Online Appendix

for **Martin, Ralf, Mirabelle Muûls, Laure B. de Preux and Ulrich J. Wagner**. 2013. “Industry Compensation Under Relocation Risk: A Firm-level Analysis of the EU Emissions Trading Scheme” *The American Economic Review,* forthcoming.

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A Background on the management interviews

A.1 Interview practice

Interviews were carried out by graduate and postgraduate students after they had been trained. The interviewers were paid according to the number of interviews conducted, encouraging them to do more interviews and discouraging any firm background research, thus preserving the double-blind nature of the survey. Interviewers made "cold calls" to production facilities (not head offices), gave their name and affiliation and then asked to be put through to the production or environmental manager. In the case of EU ETS firms, interviewers requested to speak to the person responsible for the EU ETS. At this stage, the terms "survey" and "research" were avoided as both are associated with commercial market research and some switchboard operators have instructions to reject such calls. Instead, we told them that we were doing "a piece of work" on climate change policies and their impact on competitiveness in the business sector and would like to have a conversation with the manager best informed.

Once the manager was on the phone, the interviewer asked whether s/he would be willing to have a conversation of about 40-45 minutes about these issues. Depending on the manager's willingness and availability to do so, an interview was scheduled. If the manager refused, s/he was asked to provide the interviewer with another knowledgeable contact at the firm who might be willing to comment. Managers who agreed to give an interview were sent an email with a letter in PDF format to confirm the date and time of the interview and to provide background information and assure them of confidentiality. A similar letter was sent to managers who requested additional information before scheduling an interview.

All interviewers worked on computers with an internet connection and used VOIP software to conduct the interviews. They accessed a central interview database via a custom-built, secure web interface which included a scheduling tool and the interview application which displayed the questions along with the scoring grid. The interview screen contained hyperlinks to a manual with background information on each question. Interviewers scored answers during the interview. For all interviews, the scheduling history as well as the exact time and date, duration, identity of interviewer, etc. were recorded. All interviews were conducted in the language of the interviewee's residence.

The interview format follows the design pioneered by Bloom and van Reenen (2007). This approach seeks to minimize cognitive bias by asking open-ended questions and by delegating the task of scoring the answers to the interviewer. In addition, a large sample size and interviewer rotation is exploited to control for possible bias on the part of the interviewers by including interviewer fixed effects in regres-

Table A.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.

sion analyses. For further details, see Bloom and van Reenen (2010).

A.2 Sample characteristics

Table A.1 provides an overview of the number of interviews and the response rates broken down by country and by EU ETS participation status.[1] The last column shows the response rate i.e. the fraction of firms that were contacted and with whom we successfully conducted an interview. These vary somewhat between different countries. For example, it is particularly low in Germany (38%) and the UK (40%), whereas in Belgium or Hungary, firms were more willing to participate (74% and 78%, respectively). Generally, these figures are very high compared to response rates achieved in postal or online surveys.

It is important for the validity of our analysis to rule out possible selection bias in our sample. EU ETS firms are different from non-ETS firms, but within these two categories, interviewed firms are not significantly different from non-interviewed firms in regards to the most common characteristics available in ORBIS. This is shown in Panel A of Table A.2 where each of the principal firm characteristics available from the ORBIS database (turnover, employment and capital) is regressed on a dummy variable indicating that a firm is part of the EU ETS, a dummy indicating that a firm was contacted, and a full set of sector and year dummies, with the result that the estimated coefficients are small and statistically insignificant. For the set of firms that either conceded or refused an interview, we ran analogous regressions to

[1] All analysts would first conduct interviews in the UK and only then go on to conduct interviews in another country allowing a common reference, hence the larger number of interviews for this country. This allows us to control for interviewer bias as discussed below and also for UK responses to be used as a benchmark.

Table A.2: Sample representativeness

	(1) Turnover	(2) Employment	(3) Capital
A. All firms			
Firm contacted	-0.0322	-0.0794	0.172
	(0.0786)	(0.0611)	(0.108)
EU ETS firm	2.031***	1.452***	2.530***
	(0.095)	(0.080)	(0.145)
Number of observations	118,874	107,830	113,771
Number of firms	12,322	12,921	118,874
R-squared	0.511	0.364	12322
B. Contacted firms			
Firm granted interview	-0.0983	-0.0373	0.0443
	(0.118)	(0.0957)	(0.150)
EU ETS firm	2.044***	1.547***	2.540***
	(0.124)	(0.107)	(0.160)
Number of observations	26,114	23,933	25,815
Number of firms	1,373	1,420	1,297
R-squared	0.659	0.589	0.618

Notes: Regressions in panel A are based on the set of manufacturing firms with more than 50 employees contained in ORBIS for the six countries covered by the survey. Each column shows the results from a regression of the ORBIS variable given in the column head on a dummy variable indicating whether a firm was contacted or not and a dummy variable indicating whether a firm was taking part in the EU ETS at the time of the interviewing. Panel B shows analogous regressions for the set of contacted companies and with an indicator for whether an interview was granted. All regressions are by OLS and include country dummies, year dummies and 3-digit sector dummies. Standard errors are clustered at the firm level and are robust to heteroskedasticity and autocorrelation of unknown form.* significant at 10%; ** significant at 5%; *** significant at 1%.

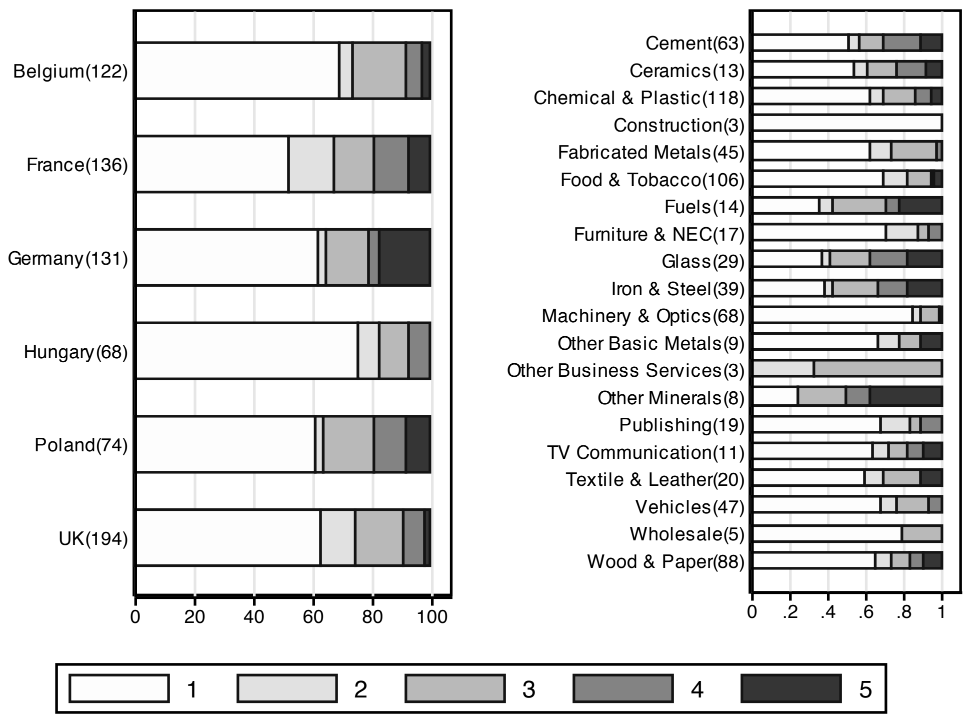
estimate an intercept specific to firms that granted us an interview. The results in Panel B of Table A.2 show that none of these intercepts is statistically significant. We thus conclude that our sample is representative of the underlying population of medium-sized manufacturing firms in the six European countries covered by our study.

B Robustness of vulnerability score

B.1 External consistency: Energy price regressions

We compile data on firm-level employment, wages and energy prices in European and OECD countries for the years from 1999 until 2007. Table B.1 summarizes the data.

Figure A.1: Distribution of vulnerability score by country and industry



Notes: Bar charts show the distribution of the vulnerability score by country (left) and by 3-digit NACE sector (right). The score ranges from 1 (no impact) to 5 (complete relocation). A score of 3 is given if at least 10% of production or employment would be outsourced in response to future carbon pricing. The number of observations in each country and industry is given in parenthesis. NEC: Not elsewhere classified.

Table A.3: Firm characteristics by ETS participation status

	ETS Firms			non ETS Firms		
	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.
Firm						
Age (years) *	40	37	409	33	37	327
Turnover (EUR million) **	725.73	3,611.50	398	146.42	767.93	298
Number of employees **	1,418	5,092	394	469	857	305
EBIT (EUR million) **	26.12	100.54	391	5.22	23.47	292
Number of shareholders	2	5	429	3	5	332
Number of subsidiaries	6	32	429	2	5	332
Firm's Global Ultimate Owner						
Turnover (USD million)	31,695	67,080	142	12,464	21,980	99
Number of employees	50,012	71,864	131	42,381	73,834	95

Notes: Based on 2007 data. Stars next to a variable name indicate that the respective means for ETS and non ETS firms are significantly different at the 10% (*), 5% (**), and 1% (***) levels.

Employment Our sample covers all firms contained in the ORBIS database which have 10 or more employees in at least one year during the sample period. In addition to employment, this source also provides industry codes at the 3-digit NACE level. The EU sample includes Austria, Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden and the United Kingdom. In addition to those countries, the OECD sample includes Canada, Mexico, Japan, Switzerland, and the United States of America, but not Romania.

Energy prices Price data for electricity, gas, liquid and solid fuels comes from the 'Energy Prices and Taxes database' maintained by the International Energy Agency (2009). To ensure comparability of prices across fuels, we adjust for net calorific value using prices in US$ per ton of oil equivalent (TOE). For each country c and year t, we compute the energy price in sector s as

$$EP^{D}_{cst} = \left(\sum_{e} \omega^{e}_{s} ln(p^{e}_{ct}) \right) \tag{B.1}$$

where p^{e}_{ct} is the price of fuel $e \in$ {electricity, gas, liquid fuel, solid fuel} and ω^{e}_{s} is the expenditure share of fuel e in sector s. Since expenditure shares are not available for all countries in the sample, we impute them using UK data at the 3-digit NACE code taken from the Quarterly Fuels Inquiry data maintained by the UK Office for National Statistics (2004). We hold these shares fixed at their 2004 values –

Table A.4: Descriptive statistics of the vulnerability score

	Mean	Standard deviation	Min	P25	Median	P75	Max	Firms
Overall vulnerability score	1.87	1.29	1	1	1	3	5	725
A. by country								
Belgium	1.69	1.13	1	1	1	3	5	122
France	2.07	1.34	1	1	1	3	5	136
Germany	2.12	1.58	1	1	1	3	5	131
Hungary	1.50	0.95	1	1	1	2	4	68
Poland	2.03	1.40	1	1	1	3	5	74
UK	1.75	1.12	1	1	1	3	5	194
B. by 3-digit sector								
Cement	2.33	1.52	1	1	1	4	5	63
Ceramics	2.15	1.46	1	1	1	3	5	13
Chemical & Plastic	1.86	1.26	1	1	1	3	5	118
Construction	1.00	0.00	1	1	1	1	1	3
Fabricated Metals	1.67	0.93	1	1	1	3	4	45
Food & Tobacco	1.56	1.01	1	1	1	2	5	106
Fuels	2.71	1.59	1	1	3	4	5	14
Furniture & NEC	1.47	0.87	1	1	1	2	4	17
Glass	2.76	1.57	1	1	3	4	5	29
Iron & Steel	2.69	1.56	1	1	3	4	5	39
Machinery & Optics	1.26	0.68	1	1	1	1	4	68
Other Basic Metals	1.78	1.39	1	1	1	2	5	9
Other Business Services	2.67	0.58	2	2	3	3	3	3
Other Minerals	3.38	1.69	1	2	4	5	5	8
Publishing	1.58	1.02	1	1	1	2	4	19
TV Communication	1.91	1.45	1	1	1	3	5	11
Textile & Leather	1.90	1.33	1	1	1	3	5	20
Vehicles	1.62	0.99	1	1	1	2	4	47
Wholesale	1.40	0.89	1	1	1	1	3	5
Wood & Paper	1.85	1.36	1	1	1	3	5	88

Notes: Summary statistics of the overall vulnerability score (first row), by country (panel A) and by 3-digit NACE sector (panel B). The score ranges from 1 (no impact) to 5 (complete relocation). A score of 3 is given if at least 10% of production of employment would be outsourced in response to future carbon pricing. NEC: Not elsewhere classified.

Table A.5: Differences in vulnerability score by sector and country

	(1)	(2)
	Deviations from the overall mean	
A. Countries		
Belgium	-0.034	0.054
France	0.361 **	0.322 *
Germany	0.032	0.021
Hungary	-0.402 *	-0.378
Poland	0.311	0.013
United Kingdom	-0.269	-0.032
3-digit Sector controls	no	yes
B. Sectors		
Ceramics	-0.011	-0.010
Cement	0.379 **	0.382 **
Chemical & Plastic	-0.168	-0.171
Fabricated Metals	-0.268 *	-0.272 *
Food & Tobacco	-0.474 ***	-0.474 ***
Fuels	0.563	0.566
Furniture & NEC	-0.584 ***	-0.583 ***
Glass	0.752 ***	0.752 ***
Iron & Steel	0.703 ***	0.697 ***
Machinery & Optics	-0.731 ***	-0.733 ***
Other Basic Metals	-0.284 **	-0.287
Other Minerals	1.278 **	1.285 **
Publishing	-0.415 *	-0.413 *
Textile & Leather	-0.130	-0.125
TV & Communication	-0.028	-0.025
Vehicles	-0.434 ***	-0.447 ***
Wood & Paper	-0.149	-0.147
Employment control	no	yes
Observations	725	725

Notes: Reported coefficients represent the deviation of a country/sector's intercept from the overall mean vulnerability score. Panel A is based on a regression of the vulnerability score on country dummies with additional controls for interview noise and 3-digit sector (column 2). Panel B is based on a regression of the vulnerability score on broadly defined sector dummies with additional controls for interview noise and employment (column 2). The asterisks indicate statistical significance of a t-test of equality of the country/sector's intercept and the overall mean (* $p<0.1$, ** $p<0.05$, *** $p<0.01$). NEC: Not elsewhere classified.

Table B.1: Descriptive statistics: Employment, energy prices and wages

	Mean	Standard deviation	Min	P25	Median	P75	Max
A. OECD							
Employment	120	542	1	20	39	93	86,607
log(employment)	3.87	1.14	0.00	3.00	3.66	4.53	11.37
Δlog(employment)	0.01	0.23	-1.99	-0.05	0.00	0.06	2.00
Domestic EP index [EP^D]	6.28	0.47	4.87	5.92	6.27	6.64	7.84
Foreign EP index [EP^F]	6.15	0.31	5.17	5.93	6.15	6.38	7.10
Relative energy price [EP^D-EP^F]	0.13	0.36	-0.73	-0.16	-0.01	0.50	1.05
ΔRelative energy price	0.00	0.08	-0.30	-0.06	-0.01	0.05	0.49
Domestic wage index [W^D]	0.00	0.08	-0.50	-0.05	0.00	0.04	5.19
Foreign wage index [W^F]	0.03	0.14	-0.28	-0.06	0.04	0.10	0.68
Relative wage [$Wage^D$-$Wage^F$]	-0.03	0.14	-0.81	-0.05	-0.02	0.03	5.36
ΔRelative wage	-0.02	0.13	-4.69	-0.04	-0.02	0.00	0.72
Firms: 113,680 (Observations: 464,272)							
B. Europe							
Employment	117	546	1	19	37	86	86,607
log(employment)	3.81	1.15	0.00	2.94	3.61	4.45	11.37
Δlog(employment)	0.01	0.24	-1.99	-0.05	0.00	0.07	2.00
Domestic EP index [EP^D]	6.23	0.47	4.87	5.89	6.17	6.52	7.84
Foreign EP index [EP^F]	6.14	0.31	5.17	5.92	6.14	6.37	7.10
Relative energy price [EP^D-EP^F]	0.09	0.36	-0.73	-0.17	-0.04	0.41	1.05
ΔRelative energy price	0.02	0.08	-0.30	-0.04	0.00	0.07	0.49
Domestic wage index [W^D]	0.00	0.09	-0.65	-0.05	0.00	0.05	5.19
Foreign wage index [W^F]	0.03	0.15	-0.27	-0.06	0.04	0.10	0.68
Relative wage [$Wage^D$-$Wage^F$]	-0.03	0.15	-0.81	-0.04	-0.02	0.03	5.36
ΔRelative wage	-0.01	0.14	-4.69	-0.03	-0.02	0.00	0.72
Firms: 94,398 (Observations: 396,182)							

Notes: The sectoral energy price (EP^D) is the average of the logarithmic prices of different fuel categories, weighted by the sector's expenditure shares for each category in the UK in 2004. The domestic wage index is the logarithmic change in the wage against its level in 2004. Foreign EP and wage indices are the averages of all foreign EP and wage variables, respectively, inversely weighted by the geographical distance to the foreign country. Δ stands for the first time difference (t-(t-1)) of a variable.

the latest year for which we have this information – in order to avoid the issue of endogenous changes in fuel expenditures.

In order to account for energy price variation in the other countries, we calculate a sectoral index of foreign energy prices as the average of the energy price indices (EP^D) in all countries j other than c, inversely weighted by their geographical distance d_{cj} to country c:

$$EP^F_{cst} = \sum_{j \neq c} EP^D_{jst} \left(\frac{d^{-1}_{cj}}{\sum_{k \neq c} d^{-1}_{ck}} \right) \tag{B.2}$$

Finally, we define the energy price differential between home and foreign countries as

$$\widetilde{EP}_{cst} \equiv EP^{D}_{cst} - EP^{F}_{cst} \tag{B.3}$$

Wages Wages at the 2-digit industry level, W_{cst}, are taken from the LABORSTA database maintained by the International Labor Organization (1997-2008). Note that wage data are reported on different scales (e.g. monthly, hourly) by the different sectors. This is however not an issue as we take the logarithmic measure of wages and control for sectoral trends in the regressions. We construct an index of foreign wages for each country c and sector s in year t as

$$W^{F}_{cst} = \sum_{j \neq c} \ln W_{jst} \left(\frac{d^{-1}_{cj}}{\sum_{k \neq c} d^{-1}_{ck}} \right) \tag{B.4}$$

and define the difference between local and foreign wages as

$$\widetilde{W}_{cst} \equiv W^{D}_{cst} - W^{F}_{cst}. \tag{B.5}$$

Vulnerable sectors We want to assess the ability of the VS measure to identify firms that are at risk of relocation. Since we do not have firm-level VS for the entire ORBIS sample, we compute the employment-weighted average VS for each (3-digit level) sector in the interview sample. We examine the relationship between VS and the price elasticities of employment using 3 types of interactions. Firstly, we interact the price variables (energy and wages) with an above-median indicator variable ($\mathbb{I}\{VS_s > q(50)\}$). This group is referred to as "High VS". Secondly, we interact the price variables with the deviation from the mean VS ($VS_s - \bar{VS}$). Finally, we re-estimate the first specification but interact the price variables also with indicators of the second and fourth quartiles of the VS distribution, i.e. $\mathbb{I}\{q(25) < VS_s < q(50)\}$ and $\mathbb{I}\{q(75) < VS_s\}$. The coefficients on these variables tell us if price elasticities of employment vary significantly between the quartiles on either side of the median.

Estimation We estimate equations of the form

$$\begin{aligned} l_{isct} \quad = \quad & \beta_l l_{isct-1} + \beta_P \widetilde{EP}_{sct-1} + \beta_W \widetilde{W}_{sct-1} \\ & + \textstyle\sum_{X \in \mathbb{X}} X_s \left(\beta_{XP} \widetilde{EP}_{sct-1} + \beta_{XW} \widetilde{W}_{sct-1} \right) \\ & + \alpha_{ct} + \alpha_{st} t + \alpha_i + \varepsilon_{it} \end{aligned} \tag{B.6}$$

Table B.2: Dynamic Panel Regressions of (log) employment

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment					
	OECD			European Union		
$Employment_{t-1}$	0.966***	0.966***	0.966***	0.950***	0.949***	0.950***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)
Relative energy price [EP^D-EP^F]	0.046***	0.038**	0.040**	0.089***	0.072***	0.080***
	(0.018)	(0.018)	(0.017)	(0.016)	(0.016)	(0.016)
× High VS [3rd & 4th VS quartiles]	-0.019***		-0.017***	-0.026***		-0.025***
	(0.004)		(0.005)	(0.004)		(0.005)
× VS-mean(VS)		-0.007***			-0.009***	
		(0.002)			(0.002)	
× 2nd VS quartile			-0.008			-0.006
			(0.006)			(0.006)
× 4th VS quartile			-0.006			-0.002
			(0.005)			(0.005)
Relative wage (W^D-W^F)	-0.022***	-0.022***	-0.021***	-0.012**	-0.012**	-0.012**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
× High VS [3rd & 4th VS quartiles]	-0.001**		0.001	0.003		0.009***
	(0.000)		(0.001)	(0.002)		(0.003)
× (VS-mean(VS))		-0.001***			-0.001	
		(0.000)			(0.001)	
× 2nd VS quartile			-0.001			-0.003
			(0.001)			(0.003)
× 4th VS quartile			-0.003***			-0.012***
			(0.001)			(0.002)
Country-by-year effects	yes	yes	yes	yes	yes	yes
Sector trends	yes	yes	yes	yes	yes	yes
Firms	113,680	113,680	113,680	94,398	94,398	94,398
Observations	464,272	464,272	464,272	396,182	396,182	396,182

Notes: The dependent variable is the firm employment measured on a logarithmic scale. The vulnerability score (VS) is the sectoral employment-weighted vulnerability score, and the quartiles are defined on the panel sample. All regressions are implemented with the System GMM by Blundell and Bond which includes a level and a differenced equation with lagged differences and twice-lagged levels of the endogenous variables as instruments. Robust standard errors, clustered at the firm level, are in parentheses. Asterisks indicate statistical significance at the 10%(*), 5%(**) and 1%(***) level.

where l is the logarithmic employment, $\mathbb{X}$ contains different sets of variables derived from the sectoral VS,[2] α_{ct} is a country-by-year effect, α_{st} captures a sector specific trend and α_i is a firm fixed effect. Following Blundell and Bond (1998), we estimate a system of equation (B.6) in levels and first differences with differences of the explanatory variables and lagged levels, respectively, as instruments. The system GMM estimator is necessary in our case as its less restrictive alternative, the Arellano-Bond estimator, is susceptible to a severe weak instrument bias given the high auto-correlation coefficient β_l that we find below. In Table B.3 we also report OLS estimates of equation (B.6) (i.e. abstracting from firm fixed effects) which leaves our key qualitative results on energy prices intact.

In addition to the energy price elasticities reported in Table 2 in the main text, Table B.2 reports the coefficients on wages as well as an additional specification in columns 3 and 6 where we interact the price coefficients with four VS quartile band indicators. The effects of energy prices in the second and fourth quartiles are not statistically significant, which supports the more parsimonious specification with the High VS dummy that we report in main text.

In all specifications, employment responds negatively to an increase in relative wages, which is in line with expectations. There is some evidence of negative interactions with the VS measures, yet the pattern is less robust than the one found for energy prices. For the EU sample, for instance, we find a non-monotone relationship in column 6 where the third quartile is less responsive than the fourth quartile. Of course there is no reason why we should expect a particular pattern for wages in terms of VS. Finally, the OLS estimates of energy prices elasticities reported in Table B.3 lead to comparable results, although the coefficients on the endogenous wage variable naturally look less plausible.

B.2 Reliability of the vulnerability score: a regression discontinuity design

This section performs an additional test of the reliability of the vulnerability score (VS). The score is based on the interviewees' assessment of their reaction to carbon pricing policies until 2020, when assuming that they would not receive any permits for free. This is a counterfactual scenario because the manufacturing firms we interviewed could expect to receive part of their emission permits for free under the benchmarking rule, or receive even more permits for free if they were considered to be at risk of carbon leakage. The criteria and thresholds for determining

[2] In the first specification, $\mathbb{X} = \{\mathbb{I}\{q(50) < VS_s\}\} = High\,VS$, in the second specification $\mathbb{X} = \{VS - mean(VS)\}$, and in the last specification $\mathbb{X} = \{\mathbb{I}\{q(50) < VS_s < q(100)\}, \mathbb{I}\{q(25) < VS_s < q(50)\}, \mathbb{I}\{q(75) < VS_s\}\}$.

Table B.3: OLS Regressions of (log) employment

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment					
	OECD			European Union		
Employment$_{t-1}$	0.973***	0.973***	0.973***	0.970***	0.970***	0.970***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Relative energy price [EP^D-EP^F]	0.017***	0.009*	0.015***	0.008	0.000	0.007
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
× High VS [3^{rd} & 4^{th} VS quartiles]	-0.010***		-0.006**	-0.011***		-0.008***
	(0.002)		(0.003)	(0.002)		(0.003)
× VS-mean(VS)		-0.004***			-0.005***	
		(0.001)			(0.001)	
× 2^{nd} VS quartile			0.010**			0.007*
			(0.004)			(0.004)
× 4^{th} VS quartile			-0.005			-0.005
			(0.003)			(0.003)
Relative wage (W^D-W^F)	0.000	0.000	0.001	0.006**	0.006**	0.007**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
× High VS [3^{rd} & 4^{th} VS quartiles]	-0.001***		-0.000	-0.000		-0.001**
	(0.000)		(0.000)	(0.001)		(0.001)
× (VS-mean(VS))		-0.001***			-0.000	
		(0.000)			(0.000)	
× 2^{nd} VS quartile			-0.002***			-0.002***
			(0.000)			(0.001)
× 4^{th} VS quartile			-0.002***			0.000
			(0.000)			(0.001)
Country-by-year effects	yes	yes	yes	yes	yes	yes
Sector trends	yes	yes	yes	yes	yes	yes
Firms	113,680	113,680	113,680	94,398	94,398	94,398
Observations	464,272	464,272	464,272	396,182	396,182	396,182

Notes: The dependent variable is the firm employment measured on a logarithmic scale. The vulnerability score (VS) is the sectoral employment-weighted vulnerability score, and the quartiles are defined on the panel sample. All regressions are estimated by OLS. Robust standard errors, clustered at the firm level, are in parentheses. Asterisks indicate statistical significance at the 10%(*), 5%(**) and 1%(***) level.

carbon leakage risk were set out in Directive 2009/29/EC, published four months before we started the interviews. Therefore, we cannot rule out the possibility that some respondents correctly anticipated that they would receive free permits. Here we employ a regression discontinuity design (RDD) to test whether anticipation of free permit allocation influenced interview responses in spite of our request to consider the case of no free permits. As discussed in the main text, the criteria for free allocation were defined in terms of a number of thresholds for the sector's trade and carbon intensity. If the criteria were in fact known by the respondents and affected their reported VS, we should observe discrete jumps in VS around the relevant threshold values.

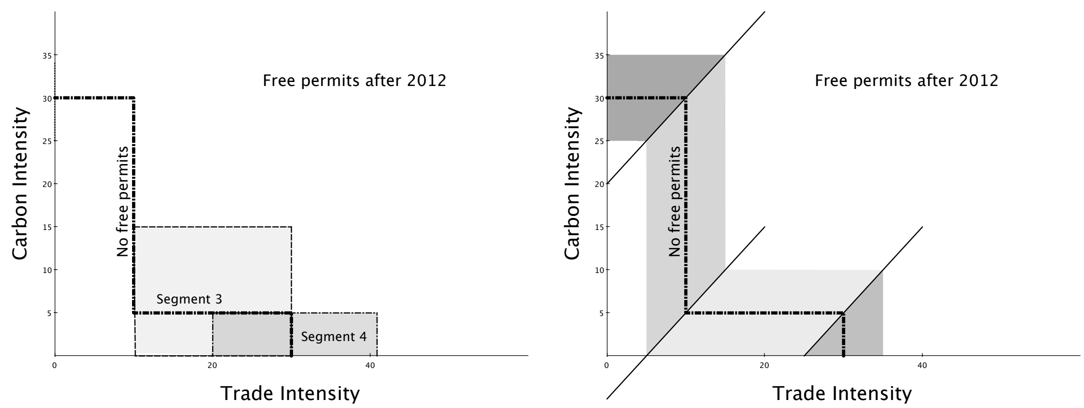
This test only has power if the sharp discontinuity in free permit allocation at the thresholds translated into a sharp discontinuity in managers' expectations. The data requirements for computing sector averages are not trivial (Juergens, Barreiro-Hurlé and Vasa, 2013; EU Commission, 2009), and the first official list of sectors at risk was not published until after the interview process was completed (cf. Decision 2010/2/EU of 24 December 2009). If managers did hold expectations about free permit allocation but failed to predict on which side of the thresholds their sector was going to be, then the RDD based test proposed here might fail to reject for the wrong reason.

To guard against this possibility, we also test for discrete jumps in the score relating to the expected stringency (ES) of phase III of the EU ETS. This score, which is based on questions 9b)-9e) of the interview script reproduced in Appendix G, measures stringency not only in terms of the overall cap – which determines the permit price – but also in terms of how difficult it will be for the firm to keep emissions in check with the free permit allocation it expects to receive in the future. Since this latter aspect of stringency varies with free permit allocation, it also depends on the thresholds for carbon leakage sectors. Finding threshold effects for ES would thus strengthen the power of the RDD based test performed on the VS.

To begin, consider the four thresholds depicted by the bold line in panel (a) of Figure B.1. CI thresholds are at 30% (segment 1) and at 5% (segment 3), whilst thresholds for TI are at 10% (segment 2) and at 30% (segment 4). Most of the firms in our sample are concentrated in segments 3 and 4. A traditional RDD can be employed to estimate the threshold effect in a narrow band around the threshold. For example, panel (a) of Figure B.1 depicts 10% bands on either side of segments 3 and 4. Figure B.2 plots fitted regression lines and confidence bands on either side of the thresholds, for either of the two segments. Panels (a) and (c) of the figure focus on the 5% threshold for CI, and panels (b) and (d) on the 30% threshold for TI. In panels (c) and (d) of Figure B.2, the regression lines are restricted to have the same slope above and below the threshold. In neither case can we detect a significant discontinuity at the threshold. The point estimates of these threshold effects are

Figure B.1: Defining threshold bands

(a) Overlapping bands (b) Non-overlapping bands



small, positive and statistically insignificant. Had the interviewees factored their subsequent continued free allocation into their responses, we should have observed a negative and statistically significant effect. Interestingly, we do observe such an effect for the ES score. Panels (b) and (d) of Figure B.3 show a clear jump in the score value when the 30% trade intensity threshold is crossed.

To account for multiple running variables and two-dimensional thresholds, we use an approach similar to Papay, Willett and Murnane (2011). First, we partition the sample along the four segments, as shown in panel (b) of Figure B.1. Next, we estimate the equation

$$VS_{ij} = \sum_{s=1}^{4} \mathbb{I}_{\{i \in \mathscr{F}_s(B)\}} \cdot \left(\beta^s_{CI} \cdot CI_j + \beta^s_{TI} \cdot TI_j\right) + \beta_D \cdot EXEMPT_j + \mathbf{x}'_{ij}\beta_x + \varepsilon_{ij} \quad \text{(B.7)}$$

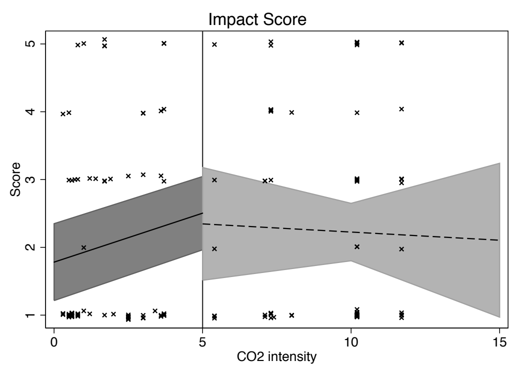
where s indexes the segment, $\mathscr{F}_s(B)$ denotes the set of firms i in sector j that fall into the band B around a particular segment, $\mathbb{I}\{\cdot\}$ is the indicator function and $\mathbf{x}_{ij}$ is a vector of additional control variables.[3] $EXEMPT_j$ is a dummy variable indicating that sector j will receive free permits by virtue of being above the threshold. The threshold effect is identified across all partitions, using observations within a 10% band from each threshold. We allow for different coefficients on the running variables CI_j and TI_j underlying the threshold dummy D_j.

Panel A of Table B.4 summarizes the results. The baseline specification, which

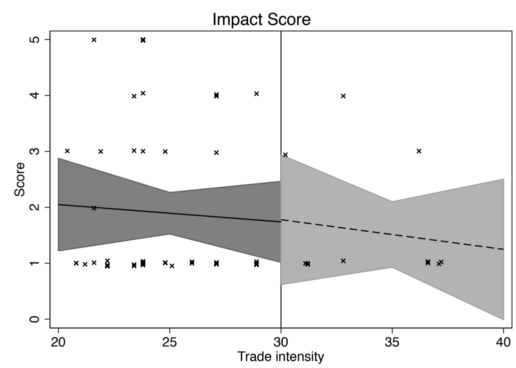
[3] We experiment with different specifications for the running variables (linear vs. quadratic) and controls, as well as with different bandwidths. They all yield similar results, as shown in Table B.4. Additional results are available from the authors upon request.

Figure B.2: Effect of exemption thresholds on VS? Graphical analysis

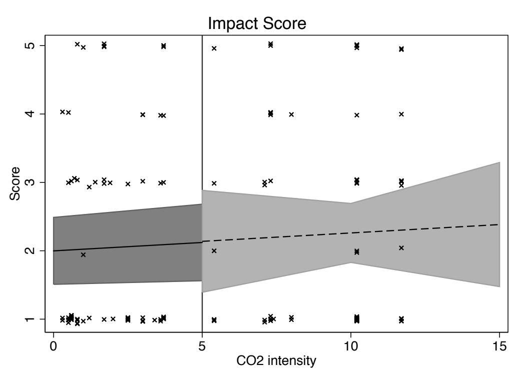
(a) 5% CI Threshold - 10% Bands



(b) 30% TI threshold - 10% Bands



(c) 5% CI threshold - 10% Bands - equal slopes



(d) 30% TI threshold - 10% Bands - equal slopes

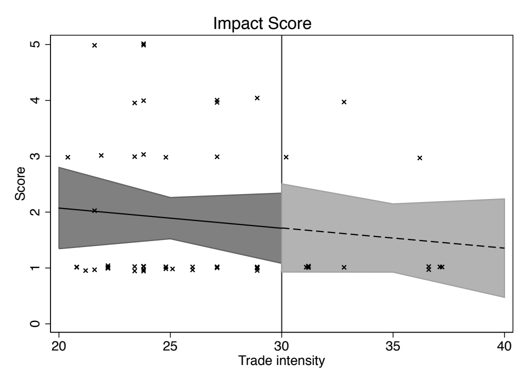
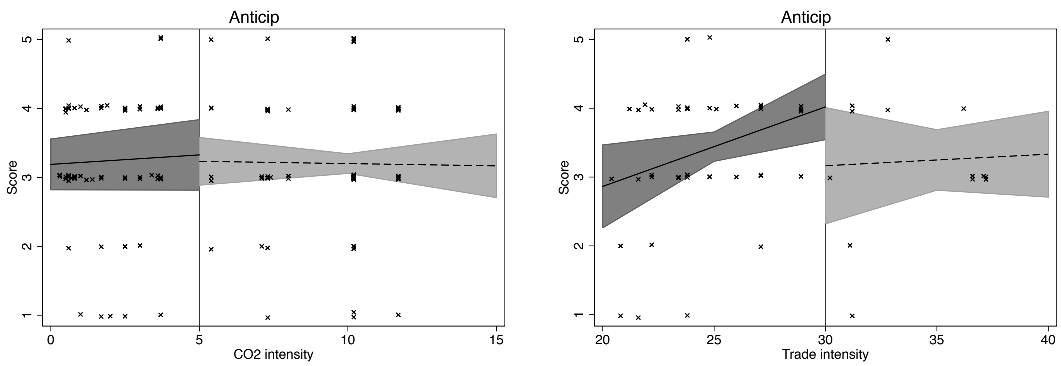


Figure B.3: Effect of exemption thresholds on expected stringency? Graphical analysis

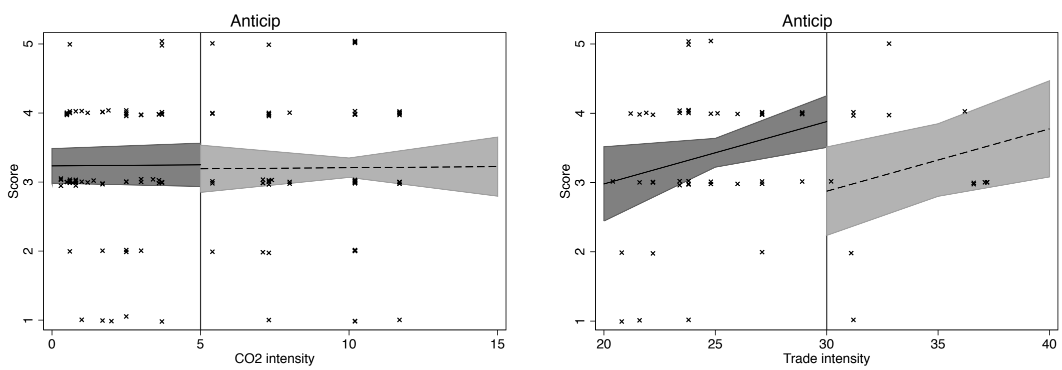
(a) 5% CI Threshold - 10% Bands

(b) 30% TI threshold - 10% Bands



(c) 5% CI threshold - 10% Bands - equal slopes

(d) 30% TI threshold - 10% Bands - equal slopes



is linear in the running variables and lacks further controls, yields a statistically insignificant coefficient of 0.21 (in column 1). This means that firms just above the threshold for free permit allocation have a VS that is 0.21 points (about one tenth of the standard deviation in this sample) higher on average than the VS for firms just below the threshold. The specification in column 2 includes firm-level CO_2 emissions and employment as control variables, in addition to interview noise controls (i.e. interviewer dummies as well as interview and interviewee characteristics). The point estimate for the threshold effect becomes negative but remains insignificant and small in magnitude. Choosing narrower bands (5% on either side of the threshold) changes the threshold estimate very little, as reported in column 3. If anything, the point estimate is closer to 0. Columns 4 through 6 report the results when eq. (B.7) is estimated with 15% and 20% bands, or with a second-order polynomial in the running variables. Neither specification gives rise to a statistically significant threshold effect.

Panel B of Table B.4 reports results based on the same specifications, but using ES as the dependent variable. We find a significant negative threshold effect for all specifications, suggesting that a considerable number of firms had correct expectations about their future permit allocation situation. Since we do not find threshold effects on VS in spite of this, we conclude that managers understood correctly that their response to the question underlying the VS was conditional on not receiving free permits.

C Computational appendix

C.1 Firm level allocation

We implement the dynamic programming algorithm to solve programs (4) and (6) in a STATA ado file using MATA language. The structure of these programs is akin to a dynamic 'cake eating problem' (see e.g. Adda and Cooper, 2003), with the difference that the 'cake' is not distributed over time but across firms. This approach can be applied to a broad class of specifications for the relocation probability and objective functions. Importantly, it allows us to solve the dual problem (6) as well.

Primal program: Minimize risk subject to fixed permit allocation Firm i's contribution to aggregate relocation risk is given by

$$r_i(q_i) = \frac{d_i}{1 + \exp(\beta_{0i} + \beta_{1i} q_i)} \tag{C.1}$$

Table B.4: Effect of exemption thresholds on VS and ES? RDD estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	A. Dependent Variable: Vulnerability Score (VS)					
EXEMPT	0.21	-0.23	-0.17	-0.22	-0.52	-0.37
	(0.256)	(0.314)	(0.376)	(0.331)	(0.515)	(0.479)
Log(employment)		-0.07	-0.08	-0.08	-0.09	-0.09
		(0.073)	(0.072)	(0.073)	(0.071)	(0.070)
Log(CO_2 emissions)		0.191**	0.199***	0.199**	0.206**	0.192**
		(0.078)	(0.076)	(0.078)	(0.079)	(0.077)
Multinational dummy		-0.23	-0.16	-0.23	-0.19	-0.17
		(0.176)	(0.181)	(0.173)	(0.178)	(0.174)
	B. Dependent Variable: Expected Stringency (ES)					
EXEMPT	-0.356*	-0.461**	-0.417*	-0.466**	-0.513**	-0.967***
	(0.191)	(0.191)	(0.221)	(0.189)	(0.226)	(0.284)
Log(employment)		-0.001	0.007	-0.001	0.010	0.009
		(0.038)	(0.038)	(0.038)	(0.037)	(0.042)
Log(CO_2 emissions)		0.148***	0.152***	0.146***	0.142***	0.133***
		(0.049)	(0.046)	(0.048)	(0.049)	(0.048)
Multinational dummy		0.293**	0.279**	0.293**	0.313**	0.317**
		(0.134)	(0.128)	(0.134)	(0.135)	(0.128)
Noise controls	no	yes	yes	yes	yes	yes
Observations	310	310	310	310	310	310
above thresholds in band	106	106	34	109	146	106
below thresholds in band	137	137	102	137	137	137
Bands	10%	10%	5%	15%	20%	10%
Running variables	Linear	Linear	Linear	Linear	Linear	Quadratic

where d_i is the damage caused by relocation of firm i. This is substituted into the Bellman equation

$$V_i(s_i) = \min_{0 \le q_i \le s_i} r_i(q_i) + V_{i+1}(s_i - q_i) \tag{C.2}$$

We evaluate eq. (C.1) for each firm on a grid ranging from 0 to $\bar{Q}$. This matrix is passed on to the program cake.ado which evaluates and solves (C.7).

Dual Program: Minimize free permit allocation subject to fixed risk. Since $F_i(-\pi_i(\cdot))$ is strictly monotonic in q_i we can invert eq. (C.1) to get

$$q_i = \pi_i^{-1}\left[-F_i^{-1}\left(\frac{r_i}{\alpha l_i + (1-\alpha)e_i}\right)\right]$$

and rewrite the dual program (6) as

$$\min_{\{r_i \ge 0\}} \sum_{i=1}^{n} \pi_i^{-1}\left[-F_i^{-1}\left(\frac{r_i}{\alpha l_i + (1-\alpha)e_i}\right)\right] \text{ s. t. } \left(\sum_i r_i \le \bar{R}\right). \tag{C.3}$$

That is, rather than allocating the pieces of a fixed pie of free permits so as to reduce total risk, we now allocate the pieces of a fixed pie of relocation risk so as to minimize total permits. For all firms with $\beta_{1i} > 0$ we invert function (C.1) over the positive range to obtain

$$q_i(r_i) = \begin{cases} \frac{1}{\beta_{1i}} \log\left(\frac{d_i}{r_i} - 1\right) - \frac{\beta_{0i}}{\beta_{1i}} & r_i < \frac{d_i}{1+\exp(\beta_{0i})} \\ 0 & \text{otherwise} \end{cases} \tag{C.4}$$

The corresponding Bellman equation is given by

$$W_i(s_i) = \min_{0 \le r_i \le s_i} q_i(r_i) + W_{i+1}(s_i - r_i) \tag{C.5}$$

Again this function can be written as a vector on a grid and passed on to cake.ado which computes the minimum allocation.

C.2 Sector level allocation

In the sector-level allocation scenario, it is assumed that the regulator assigns free permits to the sector as a whole but refrains from redistributing emission permits amongst the firms in this sector. Denote by θ_{ij} ($0 \le \theta_{ij} \le 1$) firm i's share in the total amount of permits Q_j allocated to sector j. We assume that firms receive emission permits in proportion to their historical emissions e_i, i.e. $\theta_{ij} = \frac{e_i}{\sum_{k\in j} e_k}$.

Primal program Sector j's contribution to aggregate risk of relocation is given by

$$R_j(Q_j) = \sum_{i\in j} \frac{d_i}{1+\exp\left(\beta_{0i}+\beta_{1i}\theta_{ij}Q_j\right)}. \tag{C.6}$$

These can be vectorized and passed on to the cake.ado program to solve the Bellman equation

$$V_j\left(S_j\right) = \min_{0\leq Q_j\leq S_j} R_j(Q_j) + V_{j+1}\left(S_j - Q_j\right). \tag{C.7}$$

The program returns the optimal quantities of free permits for each sector, and thanks to the shares θ_{ij} these map directly into firm level allocations.

Dual Program In order to use cake and the assumption of proportional permit allocation within sectors, one would have to invert the sector risk function (C.6). Since there is no closed-form solution for the inverse, we do not compute the permit minimizing sector-level allocation.

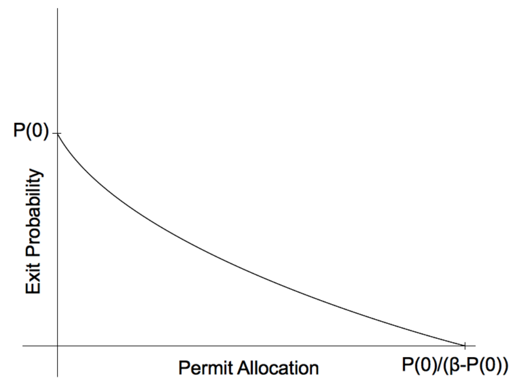
C.3 Further details on computation

Characteristics of the relocation probability The probability of exiting is a declining function of free permits q_i bounded between 0 and 1 (cf. Figure C.1). The marginal impact on firm exit of an additional unit of free permits for firm i is given by

$$\frac{dF_i\left[-\pi_i(q_i)\right]}{dq_i} = \beta_{1i}\frac{-\exp\left(\beta_{0i}+\beta_{1i}q_i\right)}{\left[1+\exp\left(\beta_{0i}+\beta_{1i}q_i\right)\right]^2} \tag{C.8}$$

which is strictly negative for $\beta_{1i} > 0$. This is the case if allocating more permits for free strictly reduces the relocation probability, i.e. $F_i(0) > F_i(0.8e_i)$. Since the marginal impact of free permits on the relocation probability is declining in absolute value, the government should allocate free permits first to firms with the highest absolute impact of the first free permit, $\frac{\beta_{1i}\exp(\beta_{0i})}{[1+\exp(\beta_{0i})]^2}$.

Figure C.1: The shape of the exit probability function



Sample Out of 770 interviewed firms, there are 429 EU ETS firms. Of these we dropped firms with missing information on the survey questions, on the ORBIS variables, and on the phase III benchmark allocation. This leaves us with 344 observations across the six countries for the simulations.

Variables Employment l_i and turnover are calculated as pre-sample averages of the number of employees from ORBIS over the years from 2005 to 2008. CO_2 emissions, e_i, are calculated as the average of surrendered permits from CITL in years 2007 and 2008. Carbon intensity and trade intensity are computed for each sector as documented in Section I.

Permit allocations in the reference scenarios are calculated as follows. The grandfathering allocation corresponds to the average CO_2 emissions, as calculated above. The benchmarking allocation is the mean allocation from 2013 until 2020, taken from the official NIMs for the six countries. The overall cap $\bar{Q}$ is calculated as the sum of the reference allocations across all firms in the sample.

C.4 Dynamic programming using cake.ado

The ado file cake.ado uses dynamic programming to solve a minimization program of the type

$$\min_{x_i} \sum_{i=1}^{N} f_i(x_i) \qquad \text{s.t.} \sum_{i=1}^{N} x_i \leq \bar{x}.$$

Before calling cake.ado we need to

1. Discretize the vector x on a finite support. For simplicitly, suppose that we have discrete support $1, 2, \ldots, \bar{x}-1, \bar{x}$.

2. Evaluate, for each firm i, the risk at each point of the support:

$$\mathbf{f} = \begin{bmatrix} f_i(0) \\ f_i(1) \\ \vdots \\ f_i(\bar{x}-1) \\ f_i(\bar{x}) \end{bmatrix}$$

The vector $\mathbf{f}$ is an input to the STATA program cake.ado. The program does the following:

1. Set the continuation value for the last firm to $v_N(x) = f_N(x)$ and iterate backwards. The continuation value for the penultimate firm is given by $v_{N-1}(x) = \min_c f_{N-1}(c) + v_N(x-c)$. To do this numerically, v_{N-1}must be evaluated for each x and c. This is done by building a matrix with values $v_{N-1}(x,c) = f_{N-1}(c) + v_N(x-c)$ where x shifts along the rows and c along the columns. The components of this matrix are:

$$V_N(x) = \begin{bmatrix} v_N(0) & B & B & B \\ v_N(1) & v_N(0) & B & B \\ \vdots & \vdots & \ddots & B \\ v_N(\bar{x}) & v_N(\bar{x}-1) & \ldots & v_N(0) \end{bmatrix}$$

   and

$$F_{N-1}(c) = \begin{bmatrix} f_{N-1}(0) & B & B & B \\ f_{N-1}(0) & f_{N-1}(1) & B & B \\ \ddots & \vdots & \ddots & B \\ f_{N-1}(0) & f_{N-1}(1) & \ldots & f_{N-1}(\bar{x}) \end{bmatrix}$$

   where B is a large number. The vector $v_{N-1}(x)$ is obtained by adding the two matrices and picking the minimum in each row. The policy function $a_{N-1}(x)$ is obtained in a similar fashion, as the $\arg\min$of each row of the matrix.

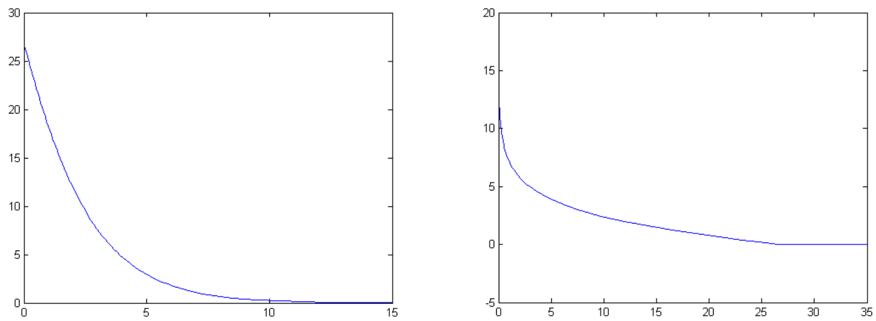
2. This step is repeated recursively for all firms. The result is a vector $v_1(x)$ which gives the minimal risk for every possible initial allocation of permits, and a policy matrix A which results from concatenating all the a vectors.

3. To obtain the optimal allocation, one can start with allocation $\bar{x}$ and consult the policy function for the first firm (in the first column of A). For example, if

Figure C.2: Function plots: damage=100, $\beta_0 = 1$, $\beta_1 = .5$,

(a) Risk function

(b) Inverse risk function (allocation)



$a_1(\bar{x}) = k \leq \bar{x}$ we know that the row minimum was in column k which means that the first firm should receive $k-1$ free permits. Then move on to the second column of A and evaluate at $x = \bar{x} - k$ to get the allocation for firm 2, and so on.

Figure C.2 shows the shape of the risk function (in panel a) and of the inverse risk function (in panel b). Since negative allocations are not possible, we need to truncate the function at the root and assign 0 permits to all risk allocations larger than the root. Moreover, firms that do not respond to free permit allocation at all $(\beta_1 = 0)$ are allocated 0 permits in a separate step prior to optimization.

D Output-based updating

In Section III the firm's response to free permits is modeled in terms of the *probability* of exit from the EU for different allocation levels. In line with the institutional framework of capacity-based updating, there is no intensive margin-response on employment or output. This section shows that a similar reduced-form response of home (EU) employment (or output) can be obtained when allowing for output adjustments in a more flexible framework.

Suppose that a firm's final output Q is produced by means of a Leontief production function

$$Q = \min_{v \in [\varepsilon, 1]} \{v_v\}$$

using a continuum of intermediate input varieties v_v. Production of a variety can be in home or foreign. Varieties are produced with labor and energy leading to CO_2

emissions. Home has lower effective wages (e.g. because of higher productivity), foreign has lower energy costs.

Varieties differ in the amount of energy required to produce them. The technology for producing varieties is Leontief

$$v_\nu = \min\left\{L_\nu, \frac{1}{\gamma\nu}E_\nu\right\}$$

where E_ν is the amount of energy and L_ν labour. Energy intensity of production is highest for variety $\nu = 1$ and lowest for variety $\nu = \varepsilon$. The parameter γ scales the overall energy intensity of a firm. The cost of producing one unit of a variety ν is given by

$$c_\nu = W_L + \gamma\nu W_E$$

For simplicity we normalize the energy cost in foreign and the wage cost in home to 0. If the wage in foreign is equal to w and the energy cost in home is equal to τ we can find the marginal variety s by equalizing the costs in home and foreign:

$$\tau\gamma s = w \tag{D.1}$$

The optimal offshoring decision

$$s = \begin{cases} \varepsilon & \text{if } \frac{w}{\gamma\tau} < \varepsilon \\ \frac{w}{\gamma\tau} & \text{if } \varepsilon \leq \frac{w}{\gamma\tau} < 1 \\ 1 & \text{if } \frac{w}{\gamma\tau} \geq 1 \end{cases}$$

implies that higher energy costs at home lead to a larger number of varieties being produced abroad. Moreover, firms whose energy intensity increases faster across varieties (high γ) produce a larger share of intermediates abroad.

The unit and marginal costs of producing a unit of final output will be equal to

$$c(s) = \int_\varepsilon^s \tau\gamma\nu d\nu + \int_s^1 w d\nu = \frac{1}{2}\tau\gamma\left(s^2 - \varepsilon^2\right) + w(1-s)$$

Since $\frac{\partial c(s)}{\partial s} = \tau\gamma s - w$, the heuristic derivation of the marginal variety in (D.1) gives rise to the same interior solution as the unit cost minimization program.

Free allocation Free allocation in Phase III of the EU ETS consists of a lump sum allocation $\bar{A}$ which is based on historical output and sector specific benchmarks for the emissions intensity of output. When a firm outsources a substantive share of production by shifting the production of certain varieties to foreign, the allocation is adjusted downwards. As discussed above, this practice likens free permit allocation to a step function in output. In the main text, we considered a simplified version of this step function which had only a single step (all or nothing). Here we consider the opposite extreme and assume that the number of permits that the firm can retain, A_i, is directly proportional to output if output is smaller than historical domestic output $H = \bar{s}\bar{Q}$

$$A = \begin{cases} \frac{sQ}{H}\bar{A} & \text{if } \frac{sQ}{H} < 1 \\ \bar{A} & \text{otherwise} \end{cases} \tag{D.2}$$

Profit maximization To complete the description of the firm's problem we have to make an assumption about demand. Suppose we have monopolistic competition with linear demand

$$P = a - bQ$$

Profits are given by

$$\Pi\left(Q, s, \bar{A}\right) = aQ - Q^2 b - Qc\left(s\right) + \frac{sQ}{H}\bar{A}$$

and the profit maximization problem becomes

$$\max_{Q,s} \Pi\left(Q, s, \bar{A}\right)$$

The first order conditions are given by

$$[Q] \qquad a - 2Qb - c\left(s\right) + \frac{s\bar{A}}{H} \geq 0 \qquad \wedge \tag{D.3}$$

$$[s] \qquad \frac{Q\bar{A}}{H} - Q\left(\tau\gamma s - w\right) \geq 0 \tag{D.4}$$

For an interior solution condition (D.3) implies

$$Q\left(s\right) = \frac{a - c\left(s\right) + \frac{s\bar{A}}{H}}{2b}$$

From (D.4) we can solve for the optimal relocation threshold s^*:

$$s^* = \begin{cases} \varepsilon & \text{if } \frac{1}{\gamma\tau}\left(w + \frac{\bar{A}}{H}\right) < \varepsilon \\ \frac{1}{\gamma\tau}\left(w + \frac{\bar{A}}{H}\right) & \text{if } \varepsilon \leq \frac{1}{\gamma\tau}\left(w + \frac{\bar{A}}{H}\right) < 1 \\ 1 & \text{otherwise} \end{cases} \tag{D.5}$$

From (D.3) and (D.5) it is straightforward to calculate total output Q^*, domestic output s^*Q^* and domestic employment

$$L^* = \begin{cases} (s^* - \varepsilon)\, Q^* & \text{if } (s^* - \varepsilon)\, Q^* < H \\ H & \text{otherwise} \end{cases} \tag{D.6}$$

where the two cases follow from the allocation rule in equation (D.2).

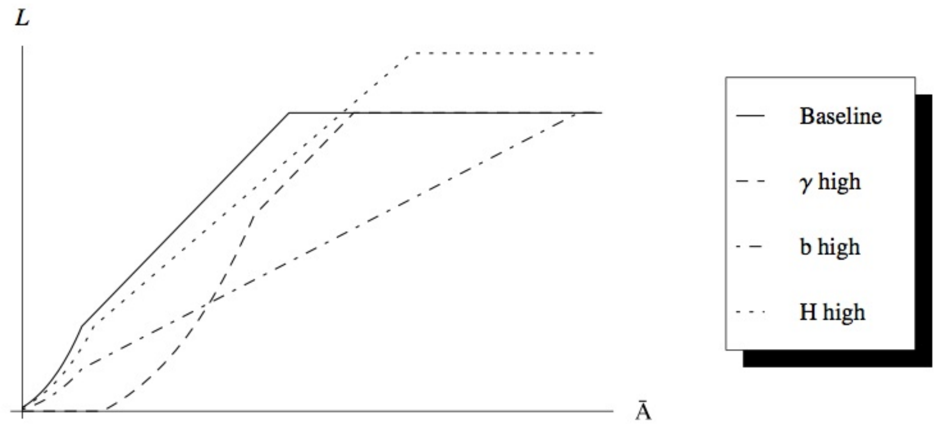
Figure D.1 plots employment in home as a function of freely allocated permits $\bar{A}$ for different parameter values. In the baseline case, employment initially increases with $\bar{A}$. The increase is more than proportional when $s < 1$, as the firm responds to free permits both by increasing the share of varieties produced at home and by increasing final output Q. Once all varieties have been repatriated, further increases in $\bar{A}$ linearly increase home employment until the firm reaches its historical output level.

Upon comparing the different cases shown in Figure D.1, we see that the response to free permits is slower when the firm is more energy intensive (γ high) because a stronger incentive is required to repatriate the more energy intensive varieties. The employment response is also slower whenthe demand elasticity is lower than in the baseline case (b high). This is because the firm has more market power and chooses lower levels of output irrespective of the share of intermediates produced at home.[4] Finally, firms with a higher historical output (H high) continue to increase employment at higher levels of $\bar{A}$ than in the baseline case. The initial marginal impact in this case is smaller than in the baseline case because the actual amount of permits received, A, is inversely proportional to the (larger) reference output.

In sum, this appendix has illustrated that the S-shaped function we have used in the main text to approximate the response of output and employment to free permit allocation provides a reasonable approximation even under the (counterfactual) assumption that free permit allocation is directly proportional to output.

[4] Hence the marginal impact of repatriating a variety and in turn the marginal impact of additional free allocations is lower.

Figure D.1: Home employment as a function of free permits



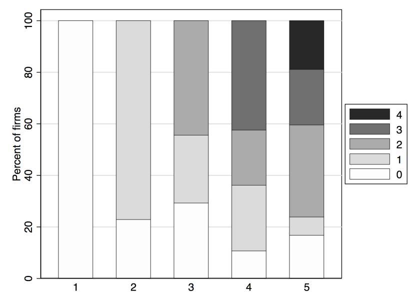
E Additional Tables and Figures

Table E.1: Sector classification

Sector	NACE Sectors	CITL 2008 sectors
Food & Tobacco	15, 16	
Textile & Leather	17, 18, 19	
Wood & Paper	20,21	9
Publishing	22	
Fuels	23	2,3
Chemical & Plastic	24, 25	
Glass	261	7
Ceramics	262	8
Cement	264, 265,266	6
Other Minerals	267, 268	
Iron & Steel	271, 272, 273, 275	5
Other Basic Metals	274	
Fabricated Metals	28	
Machinery & Optics	29, 30, 31,33	
TV & Communication	32	
Vehicles	34,35	
Furniture & NEC	36	

Notes: NACE sectors codes are based on NACE 1.1. NEC: Not elsewhere classified.

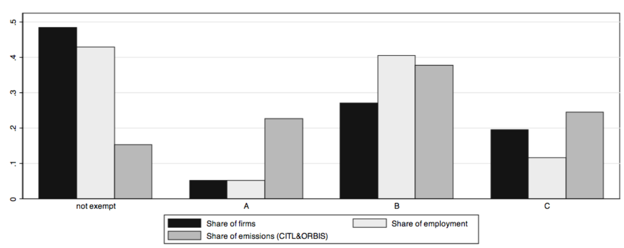
Figure E.1: Impact of free allocation on the vulnerability score



Notes: The chart shows the conditional distribution of the reduction in the vulnerability score when firms receive free permits for 80% of their direct carbon emissions. The conditioning variable is the vulnerability score in the absence of free permits. For example, the fifth bar represents firms that responded that future carbon pricing would likely force them to close down or relocate. One fifth of these firms reported that receiving free permits would have no impact on this decision whereas another fifth reported that this would neutralize any negative impact on domestic production.

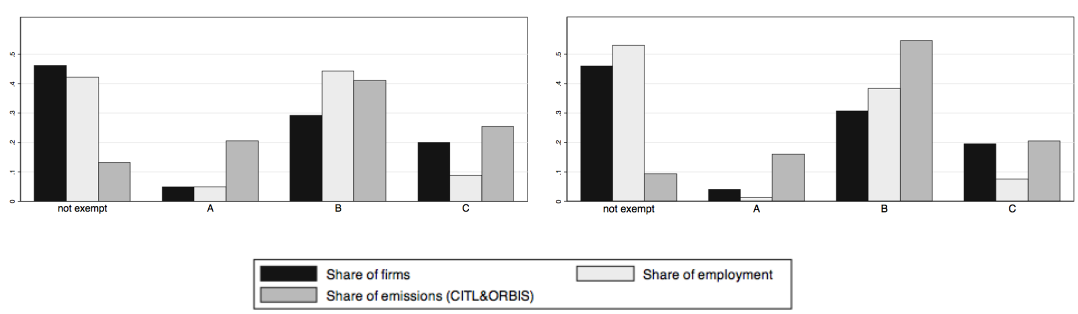
Figure E.2: Relative size of exemption groups in different samples

(a) All matched EU ETS firms



(b) Matched EU ETS firms in 6 interview countries

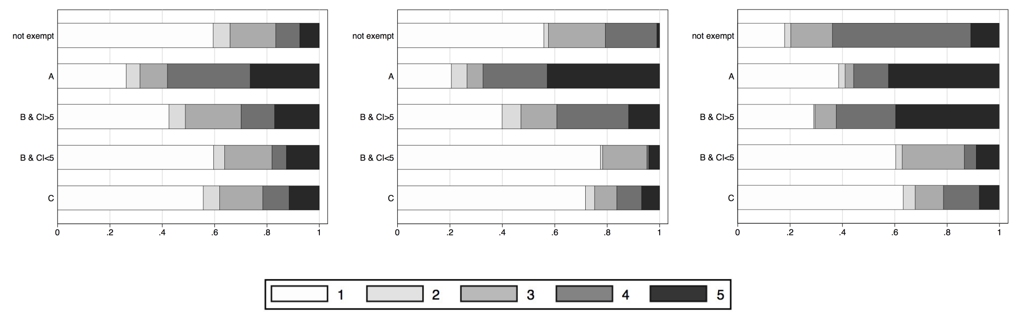
(c) Interviewed EU ETS firms only



Notes: The charts display the relative size of each category of sectors in the EU ETS defined by the exemption criteria. The first bar indicates the category's share of firms, the second bar its share in employment, and the third bar its share in CO_2 emissions, based on figures from the CITL-ORBIS match. The sample underlying figure (a) includes all manufacturing firms in the EU ETS which we could match to ORBIS. Figure (b) is based on all such firms located in the six countries under study. Figure (c) is based only on EU ETS firms that we interviewed.

Figure E.3: Distribution of the vulnerability score

(a) Shares in number of firms (b) Shares in employment (c) Shares in CO_2 emissions



Notes: The graphs show the distribution of the vulnerability score for interviewed firms included in the EU ETS and part of each group of sectors defined in Section I.B. Panel a reports the shares of firms, panel b employment shares, and panel c CO_2 emission shares, based on average permits surrendered in 2007 and 2008.

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G Questionnaire

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	
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 percentage	Absolute number Or percentage of annual operating cost
6. EU ETS management		
Ask only multi-plant firms: Is EU ETS compliance managed on the production site or elsewhere?	site, other site, national firm, european firm, dk, rf, na	

Questions	Values	Coding description	
7. ETS trading			
(a) In **March** of this year (i.e. **before** the compliance process), what was your allowance position on this site? (b) Were you short or long in allowances?	long, short, balanced, dk, rf, na		
	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? (d) If not, why not?	buy, sell, both, no: only trading during compliance period, no: no need, no: image concerns, no: transaction costs, no: other, dk, rf, na		
(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		
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?	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

Questions	Values	Coding description	
(c) Did you trade permit revenue off against emission reduction costs in your planning on this issue?			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 ? *Note: ERUs are Emission Reduction Units stemming from Joint Implementation projects. CERs are Certified Emission Reductions stemming from Clean Development Mechanism projects.*	EUAs, ERUs, CERs, EUAs and ERUs, EUAs and CERs, ERUs and CERs, all three, no, dk, rf, na		

Questions	Values	Level	Coding description

10. Awareness

Questions	Values	Level	Coding description
(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

Questions	Values	Level	Coding description
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

Questions	Values	Level	Coding description
(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.
(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

Questions	Values	Level	Coding description
(a) Do you expect that government efforts to put a price on carbon emissions will force you to outsource parts of the	1-5, dk, rf	Low	No impact of this kind.
		Mid	Significant reduction (>10%) in production/employment due to outsourcing.

Questions	Values	Level	Coding description
production of this business site in the foreseeable future, or to close down completely?		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

13. Competitors

Questions	Values	Level	Coding description
(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*	number, dk, rf		

Questions	Values	Coding description	
this interview. For instance, for multi-plant firms start the question with "For the products produced at the production site, can you tell me ..."			
(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. 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

Questions	Values	Coding description	
			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 products			
16.1 Existing climate change related products			
(a) Do you currently produce climate change related products at your production site? (Products that help your customers to reduce GHG emissions or adapt to climate change) (b) Can you give examples? (c) How important are these products as a source of revenue within your plant?	1-5, dk, rf	Low	No climate change related products and no plans to introduce any.
		Mid	Some climate change related products. These products are however not the main profit or revenue source of the firm.
		High	The majority of the firm's output can be considered a climate change related product.
16.2 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.

Questions	Values	Coding description	
V. Measures			
17. Energy monitoring			
(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%)?	percentage, dk, rf, na		
	number, dk, rf, na	Horizon (number of years)	

Questions	Values	Coding description	
Note the timetable for the target (e.g. 5 years or other number given by interviewee).			
(e) Since when do you have these targets?	2000 and earlier, list of years 2001-2010, dk, rf, na		
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:* Have 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.
(d) 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		
	number, dk, rf, na	Horizon (number of years)	

Questions	Values	Coding description
Note the timetable for the target (e.g. 5 years or other number given by interviewee)		
(e) When did you start having targets on GHG emissions?	2000 and earlier, list of years 2001-2010, dk, rf, na	

21. Target enforcement

Questions	Values	Coding description	
(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

Questions	Values	Coding description
(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

Questions	Values	Coding description
		3- (External) Energy audit 4- Installation of timers attached to machinery 5- Installation of (de-)centralised heating systems
		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)

Questions	Values	Coding description	
(f) How did you learn about this measure?	consultant, government, customer, supplier, employee, R&D project, competitor, other, dk, rf, na	Tick more than one option, if different sources mentioned	
(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		

Questions	Values	Coding description
(f) What other factors were influential in the decision?	text	
(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	

Questions	Values	Coding description	
VII. Country-specific policies			
UNITED KINGDOM			
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?	
	no, list of years 2001-2009, dk, rf, na	Carbon Trust Energy Audit or Advice? (CTaudit)	
	no, list of years 2001-2009, dk, rf, na	Innovation grants from the Carbon Trust? When?	
	no, list of years 2001-2009, dk, rf, na	Carbon Trust Standard	
	no, list of years 2001-2009, dk, rf, na	Enhanced Capital Allowance scheme? (ECA)	
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?	no, list of years 2001-2009, dk, rf, na		

Questions	Values	Coding description	
(b) Since when?			
(c) How stringent is the target imposed by the agreement? (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.
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 emission reductions ? If yes, when?	no, list of years 2001-2009, yes dk year. dk, rf, na		
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	

Questions	Values	Coding description	
VIII. Post Interview			
Interview duration (mins)	number	Minutes	
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		