (Jul.), pp. 443-457.
- Hodder, James E. and Lemma W. Senbet. 1990. "International Capital Structure Equilibrium." *The Journal of Finance*, Vol. 45, No. 5 (Dec.), pp. 1495 – 1516.

- Hymer, Stephen. 1960. *The International Operations of National Firms: A Study of Direct Foreign Investment*. Cambridge: MIT Press (published in 1976).
- Jaraite, J., F. Convery and C. Di Maria. 2009. "Transaction Costs of Firms in the EU ETS." *Working Paper, UCD*, accessible at http://irserver.ucd.ie/dspace/bitstream/10197/2077/1/dimariac_confpap_014.pdf.
- Jensen, Nathan. 2003. "Democratic Governance and Multinational Corporations: The Political Economy of Foreign Direct Investment." *International Organization* 57: 3 (Summer):587-616.
- Khanna, Tarun and Jan W. Rivkin. 2001. "Estimating the Performance Effects of Business Groups in Emerging Markets." *Strategic Management Journal* 22 (1): 45-74.
- King, Gary, Matthew Blackwell, Stefano Iacus and Giuseppe Porro. 2009. "cem: Coarsened exact matching in Stata." *The Stata Journal* 9, no. 4: 524-546.
- Knickerbocker, Frederick T. 1973. *Oligopolistic Reaction and the Multinational Enterprise*. Cambridge: Harvard University Press.
- Kogut, Bruce. 1983. "Foreign Direct Investment as a Sequential Process." In *The Multinational Corporation in the 1980s*, edited by Charles Kindleberger and David Andretsch. Cambridge: MIT Press.
- La Porta, Rafael, Florencio López-de-Silanes, Andrei Shleifer, and Robert Vishny. 1997. "Legal Determinants of External Finance." *Journal of Finance* 52: 1131-1150.
- La Porta, Rafael, Florencio López-de-Silanes, Andrei Shleifer, and Robert Vishny. 1998. "Law and Finance." *Journal of Political Economy* 106: 1113-1155.
- Lessard, Donald R. 1986. "Finance and Global Competition: Exploiting Financial Scope and Coping with Volatile Exchange Rates." in Michael E. Porter (ed.), *Competition in Global Industries*. Boston: Harvard Business School Press. 147-184.
- Li, Quan and A. Resnick. 2003. "Reversal of Fortunes: Democratic Institutions and Foreign Direct Investment Inflows to Developing Countries." *International Organization* 57:1 (Winter): 175-211.
- Lipsey, Robert E. and Irving B. Kravis. 1986. "The Competitiveness and Comparative Advantage of U.S. Multinationals, 1957-1983." *NBER Working Paper Series*, no 2051, October.
- Lütken, Soren Ender and Axel Michaelowa. 2008. *Corporate Strategies and the Clean Development Mechanism*. Cheltenham: Edward Elgar Publishing Limited.
- Magee, Stephen P., William A. Brock, and Leslie Young. 1989. *Black Hole Tariffs and Endogenous Policy Theory: Political Economy in General Equilibrium*. Cambridge: Cambridge University Press.

- Mansanet-Bataller, Maria, Julien Chevallier, Morgan Herve-Mignucci and Emilie Aberola. 2010. "The EUA-CER Spread: Compliance Strategies and Arbitrage in the European Carbon Market." *Mission Climat Working Paper*, Nr 2010-6.
- Makino, Shige, Takehiko Isobe and Christine M. Chan. 2004. "Does Country Matter?" *Strategic Management Journal* 25 (10): 1027-1043.
- Maurer, Noel. 2011. "The Empire Struck Back: Sanctions and Compensation in the Mexican Oil Expropriation of 1938." *Journal of Economic History* 71, no. 3 (September): 590 - 615.
- McCormick, Robert E., and Robert D. Tollison. 1981. *Politicians, Legislation, and the Economy*. Boston: Martinus Nijhoff, 1981.
- McGahan, Anita M. 1998. *The performance of U.S. corporations: 1981–1994*. Harvard Business School mimeo.
- McGahan, Anita M. and Michael E. Porter. 1997. "How Much Does Industry Matter, Really?" *Strategic Management Journal* 18 (Summer Special Issue): 15-30.
- Milner, Helen. 2002. "International Trade." Handbook of International Relations. Carlsnaes, Risse, and Simmons, eds., pp. 448-461.
- Mitchell, William and Michael Munger. 1991 "Economic Models of Interest Groups: An Introductory Survey." *American Journal of Political Science* 35 (May): 512-546.
- Mueller, Dennis. 2003. *Public Choice III*. New York: Cambridge University Press.
- National Allocation Plan Austria. 2004. "Nationaler Zuteilungsplan fuer Oesterreich gemaess §11 EZG – endg." Bundesministerium fuer Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, December 2004.
- NATO. 2012. "NATO Enlargement – Accession timetable." NATO Web site. http://www.nato.int/docu/enlargement/html_en/enlargement03.html, accessed April 2012.
- Naumann-Etienne, Ruediger. 1974. "A Framework for Financial Decisions in the Multinational Corporations: Summary of Recent Research." *The Journal of Financial and Quantitative Analysis*. Vol. 9, No. 5, 1974 Proceedings: 859-874.
- Nazifi, Fatemeh. 2010. "Modelling the price spread between EUA and CER Carbon prices." Available at SSRN: <http://ssrn.com/abstract=1691916>.
- New York Times (NYT). 2010. "CDM Critics Demand Investigation of Suspect Offsets." Article on the New York Times Web site. <http://www.nytimes.com/cwire/2010/06/14/14climatewire-cdm-critics-demand-investigation-of-suspect-63522.html?pagewanted=all>, accessed April 2012.
- Olson, Mancur Jr. 1965. *The Logic of Collective Action*. Cambridge: Harvard University Press.

- OneSource. 2011. Data provided by OneSource® Business BrowserSM, an online business information product of OneSource Information Services, Inc. (“OneSource”), accessed July-December 2011.
- Open Secrets (OS). 2012a. “Top Lobbying Spending.” Center for Responsive Politics Web site. <http://www.opensecrets.org/lobby/index.php>, accessed April 2012.
- Open Secrets (OS). 2012b. “Lobbying – Top Spenders.” Center for Responsive Politics Web site. <http://www.opensecrets.org/lobby/top.php?showYear=2010&indexType=s>, accessed April 2012.
- Open Secrets (OS). 2012c. “Lobbying – Top Issues.” Center for Responsive Politics Web site. <http://www.opensecrets.org/lobby/top.php?indexType=u>, accessed April 2012.
- Orbis. 2011. Data provided through the Orbis database, an online business information product of Bureau van Dijk. (“Orbis”), accessed July-December 2011.
- Peteraf, Margaret A. 1993. “The Cornerstones of Competitive Advantage: A Resource-Based View.” *Strategic Management Journal* 14 (3): 179-191.
- Polity IV. 2010. Polity IV Project Database. Polity IV Project Web site. <http://www.systemicpeace.org/polity/polity4.htm>, accessed December 2010.
- Rangan, Subramanian. 1999. “Do Multinationals Shift Production in Response to Exchange Rate Changes?” in Dennis J. Encarnation (ed.), *Japanese Multinationals in Asia – Regional Operations in Comparative Perspectives*. New York: Oxford University Press.
- Rautaruukki. 2008. *Rautaruukki Corporation Annual Report 2008*. Rautaruukki.
- Roquebert, Jaime A., Robert L. Phillips and Peter A. Westfall. 1996. “Markets vs. Management: What ‘drives’ profitability?” *Strategic Management Journal* 17 (8): 653-664.
- Rumelt, Richard P. 1991. “How Much Does Industry Matter?” *Strategic Management Journal* 12 (3): 167-185.
- Schmalensee, Richard. 1985. “Do Markets Differ Much?” *American Economic Review* 75 (3): 341-351 (1).
- Siegel, Jordan I. 2007. “Contingent Political Capital and International Alliances: Evidence from South Korea.” *Administrative Science Quarterly* 52, no. 4 (December): 621 - 666.
- Thies, Cameron and Schuyler Porche. 2007. “The Political Economy of Agricultural Protection.” *Journal of Politics* 69 (1), 116-27.
- United Nations Framework Convention on Climate Change (UNFCCC). 2011a. “Feeling the heat” UNFCCC Web site. http://unfccc.int/essential_background/feeling_the_heat/items/2918.php, accessed September 2011.

- United Nations Framework Convention on Climate Change (UNFCCC). 2011b. “CDM Registry” UNFCCC Web site. <http://cdm.unfccc.int/Registry/index.html>, accessed September 2011.
- United Nations Framework Convention on Climate Change (UNFCCC). 2011c. “CDM Project Cycle”. UNFCCC Web site. <http://cdm.unfccc.int/Projects/diagram.html>, accessed September 2011.
- United Nations Framework Convention on Climate Change (UNFCCC). 2011d. “Kyoto Protocol”. UNFCCC Web site. http://unfccc.int/kyoto_protocol/items/2830.php, accessed September 2011.
- United States Marshals Service (USM). 2012. “U.S. Marshals role during prohibition.” U.S. Marshals Web site. <http://www.usmarshals.gov/history/prohibition/index.html>, accessed April 2012.
- UNEP-Riso Centre (UNEP). 2011. “CERs-CDM Pipeline spreadsheet”. UNEP Riso CDM/JI Pipeline Analysis and Database. <http://cdmpipeline.org/cers.htm>, accessed August 2011.
- Vernon, Ray. 1966. “International Investment and International Trade in the Product Cycle.” *Quarterly Journal of Economics* 83(2): 190-207.
- Walker, Gordon, Tammy L. Madsen and Gary Carini. 2002. “How does institutional change affect heterogeneity among firms?” *Strategic Management Journal* 23 (2): 89-104.
- World Bank. 2011. Database of Political Institutions. The World Bank., accessed January to June 2011.
- Yip, George S. 1991. “A performance comparison of continental and national business in Europe” *International Marketing Review* 8 (2): 31-39.