Carbon Markets, Carbon Prices and Innovation: Evidence from Interviews with Managers*

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December 2012, Preliminary

Abstract

Based on a unique dataset derived from interviews with managers of 770 manufacturing firms in six European countries, we construct a firm level indicator of climate change related innovation and econometrically estimate the impact of the EU Emissions Trading System (EU ETS) on such innovation. We find that the majority of firms in our sample engage in climate change related innovation, and that this effort is mainly focused on process innovation rather than product innovation. There are significant differences in the propensity to innovate across countries, even after controlling for differences in industrial structure. Further, we find that firms expecting less generous allocations of free permits in the third phase of the EU ETS tend to innovate more. We devise a regression discontinuity design to explore the causal effect underlying this correlation. We find a discrete drop in innovation effort around thresholds set by the EU Commission which exempt both carbon intensive and trade exposed industries from permit auctions. This suggests that allocating permits for free causes a reduction in clean innovation. This contradicts the "independence hypothesis" of emissions trading whichstates that the initial allocation of permits has no effect on firm behaviour.

JEL Classification: D22, O31, Q48, Q54

*The authors thank Morgan Bazilian and Karsten Neuhoff as well as seminar participants at the LSE and the EAERE and AERE conference for useful comments and suggestions. The authors gratefully acknowledge financial support from the British Academy (Martin), from the Leverhulme Trust (Muûls) and from the Spanish government, reference numbers SEJ2007-62908 and ECO2012-31358 (Wagner).

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1 Introduction

In advanced economies, the industrial sector is directly responsible for about a third of greenhouse gas (GHG) emissions (IEA, 2009). Understanding the drivers and barriers that affect company behavior related to climate change is therefore essential to design effective policies for reducing emissions, which aim to prevent dangerous levels of global warming. "Clean" innovation is critical for achieving the transition to a low-carbon economy, and private-sector firms are key players when it comes to investments in research and development (R&D). The relationship between "clean" R&D investments and climate change policy becomes all the more relevant if the fruits of these investments spill over across international borders and help to reduce emissions in countries with few or no climate change policies. Currently, some view this possibility as the main justification for European climate change policy, given that EU emissions reductions alone would not be sufficient to prevent dangerous global climate change from occurring.

To date, the empirical evidence on what firms are doing (or not) to curb GHG emissions is rather limited.[1] This paper examines the link between climate change regulation, investment and innovation, using detailed survey data for a representative sample of firms. The data were collected by interviewing managers on climate-change and energy related issues using a novel method that circumvents various types of bias that plague more traditional survey formats. Between August and October 2009, we collected data on approximately 800 manufacturing firms in six European countries using this approach.

Based on this dataset, we obtain a number of new descriptive results on climate friendly innovation. We find that most firms (70% of the sample) engage in what we call "clean process innovation" – formal or informal R&D aimed at curbing emissions and/or energy consumption. A smaller proportion (40%) is also pursuing "clean product innovation"; i.e. R&D aimed at developing products that can help customers to reduce their emissions. There are significant differences between countries when it comes to clean innovation. According to our study, most active on product innovation is Germany whereas process innovation is highest in France. The lowest levels of innovative activities are observed in Hungary and Poland. Also, this study shows that firms expect carbon prices to be considerably higher in the future, compared with current levels in the EU ETS. We find an average expected carbon price of €40 for the post-2012 trading period. Compared to the current

[1] See Martin, Muûls, and Wagner (2012c) for a comprehensive survey of the empirical evidence to date.

trading period (Phase II, from 2008 to 2012), firms expect the imposition of tighter caps for Phase III, starting in 2013. The proportion of firms reporting that their allowance allocation does not place a binding limit on their emissions falls from 40% in Phase II to less than 10% in Phase III.

Apart from descriptive statistics, we use regression analysis to analyze the relationship between climate policy and innovation. We provide two pieces of evidence in support of a causal link between company-specific caps – i.e. the amount of allowances companies receive for free in the EU ETS – and "clean" R&D by firms. First, we find that "clean" innovation is positively associated with the expectations firms hold about the future stringency of their cap. This relationship is robust to including a broad range of control variables.

Second, we find that firms within the EU ETS which are just below the thresholds established for free allowances are engaging more strongly in climate change related innovation than firms that are just above the threshold (and thus will continue to receive free allowances). There is a discontinuity in both expected stringency as well as "clean" innovation at the thresholds that are implied by the latest set of criteria that the European Commission has proposed for allocating free emissions allowances after 2012.[2] This result suggests that the ongoing practice within the EU ETS, of generously allocating allowances for free to manufacturing industries leads to less innovation than would otherwise be the case.

The remainder of this paper is organized as follows: Section 2 describes the process of interviewing managers about various aspects of company behavior related to climate change. Section 3 provides summary statistics of our innovation measures as well as regarding future expectations. Section 4 examines the link between innovation, future expectations and climate policy. Section 5 concludes.

2 Interviewing managers

2.1 Interview Methodology

Our survey builds upon and substantially extends previous work on climate change policies and management practices (Martin, Muûls, De Preux, and Wagner, 2012a). We conduct structured telephone interviews with managers at randomly selected

[2]The Commission takes this decision for each sector based on its carbon intensity and trade exposure. Section @ explains this in more detail.

manufacturing facilities in Belgium, France, Germany, Hungary, Poland and the UK. The interview setup follows the management survey design pioneered by Bloom and van Reenen (2007), in that the interviewer engages interviewees in a dialogue with open questions that are meant not to be answered by "yes" or "no". On the basis of this dialogue, the interviewer then assesses and ranks the company along various dimensions. Note that interviews follow a a "double-blind" setup: interviewees do not know that the interviewers are scoring their answers and interviewers do not know performance characteristics of the firm they are interviewing. This interview format is designed to avoid several sources of bias common in conventional surveys (Bertrand and Mullainathan, 2001). For instance, experimental evidence shows that a respondent's answers can be manipulated by making simple changes to the ordering of questions, to the way questions are framed, or to the scale on which respondents are supposed to answer. By asking open-ended questions and by delegating the task of scoring the answers to the interviewer, we seek to minimize cognitive bias of this type. Possible cognitive bias on the part of the interviewers can be controlled for using interviewer-fixed effects in the regression analyses. Another common observation with survey data is that respondents are tempted to report attitudes or patterns of behavior that are socially desirable but may not reflect what they actually think and do. This problem may be exacerbated in situations where respondents do not have a definite attitude toward the issues they are asked about but are reluctant to admit that. Our research design addresses this issue in two ways. First, the interviewer starts by asking an open question about an issue and then follows up with more specific questions, or asks for some examples in order to evaluate the respondent's answer as precisely as possible. Second, the results of the interviews are then linked to independent data on economic performance, as a validation exercise.

2.2 Interview Practice

Using the ORBIS database maintained by Bureau Van Dijk we obtained contact details for 44,605 manufacturing firms in Belgium, France, Germany, Hungary, Poland and the UK[3]. We randomly selected companies from that list to solicit an interview. To ensure sufficient coverage of firms subject to the EU ETS (hereafter, EU ETS firms), we also sampled manufacturing firms at random from the Community Independent Transaction Log (CITL) in these countries. Interviewers made "cold calls" to production facilities (not head offices), gave their name and affiliation with the

[3]For more details on the survey, see Anderson et al. (2011)

Table 1: Interview response rates by country

	# of Interviews	# of Firms Interviewed	# of ETS Firms Interviewed	# of Non ETS Firms Interviewed	Total Firms Contacted	Refused	Response Rate
Belgium	134	131	85	46	178	47	0.74
France	141	140	92	48	238	98	0.59
Germany	139	138	95	43	337	199	0.41
Hungary	69	69	37	32	90	21	0.77
Poland	78	78	57	21	140	62	0.56
UK	209	205	63	142	468	264	0.44
Total	770	761	429	332	1451	691	0.52

Notes: There are more interviews than interviewed firms as we conducted several interviews with different partners in a small number of firms.

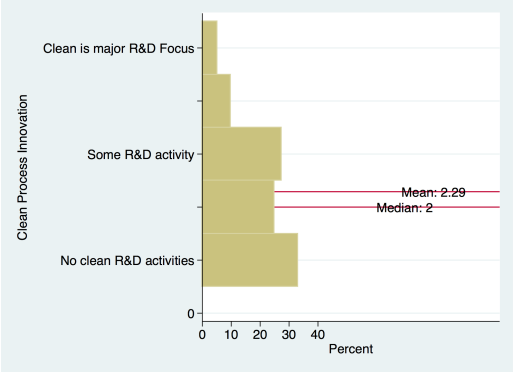
London School of Economics and then asked to be put through to the environmental manager. In the case of EU ETS firms, interviewers asked for the person responsible for the EU ETS, as it is listed in the CITL. Table 1 reports the number of calls made and various statistics about the response rates.

An ordinal scale of 1 to 5 was adopted to measure various management practices related to climate change. For each aspect of management ranked in this way, interviewers were instructed to ask a number of open questions. Questions were ordered such that the interviewer started with a fairly open question about a topic and then probed for more details in subsequent questions, if necessary. The goal was to benchmark the practices of firms according to common criteria. For instance, rather than asking the manager for a subjective assessment of the management's awareness of climate-change issues, we gauged this by how formal and far-reaching the discussion of climate-change topics is in current management. To verify the consistency of the interviewer's scoring, a subset of randomly selected interviews was double-scored by a second team member who listened in.

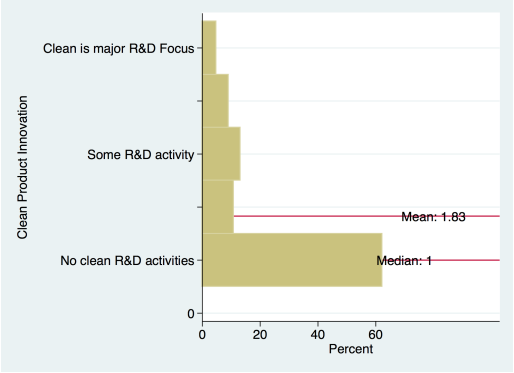
The questionnaire is divided in four sections (cf. Appendix B). The first section examines the current and anticipated future effects of the EU ETS. The second section deals with prices for energy and CO_2, competition and other external drivers of climate-change related management practices. The third section inquires about specific measures that were adopted by firms and others which were considered but eventually discarded. The last section gathers information on relevant company characteristics.

Figure 1: Distribution of the Clean Innovation Scores

(a) Clean Process Innovation



(b) Clean Product Innovation



Notes: The figures show a histogram of the scores for each of the two types of clean innovation reported by interviewed firms.

3 Descriptive evidence from interviewing managers

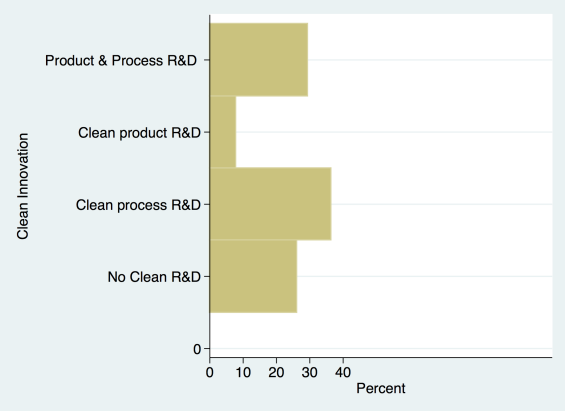
3.1 Clean Innovation

Innovation is an important path for firms to reduced GHG emissions abatement. On the one hand, a company can invest into finding cleaner production processes which help to reduce emissions on site. On the other hand, the company can develop new products that are cleaner and thereby reduce emissions of the customer. Figure 1 shows the distribution of the interview scores for clean process and product innovation.[4] An example of a clean *process* innovation is the development of a less energy-consuming way to transform limestone into quicklime. An example of clean *product* innovation is the invention of a new tyre with which cars consume less petrol. We find that almost 70% of firms are engaging in some form of clean process innovation, but less than 40% engage in clean product innovation. Figure 2 shows that clean product innovation is more likely to occur in firms that are also conducting clean process innovation.

Figure 3 examines whether there are differences in clean innovation between countries in our sample. There is clearly a gap between Western and Central/Eastern European countries, with Poland and Hungary lagging behind, both in terms of process and of product R&D. France emerges as the leader in clean process innova-

[4]The clean process and product innovation measures are throughout this paper taken from the survey responses and we hereafter use interchangeably the term innovation and R&D.

Figure 2: The relative frequency of clean process and product innovation



Notes: The figure shows a histogram of the types of clean innovation reported by interviewed firms.

Table 2: Sectors according to their focus on clean innovation

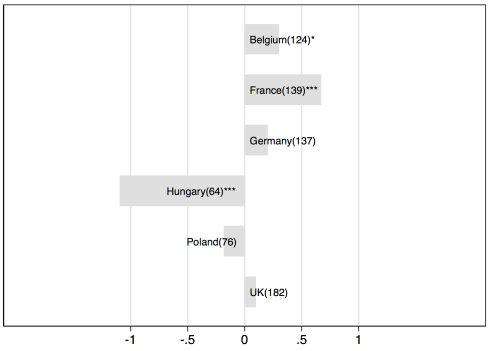
		Clean Product Innovation	
		below average	*above average*
Clean Process Innovation	*below average*	- Ceramics; - Fabricated Metals - Food & Tobacco - Publishing - Textile Leather	- Machinery & Optics; - Other Basic Metals; - Vehicles
	above average	- Cement; - Chemicals & Plastic; - Fuels; - Iron & Steel; - Wood & Paper	- Glass - Other Minerals - TV & Communication

tion whereas Germany leads in clean product R&D. The second panel of Figure 3 explores whether these differences are driven by differences in the specialization of the various economies across sectors. The figures report average differences between countries while controlling for the 3-digit sector.[5] This makes the differences found in the first panel even more pronounced, suggesting that they are not driven by differences in industrial composition.

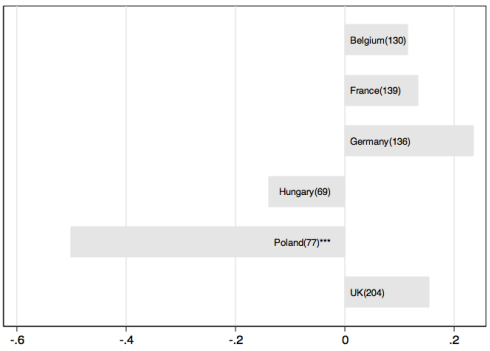
Figure 4 reveals sizeable differences in clean innovation across sectors and between types of innovation. In Table 2, we use this information to group sectors according to their focus on clean technologies. Only three sectors – Glass, Other Minerals and TV & Communication – have above-average scores in both product and process innovation.

[5]We use the NACE rev. 1.1 classification of the ORBIS data

Figure 3: Differences in clean innovative activities between countries
No industry controls

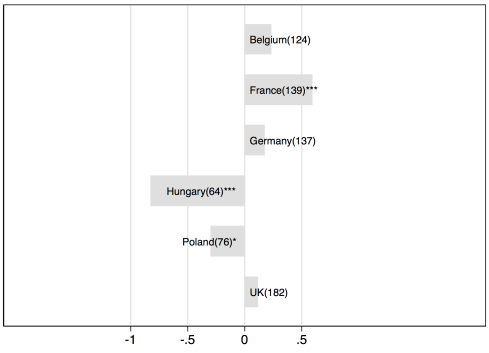


(a) Process Innovation

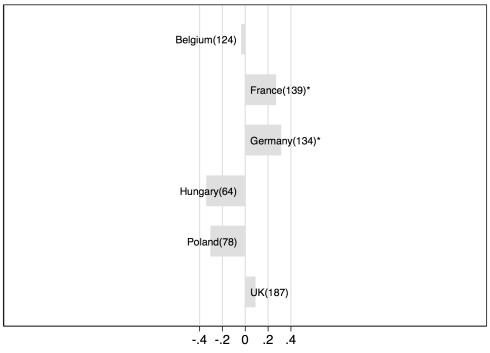


(b) Product innovation

3-digit industry controls



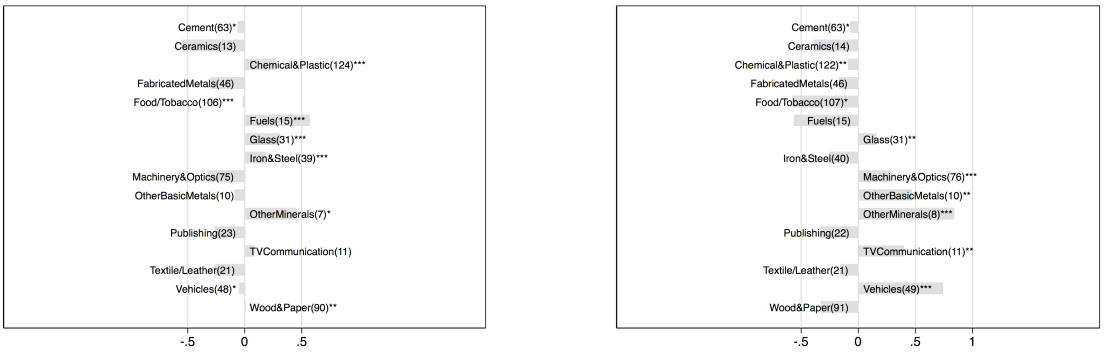
(c) Process Innovation



(d) Product innovation

Notes: Each graph shows the average difference - conditional on noise controls - between firms from different countries in terms of the interview scores for process and product innovation described in Figure 1. Stars indicate if these deviations are statistically significant and at what significance level: ***=1%, **=5%, *=10%.

Figure 4: Differences in clean innovative activities between industries



(a) Process Innovation (b) Product innovation

Notes: Each graph shows the average difference - conditional on noise controls - between firms from different sectors in terms of the interview scores for process and product innovation described in Figure 1. Stars indicate if these deviations are statistically significant and at what significance level: ***=1%, **=5%, *=10%.

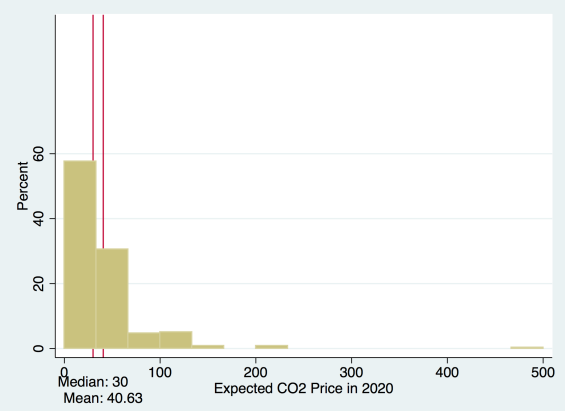
3.2 What firms expect

Investment decisions depend on the expectations held by investors. In order to elicit this information, the interview included a number of questions on expectations. This section reports on our findings, starting with an examination of differences in these expectations between firms, countries and sectors. Subsequently, we discuss expectations about future characteristics of the EU ETS.

3.2.1 Prices

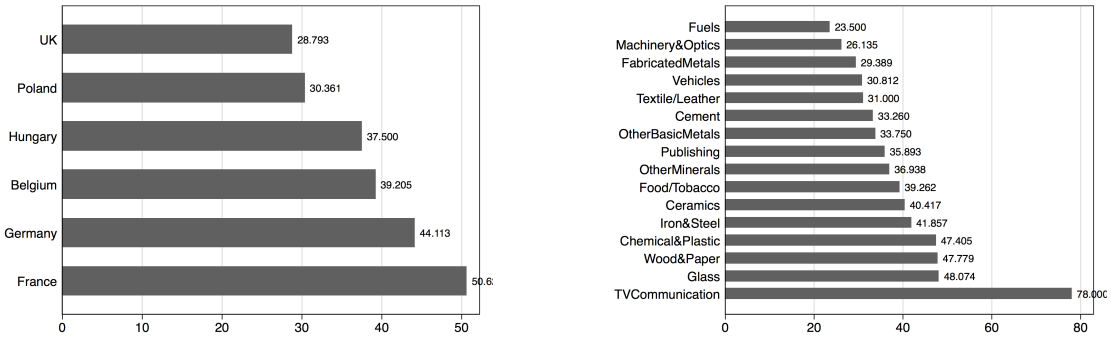
Figure 5 shows the distribution of the expected price of emitting one tonne of carbon dioxide in 2020. Forecasts range between 0 and 500. The median price reported is €30, the mean €40. There are substantial differences, not only between different firms but also between countries and sectors, as shown in Figure 6. French firms expect a much higher price, of €50 on average, whereas UK firms expect a more modest €28, on average. Across sectors, the highest price is expected by firms in TV and Communication, with an average of €78, the lowest by firms in the Fuels sector, at close to €23. There is also a sizeable variation across sectors and countries with respect to the mere existence of a price expectation. Figure 7 shows that more than 80% of interviewed Polish managers actually have a carbon price expectation versus less than 5% of the Hungarian managers that we interviewed. At the sector level, the highest proportion of firms with an expectation occurs in the Glass sector (55%), whilst the lowest percentage is only 18%, in Machinery and Optics. We also

Figure 5: Distribution of price expectations



Notes: The figure shows a histogram of the price of a tonne of CO2 that interviewed firms expect on the EU ETS market.

Figure 6: Price expectations across industries and countries



(a) Across countries (b) Across sectors

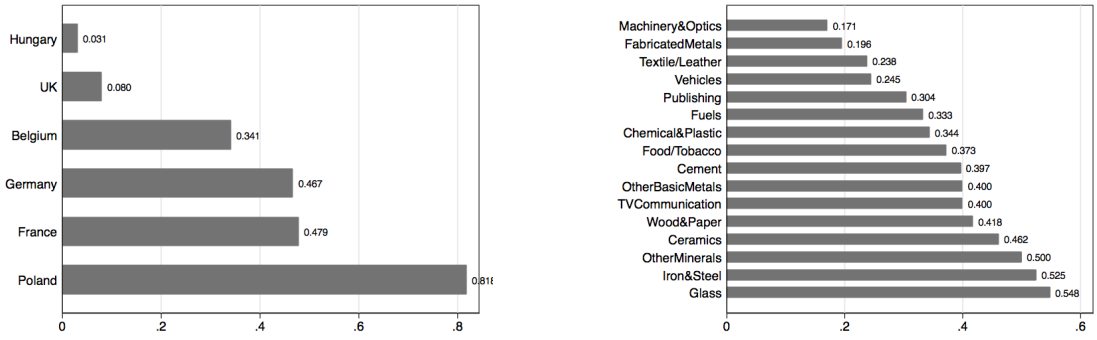
Notes: The figures show average carbon price expectations for 2020 for all interviewed firms that reported price expectations (i.e. both EU ETS and non EU ETS firms).

asked interviewees about their knowledge of the current price of a tonne of CO_2 on the EU ETS, as a way of gauging their awareness of the market and the potential integration of this price in investment and trading decisions. Again, there is a lot of variation between sectors and countries, as shown in Figure 8, with Poland and the Fuels industry exhibiting the largest shares of managers aware of the carbon price.

3.2.2 Expected stringency of EU ETS

We also asked firms about their expectations regarding the stringency of the cap on emissions implied by their participation in Phase III of the EU ETS. Put differently, we wanted to know how hard it would be for them to limit their future emissions to

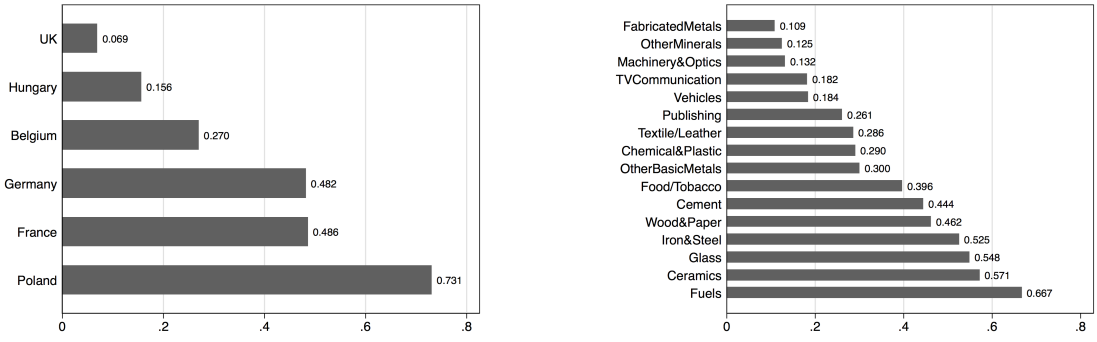
Figure 7: Existence of Price expectations



(a) Across countries (b) Across sectors

Notes: The figures show what proportion of firms in a country or a sector reported a carbon price expectation in our sample.

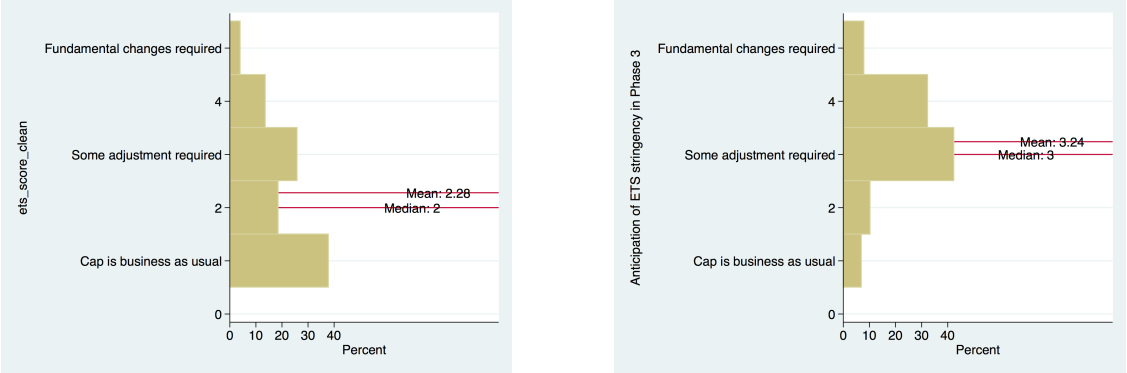
Figure 8: Knowledge about current prices



(a) Across countries (b) Across sectors

Notes: The figures show what proportion of firms in a country or a sector knew the current carbon price in the EU ETS.

Figure 9: Expected stringency and current perceived stringency



(a) Trading Phase II (b) Trading Phase III

Notes: The figure for Trading Phase II shows how stringent firm-specific caps are perceived to be. The figure for Trading Phase III shows what stringency firms expect for the Trading Phase starting in 2013

the amount they receive in free allowances (or how expensive if they do not reduce their emissions, and need to buy allowances). A firm's response to this question should depend on (i) how costly it would be to reduce its emissions, on (ii) how many allowances it receives for free and on (iii) the price they expect on the market and therefore the expected overall allocation. We asked a similar question regarding the stringency of the cap imposed by the current Phase II of the trading system. Figure 9 reports on the resulting scores. Firms clearly expect more stringent caps for Phase III. The proportion of firms answering that the cap they receive will allow them to continue under business-as-usual terms declined, from almost 40% to less than 10%. However, even for Phase III, few firms expect that fundamental changes would be needed in order to meet their cap.

4 What is driving investment in climate-change related innovation?

4.1 Regression analysis

This section examines whether there is a link between firms' expectations about future stringenyc of climate policy and their investment in R&D related to climate change. To this end, we regress different measures of innovation on expectations and other control variables. The results are displayed in three tables – one for each dependent variable – which show a range of different specifications. Table 3 reports

results from regressions of the process innovation score whereas Table 4 reports the equivalent regressions for product innovation. In Table 5 we consider the average of the process and product innovation score as the outcome variable.[6]

We start by regressing the innovation scores on a set of dummy variables indicating whether a firm is part of the EU ETS in either Phase II or III or both (column 1). This yields no significant coefficient for neither type of innovation. Hence, we cannot reject the hypothesis that ETS firms do not differ systematically in their innovativeness from non-ETS firms. In column 2 we add expectations about both price and future stringency as explanatory variables. We find positive coefficients for both variables and with both types of innovation as well as average innovation. However, these coefficients are statistically significant only for the *expected* stringency of the cap. Thus it seems that the stringency of the emissions cap is more relevant for R&D decisions than the price. This is an interesting suggestion, as a simple model of company behavior would predict the opposite: since the EU ETS is a cap-and-trade system the only thing that should matter for firms' allocation and investment decisions is the (expected) emissions price. Company-specific caps should only be relevant for determining the distribution of rents that emerge from imposing scarcity on a formerly free good (GHG pollution). The notion that allocation decisions are independent of the distribution of allowances has been referred to as the "independence property" of emissions trading (Montgomery, 1972; **?**). Subsequent work has proven a similar result for innovation, in that the allocation of permits – under competitive conditions – has no effect on the innovative activity of regulated firms (Montero, 2002; Requate and Unold, 2003).[7]

An alternative explanation for the correlation between stringency and innovation could be that we are picking up reverse causality or omitted-variables bias. For example, a firm's perception of stringency is certainly influenced by the availability of cheap technological solutions to reduce emissions. When cheap solutions are not available, a firm is likely to respond that the cap is more stringent. Therefore, such a firm might be more likely to conduct some R&D in response to higher carbon prices. In this case, a positive relationship between R&D and stringency might emerge due to unobserved heterogeneity. We address this in a number of ways. First, we add more control variables. Second, we examine what happens when we include perceived stringency of the current period (Phase II) rather than future stringency.

[6]This takes into account concerns that in some cases it might be difficult for respondents to clearly distinguish between the two.

[7]See Requate (2005) for an excellent survey of the literature on environmental regulation and innovation.

Table 3: Regressions of process innovation score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable.	Process Innovation Score							
Anticipation of ETS Stringency in Phase 3		0.174**	0.132*	0.146**	0.188**			
		(0.082)	(0.079)	(0.073)	(0.072)			
ETS Stringency in Phase 2						0.126**	0.109**	0.131**
						(0.057)	(0.052)	(0.055)
CO_2 Price expectation by 2020		0.088						
ln(CO_2 Price)		(0.073)						
CO_2 Intensity in 2008			0.078*	0.106***	0.056	0.082*	0.120***	0.081*
ln(CO_2/EMP)			(0.043)	(0.034)	(0.044)	(0.042)	(0.032)	(0.042)
Multinational Enterprise			0.198	0.174	0.330	0.200	0.185	0.389
			(0.144)	(0.128)	(0.242)	(0.143)	(0.126)	(0.238)
R&D Intensive Facility			0.172	0.173**	0.007	0.190*	0.188**	0.021
			(0.110)	(0.087)	(0.156)	(0.106)	(0.087)	(0.158)
Employment			0.254***	0.220***	0.172***	0.268***	0.233***	0.200***
ln(emp)			(0.044)	(0.036)	(0.064)	(0.045)	(0.038)	(0.062)
In ETS in Phase 2	-0.196	-0.231	-0.329	-0.167		-0.505**	-0.329	
	(0.202)	(0.200)	(0.269)	(0.251)		(0.249)	(0.248)	
In ETS in Phase 3	0.325	0.060	0.069	0.103		0.321	0.317	
	(0.324)	(0.364)	(0.365)	(0.344)		(0.335)	(0.356)	
In ETS in Phase 2 and 3	0.221	-0.024	-0.182	-0.147		-0.013	0.029	
	(0.393)	(0.437)	(0.420)	(0.395)		(0.403)	(0.387)	
Observations	685	685	684	684	303	684	684	303
R^2	0.27	0.30	0.38	0.29	0.30	0.38	0.28	0.29
Cluster	155	155	155	155	92	155	155	92
3-digit sector controls	yes	yes	yes	no	no	yes	no	no
Noise Controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit industrial sector. The dependent variable is the interview score for process innovation. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%.

Third, rather than using the survey based stringency measures we exploit variations in cap stringency implied by the EU Commission rules for continued free allocation – instead of the requirement to purchase allowances through auctioning.

More control variables Column 2 in Tables 3 and 4 already includes 3-digit industry dummies. In column 3 we add as further controls the employment size, CO_2 intensity, and dummies for foreign ownership and R&D intensity of the firm. The stringency coefficient remains positive and significant for both types of innovation. For completeness, we also examine what happens when we drop industry controls (in column 4) and when we include only firms that are participating in Phase III (in column 5).[8] The stringency-innovation relationship is robust in all of these specifications.

[8]Note that we have the expected stringency score variable only for firms that are regulated by the EU ETS in Phase III. Thus in all columns the stringency effect is identified only from those firms. Including the other firms can be useful, however, to identify the impact of variables on innovation that are relevant for all firms, such as sector, size or noise controls.

Table 4: Regressions of product innovation score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Variable.				Product Innovation Score				
Anticipation of ETS Stringency		0.180**	0.153**	0.194**	0.179**			
		(0.076)	(0.073)	(0.075)	(0.084)			
ETS Stringency in Phase 2						0.030	0.037	0.043
						(0.061)	(0.063)	(0.077)
CO_2 Price expectation by 2020		0.071						
ln(CO_2 Price)		(0.095)						
CO_2 Intensity in 2008			0.029	-0.011	-0.022	0.037	0.006	0.003
ln(CO_2/EMP)			(0.043)	(0.046)	(0.048)	(0.044)	(0.045)	(0.044)
Multinational Enterprise			0.308**	0.243*	0.429**	0.318**	0.261**	0.476**
			(0.130)	(0.129)	(0.213)	(0.128)	(0.126)	(0.202)
R&D Intensive Facility			0.245**	0.283***	0.159	0.248**	0.284***	0.168
			(0.109)	(0.107)	(0.135)	(0.111)	(0.107)	(0.139)
Employment			0.143***	0.146***	0.130**	0.159***	0.162***	0.160**
ln(emp)			(0.045)	(0.047)	(0.065)	(0.045)	(0.049)	(0.070)
In ETS in Phase 2	0.285	0.284	0.683**	0.521**		0.219	0.015	
	(0.223)	(0.217)	(0.311)	(0.260)		(0.514)	(0.547)	
In ETS in Phase 3	0.233	0.104	0.039	0.289		0.149	0.366	
	(0.334)	(0.387)	(0.395)	(0.383)		(0.340)	(0.348)	
In ETS in Phase 2 and 3	-0.245	-0.448	-0.435	-0.726*		-0.297	-0.571	
	(0.432)	(0.444)	(0.407)	(0.386)		(0.401)	(0.392)	
Process R&D Score								
Observations	685	685	684	684	303	684	684	303
R2	0.30	0.31	0.36	0.18	0.26	0.35	0.17	0.25
Cluster	155	155	155	155	92	155	155	92
3 digit sector controls	yes	yes	yes	no	no	yes	no	no
Noise Controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit industrial sector. The dependent variable is the interview score for product innovation. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%.

Table 5: Regressions of average innovation score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable.				Mean Innovation Score				
Anticipation of ETS Stringency in Phase 3		0.177***	0.146***	0.175***	0.188***			
		(0.055)	(0.053)	(0.054)	(0.062)			
ETS Stringency in Phase 2						0.079*	0.074*	0.088
						(0.043)	(0.044)	(0.056)
CO_2 Price expectation by 2020		0.080						
ln(CO_2 Price)		(0.069)						
CO_2 Intensity in 2008			0.035	0.034	0.000	0.040	0.050	0.024
ln(CO_2/EMP)			(0.034)	(0.032)	(0.038)	(0.034)	(0.032)	(0.035)
Multinational Enterprise			0.252**	0.208**	0.376*	0.258**	0.223**	0.431**
			(0.107)	(0.104)	(0.190)	(0.105)	(0.100)	(0.178)
R&D Intensive Facility			0.200**	0.222***	0.071	0.210**	0.230***	0.081
			(0.083)	(0.074)	(0.110)	(0.084)	(0.074)	(0.114)
Employment			0.190***	0.176***	0.139**	0.205***	0.190***	0.167***
ln(emp)			(0.030)	(0.030)	(0.053)	(0.031)	(0.032)	(0.053)
In ETS in Phase 2	0.045	0.027	0.265	0.278		-0.112	-0.123	
	(0.183)	(0.178)	(0.262)	(0.229)		(0.246)	(0.224)	
In ETS in Phase 3	0.279	0.082	0.057	0.201		0.243	0.350	
	(0.285)	(0.317)	(0.312)	(0.295)		(0.279)	(0.295)	
In ETS in Phase 2 and 3	-0.012	-0.236	-0.303	-0.432		-0.145	-0.261	
	(0.363)	(0.393)	(0.348)	(0.319)		(0.332)	(0.318)	
Observations	685	685	684	684	303	684	684	303
R^2	0.29	0.32	0.41	0.28	0.34	0.40	0.27	0.32
Cluster	155	155	155	155	92	155	155	92
3-digit sector controls	yes	yes	yes	no	no	yes	no	no
Noise Controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit sector. The dependent variable is the interview average of the product and process innovation scores. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%.

Using current stringency Up until and including Phase II, emission allowances were allocated by and large for free to industrial emitters. Regulation for Phase III stipulates that some firms will have to purchase an increasing fraction of their allowances through an auction or on the open market. Hence, if the relationship between stringency and innovation is driven by variations in the cap rather than abatement cost heterogeneity, we expect that the relationship is weaker or non-existent with current stringency. Again, this turns out to be the case for product innovation where the current stringency coefficient is not significant in columns 6 to 8. For process innovation, the reverse seems to be the case with the current stringency coefficient being positive and significant.

4.2 Regression discontinuity estimates

To further investigate the relationship between stringency and innovation, we exploit the link between exogenous variations in free allowance allocation, rather than relying on the self-reported stringency score.[9] Phase III will see radical changes in the number of allowances that are allocated for free to firms. Under current proposals, the European Commission will exempt certain 4-digit industries from allowance auctioning, based on two statistics, trade intensity (TI) and CO_2 intensity (CI). [10] Firms in a 4-digit industry will be exempt if the industry's TI or CI exceed 30%, or if the sector simultaneously exceeds a 10% threshold for TI and a 5% threshold for CI. Figure 10 plots the firms in our sample in the CI-TI space, where the dotted line indicates the location of those thresholds.

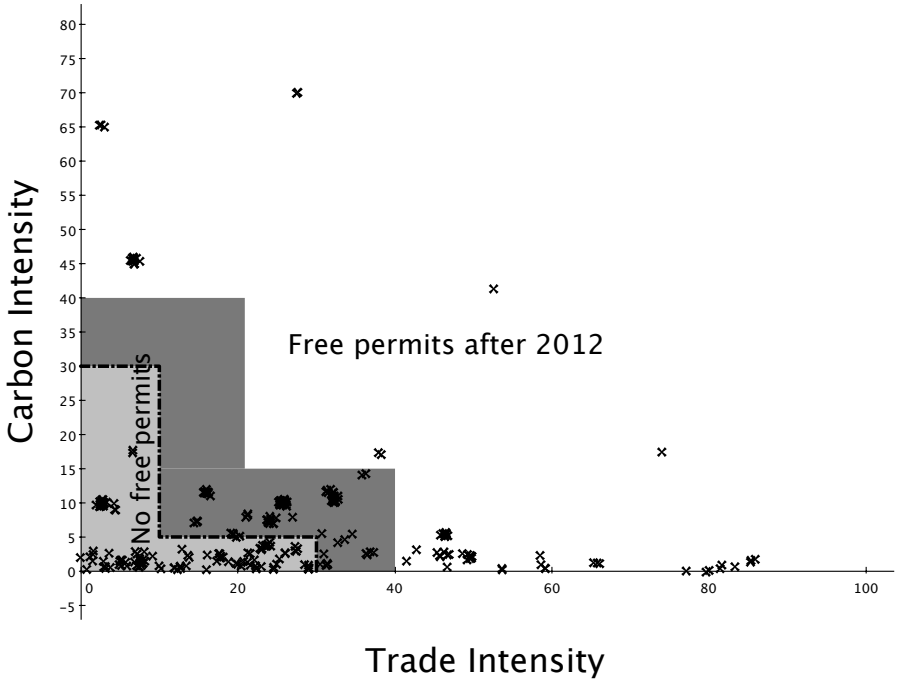
Before estimating threshold effects in a regression framework, we consider one sub segment of the threshold graphically in Figure 11.[11] The grey shaded areas in the left panel of Figure 11 indicate this segment in the CI-TI space: it involves firms in sectors with between 0 and 60% trade intensity and less than 5% carbon intensity. These firms receive free permits solely because of the trade intensity criterion as well as a suitable control group of firms that receive no free permits. The panel on theright of Figure 11 plots the production innovation score for these firms with TI on the horizontal axis. There is a visible drop in the innovation score for firms

[9] Of the three factors underlying a firm's perception of stringency (see Section 3.2.2), we focus here on point (ii), the amount of permits the firm receives for free.

[10] The Carbon Intensity is defined as the ratio between the sum of the direct and indirect costs of full auctioning and the gross value added of a sector. The direct costs are calculated as the value of direct CO_2 emissions (using a proxy price of €30/t CO_2), and the indirect costs capture the exposure to electricity price rises.

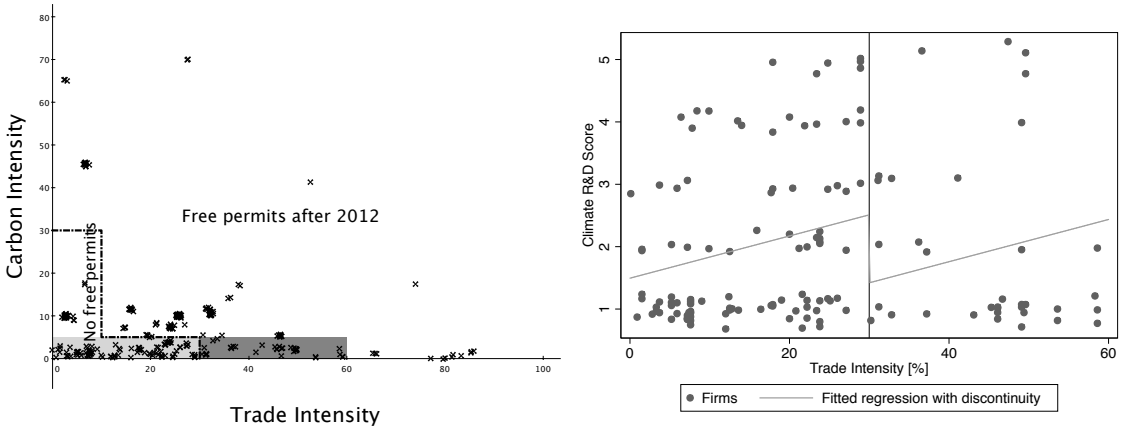
[11] This allows for a simple two dimensional treatment.

Figure 10: Location of thresholds in Carbon Intensity – Trade Intensity Space



Notes: The Figure plots interviewed firms in the Carbon Intensity (y-axis) and Trade Intensity (x-axis) space according to the industry they belong to. To make several firms in the same sector visible we added a small random error to each observation. The figure also shows the threshold in terms of both measures for a sector to receive free permits after 2012. The grey shaded areas indicate a 20 percentage point band around the threshold for inclusion in our main discontinuity regressions.

Figure 11: Illustration of the threshold effect



Notes: The figure illustrates the threshold effect on product innovation for a subset of our data: firms with less than 5% carbon intensity around the 30% threshold in terms of trade intensity. Firms that are exempt from auctioning - i.e. those with more than 30% trade sectoral trade intensity - report visibly lower levels of product innovation. Fitting a line suggests that more trade intensive firms innovate more with a significant drop at the 30% threshold however.

that lie above the 30% threshold and receive free permits. The fitted regression line exhibits a drop at the threshold.

In Table 6 we report linear regressions of various outcomes where we include a dummy "Exempt after 2012" that is equal to 1 if a firm falls above the threshold in CI-TI space as well as a range of other control variables. We restrict the sample of firms to those located in an interval of 10 percentage points on either side of the threshold for free allocation A range of different outcome variables is considered across the columns of the table. First, in column 1 we look at the reported expected stringency of firm level permit allocations after 2012. We find a significant negative value suggesting that expectations concerning stringency are driven in part by eligibility for free permits. This negative relationship is primarily a feature of the forthcoming post-2012 allocation process, since a much smaller and not significant coefficient is obtained in column 2 where the outcome variable is current stringency. In columns 3 to 6 we consider product, process and average innovation. In either case we find a negative coefficient which is large and significant at 1% for product innovation and 5% for average innovation. The coefficient value of 1.138 is approximately equal to 1 standard deviation of the product innovation score (1.254). We therefore conclude that the effect of stringency on innovation is also economically significant.

In Tables 7 and 8we explore the robustness of these results.[12] Table 7 shows results obtained after reducing the inclusion band to 7.5 percentage points on either side of the threshold for free allocation. This has hardly any effect on the estimates. In Table 8 we add quadratic and interaction terms of the running variables. While the significance of some of the estimates is weaker than in Tables 6 and 7, the point estimates remain close, which is re-assuring.

In sum, we find robust evidence that climate-change related innovation responds to the expected stringency of the EU ETS. An explanation for this could be that having to pay for all required emissions allowances has an important signaling function for companies in drawing the attention of higher management levels to the issue of emissions. It is only then that firms would take the more strategic decision to engage in product lines that are climate-change related. In such a scenario there could be information barriers that prevent senior management from seeing these opportunities until the issuance of tight, company-specific emissions caps forces them to focus on climate change issues.[13]

[12]Further robustness checks are provided in Appendix A.

[13]Stressing the importance of information flows within the firm, such an explanation is in line with recent developments in the literatures on the theory of the firm as well as on the energy efficiency paradox (DeCanio and Watkins, 1998a,b; Garicano, 2000).

Table 6: Regression discontinuity estimates

	(1)	(2)	(3)	(4)	(5)
Dependant Variable	Expected Stringency Score	Current Stringency Score	Product Innovation Score	Process Innovation Score	Mean Innovation Score
Exempt after 2012	-0.413**	-0.214	-1.138***	-0.129	-0.634**
	(0.192)	(0.332)	(0.349)	(0.256)	(0.271)
Sectoral CO_2 Intensity	5.235***	0.076	7.745**	4.566*	6.155**
(CI)	(1.964)	(2.122)	(3.704)	(2.527)	(2.910)
Sectoral Trade Intensity	1.004	1.088	2.929**	-1.439	0.745
(TI)	(0.654)	(1.243)	(1.453)	(0.947)	(1.051)
Firm level CO_2 Intensity	0.099*	0.044	-0.008	0.065	0.029
(lnCO2/EMP)	(0.056)	(0.048)	(0.066)	(0.054)	(0.049)
Multinational	0.245	-0.124	0.387	0.484*	0.435**
	(0.153)	(0.201)	(0.258)	(0.261)	(0.208)
Site does R&D	0.109	-0.023	0.162	0.222	0.192
	(0.152)	(0.180)	(0.154)	(0.169)	(0.120)
Employment	0.162**	0.032	0.146**	0.230***	0.188***
(lnEMP)	(0.071)	(0.063)	(0.060)	(0.064)	(0.048)
Share of Competitors	-0.071	0.018	-0.221	0.467*	0.123
outside the EU	(0.222)	(0.414)	(0.323)	(0.280)	(0.225)
Observations	236	236	236	236	236
R2	0.28	0.17	0.29	0.36	0.35
Cluster	66	66	66	66	66
Noise Controls	yes	yes	yes	yes	yes
Exempt within 10% band	110	110	110	110	110
Not exempt within 10% band	126	126	126	126	126

Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit industrial sector. Sectoral CO_2 intensity and trade intensity are derived from EUROSTAT data. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%.

Table 7: Regression discontinuity estimates – Narrower bands

	(1)	(2)	(3)	(4)	(5)
Dependant Variable	Expected Stringency Score	Current Stringency Score	Product Innovation Score	Process Innovation Score	Mean Innovation Score
Exempt after 2012	-0.449**	-0.173	-1.154***	-0.114	-0.634**
	(0.190)	(0.360)	(0.356)	(0.268)	(0.279)
Sectoral CO_2 Intensity	6.037***	0.182	7.879*	4.607*	6.243**
(CI)	(1.928)	(2.442)	(3.957)	(2.675)	(3.110)
Sectoral Trade Intensity	1.008	0.757	3.128*	-1.698	0.715
(TI)	(0.696)	(1.431)	(1.601)	(1.058)	(1.186)
Firm level CO_2 Intensity	0.080	0.038	-0.028	0.065	0.019
(lnCO2/EMP)	(0.058)	(0.052)	(0.071)	(0.057)	(0.053)
Multinational	0.238	-0.181	0.390	0.481*	0.435*
	(0.153)	(0.199)	(0.284)	(0.281)	(0.232)
Site does R&D	0.116	-0.015	0.203	0.230	0.216*
	(0.160)	(0.181)	(0.154)	(0.175)	(0.125)
Employment	0.154*	0.064	0.131**	0.245***	0.188***
(lnEMP)	(0.078)	(0.066)	(0.055)	(0.070)	(0.051)
Share of Competitors	-0.035	-0.054	-0.173	0.441	0.134
outside the EU	(0.228)	(0.423)	(0.327)	(0.282)	(0.223)
Observations	228	228	228	228	228
R2	0.28	0.19	0.30	0.36	0.35
Cluster	61	61	61	61	61
Noise controls	yes	yes	yes	yes	yes
Exempt within 7.5% band	108	108	108	108	108
Not exempt within 7.5% band	120	120	120	120	120

Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit industrial sector. Sectoral CO_2 intensity and trade intensity are derived from EUROSTAT data. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%. Standard errors are robust and clustered at the level of 4 digit industrial sectors.

Table 8: Regression discontinuity estimates – Squared running variables

	(1)	(2)	(3)	(4)	(5)
Dependant Variable	Expected Stringency Score	Current Stringency Score	Product Innovation Score	Process Innovation Score	Mean Innovation Score
Exempt after 2012	-0.286	-0.130	-0.907***	-0.107	-0.507**
	(0.182)	(0.362)	(0.309)	(0.275)	(0.246)
Sectoral CO_2 Intensity	15.842***	1.775	27.494***	16.068***	21.781***
(CI)	(3.756)	(8.566)	(8.347)	(5.904)	(6.476)
Sectoral CO_2 Intensity	-33.985	22.154	-72.405	-57.116	-64.760
squared	(24.286)	(58.957)	(56.285)	(34.560)	(40.942)
Sectoral Trade Intensity	0.686	8.050**	-1.187	-1.327	-1.257
(TI)	(2.035)	(3.106)	(3.336)	(2.483)	(2.425)
Sectoral Trade Intensity	-39.901***	-22.015	-70.669***	-24.642	-47.656***
squared	(10.825)	(19.399)	(22.196)	(15.264)	(15.103)
Trade Intensity X	6.893	-17.051**	22.530**	3.608	13.069*
CO_2 Intensity (TI x CI)	(5.990)	(8.264)	(9.669)	(7.421)	(6.793)
Firm level CO_2 Intensity	0.113**	0.029	0.028	0.072	0.050
(lnCO2/EMP)	(0.053)	(0.045)	(0.064)	(0.052)	(0.046)
Multinational	0.248	-0.115	0.392	0.471*	0.431**
	(0.152)	(0.199)	(0.240)	(0.266)	(0.209)
Site does R&D	0.092	0.038	0.098	0.211	0.155
	(0.147)	(0.174)	(0.148)	(0.171)	(0.112)
Employment	0.194***	0.040	0.208***	0.255***	0.231***
(lnEMP)	(0.069)	(0.070)	(0.069)	(0.063)	(0.050)
Share of Competitors	-0.062	0.123	-0.253	0.473*	0.110
outside the EU	(0.203)	(0.412)	(0.302)	(0.276)	(0.202)
Observations	236	236	236	236	236
R2	0.31	0.19	0.35	0.37	0.40
Cluster	66	66	66	66	66
Noise controls	yes	yes	yes	yes	yes
Exempt within 10% band	110	110	110	110	110
Not exempt within 10% band	126	126	126	126	126

Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit industrial sector. The dependent variable is the mean interview score for process and product innovation in columns (1) to (3) . Sectoral CO_2 intensity and trade intensity are derived from EUROSTAT data. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%.

5 Conclusion

This paper investigates climate-change related investment behavior among manufacturing firms in Europe on the basis of nearly 800 interviews with managers in six European countries. We start by looking at climate-change related innovation and find that most (70%) firms are equally engaged in formal or informal R&D with the aim of curbing emissions and/or energy consumption. A smaller proportion (40%) is also pursuing "Clean product innovation"; i.e. R&D with the aim of developing products that can help customers to reduce their emissions. Almost all firms that report product R&D also report process R&D. We find that firms expect future carbon prices to be considerably higher than current levels in the EU ETS, averaging €40 in 2020. Compared to the current second trading period, firms expect the imposition of tighter caps for the post-2012 EU ETS period. While 40% of firms reported that the current period EU ETS cap imposed on them was not binding, this proportion reduces to less than 10% for the post-2012 period. Firms that expect a more stringent EU ETS cap in Phase III are more likely to engage in product innovation. Such a correlation indicates that in a trading system the allocation of emissions allowances might not be independent of other real factors, such as the investment in R&D. We investigate this hypothesis further by examining whether there is a discontinuity in innovative activity at the thresholds implied by the European Commission criteria for exemptions from auctioning post-2012. We find that firms that narrowly qualified for exemption from auctioning were conducting significantly less innovation than firms that narrowly missed being exempted from auctioning. This finding is consistent with the hypothesis that having a tight carbon budget has an important signalling effect for firms in that it draws the attention of higher levels of management to the matter of GHG emissions. This in turn might trigger a decision to engage in climate-change related product or process R&D. On the whole, our results support the view that allocating fewer allowances for free would lead to a stronger innovation response in an otherwise identical emissions trading system.

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A Further results

Here we report further results using the regression discontinuity design discussed in section 4.2. Table 9 reports regression using wider bands – 12.5% on either side – around the threshold for free permit allocation. This has very little effect on the estimated parameters. In Table 10 we include an additional score derived from our interviews as regressor, measuring the likelihood of a firm downsizing due to climate policies.[14] This addresses the issue that permit allocation within the EUETS is conditional on firms actually remaining active within the EU. Closure of a facility covered by the EUETS would typically entail a cancellation of any free permits associated with it. This provides firms receiving free permits with an incentive not to close down operations. In addition, this could affect their attitudes towards conducting innovation. However, Table 10 suggests that such concerns have no bearing on our results.

In Figure 12 we examine as in figure 11 the innovativeness of firms around the 30% TI threshold. However, Figure 12 is based on a sample of firms that are not part of the EU ETS. This addresses the concern that the threshold effect might simply represent sectoral differences irrespective of EUETS participation. However, as the figure makes apparent, in this sample we cannot find evidence of a threshold effect.

[14] We discuss this measure in greater detail in Martin, Muûls, De Preux, and Wagner (2012b).

Table 9: Regression discontinuity estimates- Wider bands

	(1)	(2)	(3)	(4)	(5)
Dependant Variable	Expected Stringency Score	Current Stringency Score	Product Innovation Score	Process Innovation Score	Mean Innovation Score
Exempt after 2012	-0.405**	-0.232	-1.124***	-0.117	-0.620**
	(0.193)	(0.332)	(0.348)	(0.254)	(0.269)
Sectoral CO_2 Intensity	5.005**	0.585	7.338**	4.233*	5.785**
(CI)	(1.940)	(2.140)	(3.660)	(2.484)	(2.877)
Sectoral Trade Intensity	1.059	0.966	3.026**	-1.359	0.834
(TI)	(0.652)	(1.242)	(1.447)	(0.956)	(1.057)
Firm level CO_2 Intensity	0.103*	0.036	-0.001	0.070	0.035
(lnCO2/EMP)	(0.055)	(0.049)	(0.066)	(0.054)	(0.049)
Multinational	0.245	-0.124	0.387	0.484*	0.435**
	(0.153)	(0.199)	(0.255)	(0.260)	(0.206)
Site does R&D	0.102	-0.008	0.149	0.212	0.181
	(0.152)	(0.179)	(0.154)	(0.170)	(0.120)
Employment	0.162**	0.031	0.147**	0.232***	0.189***
(lnEMP)	(0.071)	(0.062)	(0.060)	(0.064)	(0.048)
Share of Competitors	-0.062	-0.004	-0.204	0.481*	0.139
outside the EU	(0.220)	(0.416)	(0.320)	(0.276)	(0.221)
Observations	237	237	237	237	237
R2	0.28	0.17	0.29	0.36	0.35
Cluster	67	67	67	67	67
Noise controls	yes	yes	yes	yes	yes
Exempt within 12.5% band	111	111	111	111	111
Not exempt within 12.5% band	126	126	126	126	126

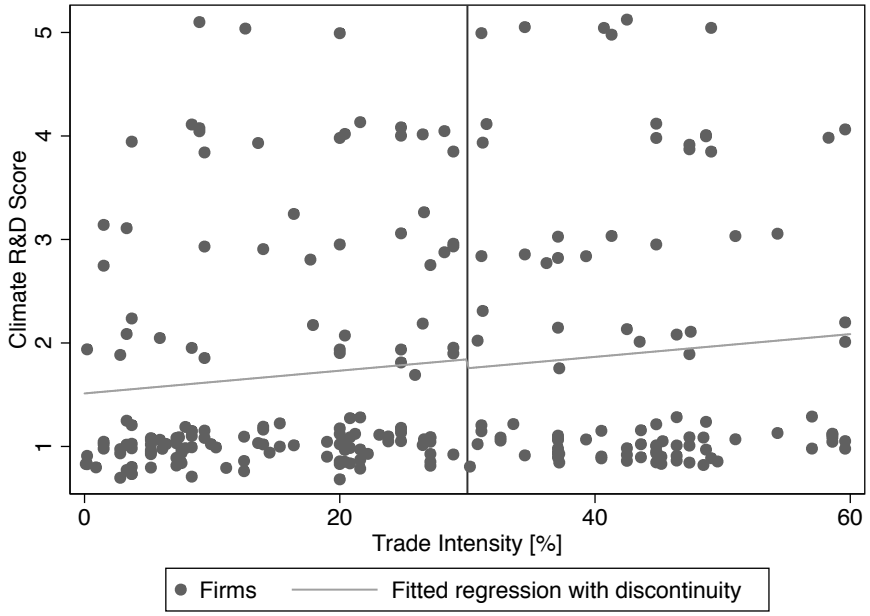
Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit industrialsector. Sectoral CO_2 intensity and trade intensity are derived from EUROSTAT data. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%.

Table 10: Regression discontinuity estimates – Vulnerability score

	(1)	(2)	(3)	(4)	(5)
Dependant Variable	Expected Stringency Score	Current Stringency Score	Product Innovation Score	Process Innovation Score	Mean Innovation Score
Exempt after 2012	-0.315*	-0.152	-1.151***	-0.042	-0.596**
	(0.188)	(0.352)	(0.342)	(0.248)	(0.262)
Sectoral CO_2 Intensity	4.016**	0.118	7.877**	4.289*	6.083**
(CI)	(1.874)	(2.235)	(3.606)	(2.441)	(2.759)
Sectoral Trade Intensity	1.117*	0.949	2.992*	-1.503	0.745
(TI)	(0.635)	(1.263)	(1.498)	(0.987)	(1.089)
Firm level CO_2 Intensity	0.061	0.037	-0.000	0.031	0.015
(lnCO2/EMP)	(0.066)	(0.060)	(0.075)	(0.065)	(0.059)
Multinational	0.264*	-0.105	0.388	0.492*	0.440**
	(0.147)	(0.204)	(0.260)	(0.264)	(0.209)
Site does R&D	0.051	-0.037	0.152	0.191	0.172
	(0.142)	(0.188)	(0.153)	(0.171)	(0.122)
Employment	0.127*	0.037	0.146**	0.210***	0.178***
(lnEMP)	(0.076)	(0.069)	(0.067)	(0.070)	(0.055)
Share of Competitors	-0.176	-0.075	-0.220	0.386	0.083
outside the EU	(0.252)	(0.445)	(0.372)	(0.296)	(0.261)
Vulnerability score	0.137***	-0.003	-0.021	0.060	0.019
	(0.033)	(0.074)	(0.073)	(0.066)	(0.056)
Observations	230	230	230	230	230
R2	0.31	0.17	0.29	0.36	0.34
Cluster	65	65	65	65	65
Noise controls	yes	yes	yes	yes	yes
Exempt within 10% band	106	106	106	106	106
Not exempt within 10% band	124	124	124	124	124

Notes: All columns estimated by OLS with robust standard errors in parentheses under coefficient estimates clustered by four-digit industrial sector. Sectoral CO_2 intensity and trade intensity are derived from EUROSTAT data. CO_2 intensity data are derived from the CITL database while employment is taken from ORBIS. All other variables are derived from the interviews. Noise controls include interviewer, country, time, day and month of the interview and manager background fixed effects. Stars indicate statistical significance level: ***=1%, **=5%, *=10%.

Figure 12: Threshold effect for non ETS firms?



Notes: The figure reproduces Figure 11 for firms which are not in the EUETS

B Questionnaire

1 Appendix: Questionnaire

Questions	Values	Coding description
I. Introduction		
1. A bit about your business		
(a) Is your firm a multinational? If yes, where is the headquarters?	no, list of countries, dk, rf	"No", if not a multinational; country where headquarters is located if a multinational
(b) On how many production sites do you operate (globally)?	number, dk, rf	Number of sites globally (approximate if unsure)
(c) How many of these sites are situated in the EU?	number, dk, rf	Number of sites in the EU
(d) How many of these sites are situated in the UK/B/FR/...?	number, dk, rf	Number of sites in current country
2. A bit about you		
(a) Job title	text	
(b) Tenure in company	number, rf	
(c) Tenure in current post	number, rf	
(d) Managerial background	commercial, technical, law, other	
3. EU ETS involvement		
As you might know, the European Union Emissions Trading System (referred to as EU ETS, hereafter) is at the heart of European climate change policy. (a) Is your company (or parts thereof) regulated under the EU ETS? (b) Since when?	no, list of years 2005-2009, yes dk year, dk, rf	
(c) How many of your European business sites are covered by the EU ETS?	number, dk, rf	

Questions	Values	Coding description
4. Site location		
For single plant firms and interviewees based at a production site: Could you tell me the postcode of the business site where you are based? *For multi-plant firms where the interviewee is located at a non-production site:* Some of the questions I am going to ask you next are specific to a production site within your firm. Please choose a particular production site and answer my questions for the particular site throughout the interview. The site should be the one you know best, the largest one, or the one nearest to you. If you are in the EU ETS, please pick a site covered by the EU ETS. Could you tell me the postcode of the chosen site?	text	Records the postcode
II. Impact of EU ETS		
5. EU ETS stringency (If not an EU ETS firm, continue with question 9)		
(a) How tough is the emissions cap/quota currently imposed by the EU ETS on your production site? (b) Can you describe some of the measures you put in place to comply with the cap?	1-5, dk, rf, na	Low: Cap is at business as usual. Mid: Some adjustments seem to have taken place, however nothing which led to fundamental changes in practices; e.g. insulation, etc. High: Measures which led to fundamental changes in production processes; e.g. fuel switching; replacement of essential plant and machinery.
(c) What is the annual cost burden of being part of the EU ETS? For example, monitoring, verification and transaction costs; the cost of buying permits or reducing emissions. *If the manager does not understand the question:* Imagine your installation was not part of the EU ETS this year, what cost saving would your firm do?	number	Absolute number
	percentage	Or percentage of annual operating cost
6. EU ETS management		
Ask only multi-plant firms:	site, other site, national firm,	

Questions	Values	Coding description
Is EU ETS compliance managed on the production site or elsewhere?	european firm, dk, rf, na	
7. ETS trading		
(a) In **March** of this year (i.e. **before** the compliance process), what was your allowance position on this site?	long, short, balanced, dk, rf, na	
(b) Were you short or long in allowances?	text	If the manager happens to mention the detailed number of allowances, make a note of it in this field.
(c) Before the compliance process in April, did you buy or sell allowances on the market or over the counter from other firms?	buy, sell, both, no: only trading during compliance period, no: no need, no: image concerns, no: transaction costs, no: other, dk, rf, na	
(d) If not, why not?		
(e) If yes, how frequently?	daily, weekly, monthly, quarterly, bi-annual, yearly, dk, rf, na	
(f) **In April this year**, what was your position after the compliance process?		
If answers "long": Did you bank permits for future years? Why?	banking to emit more in following years, banking to sell at a higher ETS permit price in future, banking dk why, long for pooling, dk, rf, na	Banking reason.
If answers "balanced/compliant" or "short": Did you borrow permits from next year's allowance? Why?	borrowing to emit less in following years, borrowing to buy at a lower ETS permit price in future, borrowing to be compliant, borrowing dk why, rf, dk, na	Borrowing reason. *Note: Only choose "borrowing to be compliant" if the manager is very short sighted and doesn't seem to understand he will eventually have to either emit less or buy permits*
If answers "short": Why did you remain short?	short for pooling, short and paid fine, other, rf, dk, na	Short reason.
	text	If “other”: why?
(g) Has this site exchanged emission permits with other installations belonging to your company that are part of the EU ETS? (pooling)	yes, no, rf, dk, na	

Questions	Values	Coding description	
8. Rationality of market behaviour			
(a) How do you decide how many permits to buy or sell or trade at all? (b) Did you base this decision on any forecast about prices and/or energy usage? (c) Did you trade permit revenue off against emission reduction costs in your planning on this issue?	1-5, dk, rf, na	Low	Take their permit allocation as a target to be met as such and do not take into account the price of permits or the cost of abatement. Just sell if there is a surplus or buy if there is a deficit.
		Mid	Are in the process of learning how the market works and in the first years did not have any market driven attitude, but now have someone in charge of managing the ETS so as to minimize compliance cost. This person has experience in financial markets and sometimes interacts with the production manager.
		High	Company has a thorough understanding of the site-specific CO2 abatement cost curve. Trading is used as a tool to reduce compliance cost and to generate extra revenues from excess abatement. Moreover, company forms expectations about permit price and re-optimizes abatement choice if necessary. Trader resorts to futures and derivatives to manage ETS permits as a financial asset.
9. Anticipation of phase III			
(a) Do you expect to be part of the EU ETS from 2012 onwards? *If not, continue with question 10*	yes, no, dk, rf, na		
(b) How stringent do you expect the next phase of the EU ETS (from 2012 to 2020) to be? (c) Will it be tough for your firm to reach such a target? Can you describe some of the measures you would have to put in place? (d) Do you believe the allowances will be distributed through an auctioning mechanism? (e) Is it likely that sanctions for non-compliance will become more stringent?	1-5, dk, rf, na	Low	Cap for phase III is anticipated to be comparable to business as usual. The manager believes there will be no additional sanctions and that they will receive the permits for free.
		Mid	Phase III is likely to trigger some adjustments, however nothing that will lead to fundamental changes in practices. Only a small part of permits will be auctioned and sanctions are not expected to be very high.
		High	The presence of strong sanctions, extensive use of auctioning and more stringent targets in Phase III is anticipated. It is likely to imply the adoption of measures which will lead to fundamental changes in production processes. It might also imply the closure of the plant, or redundancy of more than 20% of employment.
(f) Do you expect to transfer unused (banked) ERUs or CERs from Phase II to Phase III ?	EUAs, ERUs, CERs, EUAs and ERUs, EUAs and CERs, ERUs and CERs, all		

Questions	Values	Coding description
Note: ERUs are Emission Reduction Units stemming from Joint Implementation projects. CERs are Certified Emission Reductions stemming from Clean Development Mechanism projects.	three, no, dk, rf, na	

10. Awareness

(a) Are climate change topics discussed within your business? Can you give examples? (b) Are climate change related issues formally discussed in management meetings? Can you give examples? (c) Do your strategic objectives mention climate change? (d) Did you commission reports or studies on how climate change will affect your business?	1-5, dk, rf, na	*Note: Give minimum score of 3 to ETS firms and probe directly for 4 or 5, skipping (a) and (b).*	
		Low	Don't know if threat or opportunity. No awareness.
		Mid	Some awareness backed up by evidence that this is being formally discussed by management.
		High	Evidence that climate change is an important part of the business strategy.
Mentioned positive impact:	yes, no		

III. Prices

11a Energy price expectations

By how many percent do you expect energy prices to go up or down by 2020?	percentage, dk, rf	Expected price change in percent of today's price. *Note: This price includes the effect of current and future climate change policies on the energy price.*
	percentage, dk, rf	Upper bound on expected price change – record only if interviewee mentions it.
	percentage, dk, rf	Lower bound on expected price change – record only if interviewee mentions it.

11b Carbon price expectations

(a) As you might know, the EU has committed to reducing greenhouse gas emissions by 20%-30% over the next decade. What price do you expect to pay for emitting one tonne of CO2 in 2020?	percentage, dk, rf	Expected price in Euros per ton of CO2.
	percentage, dk, rf	Or expected price change in percent of today's price.
	yes, no, rf, dk	Knows today's price of CO2.
(b) What price do you expect in the worst-case scenario?		Upper bound in Euros per ton of CO2.

Questions	Values	Coding description	
(c) What price do you expect in the best-case scenario?		Lower bound in Euros per ton of CO2.	
12. Future impact of carbon pricing			
(a) Do you expect that government efforts to put a price on carbon emissions will force you to outsource parts of the production of this business site in the foreseeable future, or to close down completely?	1-5, dk, rf	Low	No impact of this kind.
		Mid	Significant reduction (>10%) in production/employment due to outsourcing.
		High	Complete close-down.
(b) What carbon price do you associate with this scenario?(Assume that you would have to pay for all allowances.) *Note: The price relates to the scenario given under (a). If answered "no impact" under (a), skip this question.*	number, dk, rf, na	Euros per ton	
(c) How would your answer to the previous questions change, if you received a free allowance for 80% of your current emissions? *Note: If answered "no impact" under (a), skip this question.*	1-5, dk, rf, na	Low	No impact of this kind.
		Mid	Significant reduction (>10%) in production/employment due to outsourcing.
		High	Complete close-down.
(d) *Note: Only ask if answered "no impact" under (a).* At what carbon price level would you be forced to close your plant down? ***If the manager has no idea or says it would need to be very high, try different prices, starting high, f****or example:* If you had to pay 200 Euros/ton of carbon, would you need to close down?	number, dk, na	**Euros per ton**	
(e) How did you reach this conclusion? (f) How concrete are the plans for outsourcing or closure?	1-5, dk, rf, na	Low	Gut feeling of the manager.
		Mid	Response is based on a plausible argument. For example, interviewee discusses available technological options and associated cost and relates them to profit margins.
		High	Commissioned a detailed study of abatement options and associated cost (in-house or external).
(g) What fraction of an energy price or carbon price increase can you pass on to your customers?	percentage, dk, rf		
IV. Competition and customers			

Questions	Values	Coding description	
13. Competitors			
(a) Can you tell me the number of firms in the world which compete with you in one or more local markets? *Note: For multi-product multi-plant firms refer to the market for the products created on the current site referred to during this interview. For instance, for multi-plant firms start the question with "For the products produced at the production site, can you tell me ..."*	number, dk, rf		
(b) How many of them are located within the EU?	number, dk, rf		
(c) How many of them are located in your country?	number, dk, rf		
(d) Location of main competitor (country)	list of countries, dk, rf, na		
(e) Do you know in which country your main competitor does most of its production?	same, EU, non-EU, list of countries, dk, rf, na		
14. Location of Customers			
(a) Share of sales exported (to the EU and the rest of the world)	percentage, dk, rf		
(b) Share of sales exported to EU countries	percentage, dk, rf		
(c) Are your products sold mainly to consumers or to other businesses?	B2B, final customer, dk, rf		
15. Customer pressure			
(a) Are your customers concerned about your GHG emissions? (b) How do they voice this concern? (c) Do your customers require hard data on your carbon emissions?	1-5, dk, rf	Low	"B2C" - Not aware that emissions performance is of significant concern to consumers of their product. "B2B" - Not aware that businesses they supply to are concerned about the emissions of the plant; quality and price are the only considerations.
		Mid	"B2C" - The business is aware of the importance of climate-change issues in general and so are conscious that their customers may consider GHG performance to be important, although they do not expect or require data as proof. "B2B" - Customers set ISO 14001 as a precondition to suppliers.

Questions	Values	Coding description	
			Evidence of environmental compliance is requested, but details of emissions figures are not required.
		High	"B2C" - Being seen to reduce GHG emissions is thought to be important in the purchasing decisions of the firm's consumers. This has been determined by market research or consumers have voiced their concern through other means. Customers also ask for certified data on emissions during production or usage. A customer-friendly system to recognize the best products in terms of energy efficiency is often available in the market (e.g. EU energy efficiency grade for home appliances). "B2B" - Customers ask for evidence of external validation of GHG figures. Customers request information on carbon emissions as part of their own supply chain carbon auditing. Customers conform to PAS 2050 or other national standard in carbon foot-printing and so require detailed information on a regular basis.
16 Climate change related product innovation			
(a) Globally, is your company currently trying to develop new products that help your customers to reduce GHG emissions? (b) Can you give examples? (c) What fraction of your Research & Development funds are used for that? (Less than 10%, more than 10%?)	1-5, dk, rf	Low	No efforts to develop climate change related products.
		Mid	Some efforts but it is not the main objective of the firms R&D efforts.
		High	The firm is focusing all product R&D efforts on climate change.
V. Measures			
17. Energy monitoring			

Questions	Values	Coding description	
(a) How detailed is your monitoring of energy usage? (b) How often do you monitor your energy usage? Since when? (c) Describe the system you have in place.	1-5, dk, rf	Low	No monitoring apart from looking at the energy bill.
		Mid	Evidence of energy monitoring as opposed to looking at the energy bill, i.e. there is some consciousness about the amount of energy being used as a business objective. However, discussions are irregular and not part of a structured process and are more frequent with price rises. Not more than quarterly monitoring of energy.
		High	Energy use is measured and monitored constantly and is on the agenda in regular production meetings. Energy use in the plant is divided up in space (by production line, machine or similar) and monitored over time (daily, hourly or continuously). The amount of energy rather than the cost is focused on.
	2000 and earlier, list of years 2001-2010, dk, rf, na	Start date (put "na" if score is "1")	
18. Targets on energy consumption for management			
(a) Do you have any targets on energy consumption which management has to observe? (e.g. kWh of electricity)	no targets, relative quantity targets, absolute quantity targets, absolute and relative quantity targets, only expenditure targets, dk, rf	Type	
(b) Can you describe some of the challenges you face in meeting the targets? (c) How often do you meet these targets? Do you think they are tough? *Note: If the manager replies they have EU ETS/CCA targets, ask "have these been translated into internal targets for management?"*	1-5, dk, rf	Low	No targets.
		Mid	Targets exist but seem easy to achieve.
		High	Evidence that targets are hard to achieve. Detailed.
(d) By approximately how much does this require reducing your current energy consumption in the next 5 years (10%, 25%, 50%)? *e the timetable for the target (e.g. 5 years or other number given by interviewee).*	percentage, dk, rf, na		
	number, dk, rf, na	Horizon (number of years)	
(e) Since when do you have these targets?	2000 and earlier, list of years 2001-2010, dk, rf, na		

Questions	Values	Coding description	
19. GHG monitoring			
(a) Do you explicitly monitor your GHG emissions? Since when? (b) How do you estimate your GHG emissions? (c) Are your GHG estimates externally validated?	1-5, dk, rf	Low	No specific GHG monitoring.
		Mid	Detailed energy monitoring with clear evidence for carbon accounting (at least firm level). Manager is aware that energy figures need to be scaled by carbon intensity.
		High	Carbon accounting of both direct and indirect emissions (supply chain emissions). External validation of GHG figures.
	2000 and earlier, list of years 2001-2010, dk, rf, na	Start date (put "na" if score is "1")	
20. Targets on GHG emissions for management			
(a) Do you have any targets on GHG emissions which management has to observe?	no targets, direct emissions, indirect and direct, dk, rf		
(b) Can you describe some of the challenges you face in meeting the targets? (c) How often do you meet these targets? Do you think they are tough? *Note: If the manager replies they have EU ETS/CCA targets, ask:* *H*ave these been translated into internal targets for management?	1-5, dk, rf	Low	No targets for GHG emissions.
		Mid	There is some awareness of the contribution of different energy sources and production processes to emissions, but this is a secondary consideration to cost focused energy targets. There is some degree of difficulty in the targets.
		HIgh	There are separate targets for GHGs, distinct from energy use. GHG emissions are a KPI (Key Performance Indicator) for the firm. The contribution of each energy source and the production process to GHG emissions is known and suggested improvement projects for the production are assessed on their potential impact on carbon as well as energy efficiency.
By approximately how much do these targets require you to reduce your emissions in the next 5 years (10%, 25%, 50%) compared their current level?	percentage, dk, rf, na		
the timetable for the target (e.g. 5 years or other number given by interviewee)	number, dk, rf, na	Horizon (number of years)	

Questions	Values	Coding description	
(e) When did you start having targets on GHG emissions?	2000 and earlier, list of years 2001-2010, dk, rf, na		
21. Target enforcement			
(a) What happens if energy consumption or GHG emission targets are not met? (b) Do you publicize targets and target achievement within the firm or to the public? Can you give examples? (c) Are there financial consequences in case of non-achievement? (d) Is there a bonus for target achievement?	1-5,dk,rf	Low	No targets or missing targets do not trigger any response.
		Mid	Both target achievement and non-achievement are internally and externally communicated.
		High	Target non-achievement leads to financial consequences internally and/or externally; including penalties, e.g. staff does not get bonus.
22. Emission-reducing measures			
(a) Can you tell me what measures you have adopted in order to reduce GHG emissions (or energy consumption) on this site? DO NOT PROMPT with the list if doesn't have an idea, rather ask: Have you bought any new equipment, or have you changed the way you produce?	List of tickboxes	I. Heating and cooling: 1- Optimised use of process heat 2- Modernisation of cooling/refrigeration system 3- Optimisation of air conditioning system 4- Optimisation of exhaust air system and/or district heating system	
		II. More climate-friendly energy generation on site: 1- Installation of combined heat and power (CHP) plant / cogeneration 2- Biogas feed-in in local combined heat and power plant or domestic gas grid 3- Switching to natural gas 4- Exploitation of renewable energy source	
		III. Machinery: 1- Modernisation of compressed air system 2- Other industry-specific production process optimisation/machine upgrade 3- Production process innovation	
		IV. Energy management: 1- Introduction of energy management system 2- Submetering / upgrade of an existing energy management system 3- (External) Energy audit 4- Installation of timers attached to machinery 5- Installation of (de-)centralised heating systems	

Questions	Values	Coding description
		V. Other measures on production site: 1- Modernisation of lighting system 2- Energy-efficient site extension/improved insulation/introduction of building management 3- Employee awareness campaigns and staff trainings 4- Non-technical reorganisation of production process 5- Installation of energy-efficient IT-system 6- Improved waste management/recycling
		VI. Beyond production on site: 1- Introduction of climate-friendly commuting scheme 2- Consideration of climate-related aspects in investment and purchase decisions 3- Consideration of climate-related aspects in distribution 4- Customer education programme 5- Participation in carbon offsetting schemes
(b) Which one of these measures achieved the largest carbon saving?	measure code	*Fill in the code corresponding to the measure in (a) (e.g. II-4 for "Exploitation of renewable energy source").*
(c) By how much did this measure reduce your total energy consumption?	percentage, dk, rf, na	
(d) By how much did this measure reduce your total GHG emissions?	percentage, dk, rf, na	
(e) What motivated the adoption of these measures?	EU ETS, energy cost saving / high profitability, pollution reduction, reputation, customer pressure, employee initiative, public investment support, compliance with regulation, compliance with expected future regulation, other, dk, rf, na	Main motivation (select only ONE)
	text	Other motivation (if not in tick boxes, or second)
(f) How did you learn about this measure?	consultant, government, customer, supplier, employee, R&D project, competitor, other,	Tick more than one option, if different sources mentioned

Questions	Values	Coding description	
	dk, rf, na		
(g) When did you implement this measure?	2000 and earlier, list of years 2001-2010, dk, rf, na		

VI. Innovation, barriers to investment and management

23. Climate change related process innovation

(a) Do you dedicate staff time and/or financial resources to finding new ways of reducing the GHG emissions at your facility? Did you commission any studies for that purpose? (b) Can you give examples? (c) What fraction of your firm's global Research & Development funds are used for that? (less than 10%, more than 10%?) *Note: This does not include expenses for staff trainings or energy monitoring, but actual innovation.*	1-5, dk, rf	Low	No R&D resources committed to reducing GHG emissions.
		Mid	Evidence of R&D projects to reduce emissions.
		High	Evidence that this kind of R&D is an important component in the company's R&D portfolio (5 or higher).

24. Barriers to adopting energy-efficiency investments

(a) Can you give one example of a measure to enhance energy efficiency which was considered, but eventually not adopted?	List of tickboxes	Same list as for question 22a.	
(b) Which payback time was required in the economic evaluation of this measure?	number, dk, rf, na	"Years"; if in months, put equivalent in years, e.g. record 6 months as 0.5.	
(c) Is this payback time longer or shorter than the one applied to non-energy related measures to cut costs?	1-5, dk, rf, na	Low	Longer, i.e. much less stringent
		Mid	Equal
		High	Shorter, i.e. much more stringent
(d) If different: why?	text		
(e) Was uncertainty about future prices or regulation important for the decision to reject?	no, yes_prices, yes_regulation, yes_both, dk, rf, na		
(f) What other factors were influential in the decision?	text		

Questions	Values	Coding description
(g) Has the current economic downturn affected your investment criteria for clean technologies? How?	no, favors clean, favours other, more stringent overall, less stringent overall, dk, rf, na	
25. Further reductions		
(a) By how much (in percentage points) could you - at current energy prices - further reduce your current GHG emissions without compromising your economic performance? (i.e. how much more emission reduction could be achieved without increasing costs)	percentage, dk, rf	
(b) If so, why have you not implemented these measures yet?	text	
(c) What further GHG emission reduction (in percentage points) would be technologically possible (although not necessarily at no extra cost)?	percentage, dk, rf	Notes: Assuming that production stays constant and that no processes are being outsourced. This should not include emission reduction achieved by switching to renewable electricity. Include emissions reductions through combined heat and power however.
26. Manager responsible for Climate Change issues		
(a) At the management level, who is responsible for dealing with climate change policies and energy and pollution reduction in the firm nationally? What is the official job title? *Note: If several, ask for highest-ranking. If nobody, put title "no clear responsibility".*	text	Job title of the manager
(b) How far in the management hierarchy is this manager below the CEO? (figure out through sequential questioning if necessary)	CEO, number, no clear responsibility, dk, rf	No of people between CEO and Manager, e.g. if reports directly to CEO, put 0
(c) Has there recently been a change in responsibilities for climate change issues? When?	no change, list of years 2000-2010, yes dk year, dk, rf	
(d) How far in the management hierarchy was this manager below the CEO? (figure out through sequential questioning if necessary)	CEO, number, no clear responsibility, dk, rf	
	text	Record past manager title if mentioned, but do not prompt for it.

Questions	Values	Coding description
VI. Firm Characteristics		
27. Firm/Plant Details		
(a) How many people are employed in the firm globally (including this country)? *Note: If a multinational, ask for the whole group's number.*	number, dk, rf	
(b) How many people does the firm employ in your country?	number, dk, rf	
(c) How many people are employed at the current site?	number, dk, rf	
(d) Annual Energy Bill-Annual:	number, dk, rf	
		Do not ask, but in case interviewee does not know the absolute number and answers with one of the following:
	percentage, dk, rf, na	Energy cost as percentage of ***turnover***
	percentage, dk, rf, na	Energy cost as percentage of ***costs***
(e) Total annual running costs (wage cost + materials, including energy):	number, dk, rf	
Answered (d) and (e) at the site level or at the company level?	site, company, na	
(f) Does your company purchase renewable power?	yes, no, dk, rf	*Note: Do not include electricity generated on site.*
(g) Does this site do any product R & D? *Note: Do not dwell on this question, make a judgement from first answer.*	yes, no, dk, rf	
(h) Is Marketing for your products done from this site? *Note: Do not dwell on this question, make a judgement from first answer.*	yes, no, dk, rf	
(i) Does this site have an environmental management system (ISO 14000)?	yes, no, dk, rf	
VII. Country-specific policies		
UNITED KINGDOM		

Questions	Values	Coding description	
UK.1 Participation in voluntary government climate change policies			
(a) Are you aware of voluntary government schemes to help businesses reduce GHG pollution? (b) Which ones? (c) Are you participating in any?	no, list of years 2001-2009, dk, rf, na	Carbon Trust Online Tools (Benchmarking Tools, Action Plan Tool) When?	
		Carbon Trust Energy Audit or Advice? (CTaudit)	
	no, list of years 2001-2009, dk, rf, na	Innovation grants from the Carbon Trust? When?	
		Carbon Trust Standard	
	no, list of years 2001-2009, dk, rf, na	Enhanced Capital Allowance scheme? (ECA)	
	no, list of years 2001-2009, dk, rf, na		
	no, list of years 2001-2009, dk, rf, na		
UK.2 Participation in Climate Change agreement			
(a) Is your company (or parts thereof) subject to a UK Climate Change Agreement? (b) Since when?	no, list of years 2001-2009, dk, rf, na		
(c) How stringent is the target imposed by the CCA? (d) Can you describe some of the measures you had to put in place to comply with the cap?	1-5, dk, rf, na	Low	No targets.
		Mid	Targets exist but seem easy to achieve.
		High	Evidence that targets are hard to achieve. Detailed description of serious problems in achieving targets.
((e) Did you buy or sell emission rights via the UK ETS?	no because of image concerns, no because no capacity, no other, bought, sold, both, dk, rf, na		
BELGIUM			
B.1 Participation in industry agreements (accords de Branche/Bechmarkconvenanten) (a) Is your company (or parts thereof) subject to an industry agreement? (b) Since when?	no, list of years 2001-2009, dk, rf, na		
(c) How stringent is the target imposed by the agreement?	1-5, dk, rf, na	Low	No targets.

Questions	Values	Coding description	
(d) Can you describe some of the measures you had to put in place to comply with the cap?		Mid	Targets exist but seem easy to achieve.
		High	Evidence that targets are hard to achieve. Detailed description of serious problems in achieving targets.
B.2 Do you benefit from any tax reduction from the Federal government because of investments that reduce energy consumption/loss? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na		
B.3 **Brussels:** Have you had a grant for an energy audit or advice financed by the Brussels region? If yes, when? **Walloon:** Have you had any energy audit (AMURE) or advice financed by the Walloon region? If yes, when? **Flanders:** Have you received any advice or energy audit financed by VLAO (Vlaams Agentschap Ondernemen)? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na		
B.4 **Brussels:** Have you benefited from an investment subsidy from the Brussels region for improving your building's or production process's energy efficiency ? If yes, when? **Walloon:** Have you had a grant from the energy fund of the Walloon region for improving your building's or production process's energy efficiency? If yes, when? **Flanders:** Have you received an ecological grant (Ecologipremeie) of the Flemish region for improving your building's or production process's energy efficiency? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na		
B.5 **Flanders:** Do you have a heat and power certificate from the Flemish region (warmtekrachtcertificaat)? If yes, since when?	no, list of years 2001-2009, yes dk year. dk, rf, na		
FRANCE			
F1. Are you part of the AERES (Association des entreprises pour la réduction de l'effet de serre) and have signed up to voluntary GHG emission reductions? If yes, since when?	no, list of years 2001-2009, yes dk year. dk, rf, na		
F2. Have you had a grant for an energy audit or advice financed by ADEME? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na		
F3. Have you benefited from a “FOGIME” guarantee for loans you have taken to invest into energy efficiency improvements or	no, list of years 2001-2009, yes dk year. dk, rf, na		

Questions	Values	Coding description
emission reductions ? If yes, when?		
F4. Have you benefited from a grant from ADEME for improving your building's or production process's energy efficiency ? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na	
GERMANY		
G.1 Renewable Energy Sources Act		
(a) In previous year, have you been granted a discount on your energy cost which reduces the energy cost apportionment embodied in the Renewable Energy Sources Act?	no, yes, dk, rf, na	
(b) Have you applied for the discount (also) in 2009?	no, yes, dk, rf, na	
(c) Did the certification process require you to upgrade your energy management system? *Note: Since 2009 the approval of the discount is subject to the certification of your energy management system by 30 June 2009.*	yes, no upgrade necessary, no had certificate before, dk, rf, na	
G.2 Public support programmes		
Have you participated in public support programs aimed at saving energy or at reducing GHG emissions?	no, list of years 2001-2009, yes dk year. dk, rf, na	Climate initiative
	no, list of years 2001-2009, yes dk year. dk, rf, na	ERP Environment and Energy Efficiency Programme
	no, list of years 2001-2009, yes dk year. dk, rf, na	Grant for independent energy audit from fonds for energy efficiency in SME
	no, list of years 2001-2009, yes dk year. dk, rf, na	Provision of cut-rate investment credit from fonds for energy efficiency in SME to implement identified energy-saving measures
	no, list of years 2001-2009, yes dk year. dk, rf, na	Support scheme of a federal state
	text	Other

Questions	Values	Coding description
HUNGARY		
H1. Have you received government support for any of your investments to reduce emissions or implement energy efficiency measures or increase the use of renewables? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na	Környezetvédelmi Alap Célelőirányzat
H2.(a) Have you received EU funds to support any of your investments to reduce emissions or implement energy efficiency measures or increase the use of renewables? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na	
(b) If yes, for which Operative Program; which call for proposal?	KEOP, KIOP, ERFA, dk, rf, na	
H3. Have you received funding from the Norwegian Fund for support? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na	EGT és Norvég Finanszírozási Mechanizmusok program
POLAND		
P.1 Do you use the sectoral information brochures published by the Ministry of Environment that include the information about the best available technologies for different economic activity? Since when?	no, list of years 2001-2009, yes dk year. dk, rf, na	
P.2 Have you ever taken a technological credit provided by the Technological Credit Fund? If yes. when?	no, list of years 2001-2009, yes dk year. dk, rf, na	
P.3 Have you ever been co-financed or have taken a preferential credit from the National Fund of Environmental Protection and Water Management, Bank of Environmental Protection and EkoFund? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na	
P.4 Have you ever benefited from the subventions and tax reductions from the government for environmental purposes? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na	
VIII. Post Interview		
Interview duration (mins)	number	Minutes

Questions	Values	Coding description	
Interviewers' impression of interviewee's reliability	1-5, dk, rf	Low	Some knowledge about his site, and no knowledge about the rest of the firm.
		Mid	Expert knowledge about his site, and some knowledge about the rest of the firm.
		High	Expert knowledge about his site and the rest of the firm.
Interviewee seemed concerned about climate change	1-5, dk, rf	Low	Not concerned.
		Mid	Somewhat.
		High	Very concerned.
Interviewee seemed skeptic about action on climate change	1-5, dk, rf	Low	Not skeptic at all.
		Mid	Somewhat skeptic.
		High	Very skeptic.
Mentioned other climate change related policies	text		
Moaned a lot about high energy prices	no, a little, a lot		
Number of times interview needed to be rescheduled	number		
Seniority of interviewee	Director, VP/General Manager, Plant/Factory Manager, Manufacturing/Production Manager, (Environmental), Health & Safety Manager, Technician		
Age of interviewee *Note: Do not ask, guess!*	number		
Gender of interviewee	male, female		
Interview language	English, French, German, Dutch, Hungarian, Polish		