

**Online Appendix**  
**Coase and Cap-and-Trade: Evidence from the European Carbon**  
**Market**

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## A. Appendix

### A.1. Descriptive overview at the installation level

Table 1: Descriptive overview, installation level data

	Treatment group			Control group		
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median
<b>Installation-level data</b>						
<i>Coal and gas</i>						
Emissions (tons of CO <sub>2</sub> )	1,146,599	2,844,325	265,104	1,684,523	3,533,450	486,467
No. installations	462			139		
No. observations	4,158			1,251		
<i>Coal-fired installations</i>						
Emissions (tons of CO <sub>2</sub> )	3,132,774	4,795,398	1,532,082	2,010,040	3,887,297	753,381
No. installations	125			110		
No. observations	1,125			990		
<i>Gas-fired installations</i>						
Emissions (tons of CO <sub>2</sub> )	409,887	748,665	127,796	449,806	781,842	232,371
No. installations	337			29		
No. observations	3,033			261		

Notes: Data on emissions is from the EUTL, data on fuel type from Open Power System Data and web search. Country-level covariates are from Eurostat, while data on allowance and fuel prices is from Bloomberg. Renewable energy produced covers production from wind, solar, biomass and hydro sources. All numbers are rounded to the last digit.

## A.2. Distribution of installation-level propensity scores

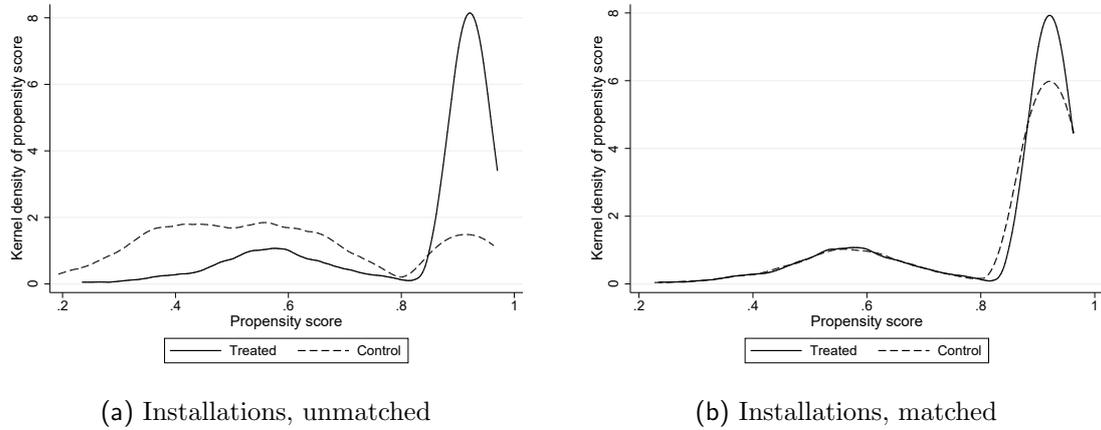


Figure 1: Propensity scores, by treatment status

Note: Distribution of propensity scores from one-to-one nearest neighbor propensity score matching with replacement, for the unmatched and matched full installation-level sample. Installations are matched on the common support, using average log pre-treatment emissions, i.e. emissions during the period 2009-2012, as the matching variable. Installations are matched within the main fuel type (coal and gas).

## A.3. Installation-level allowance allocations, by treatment status

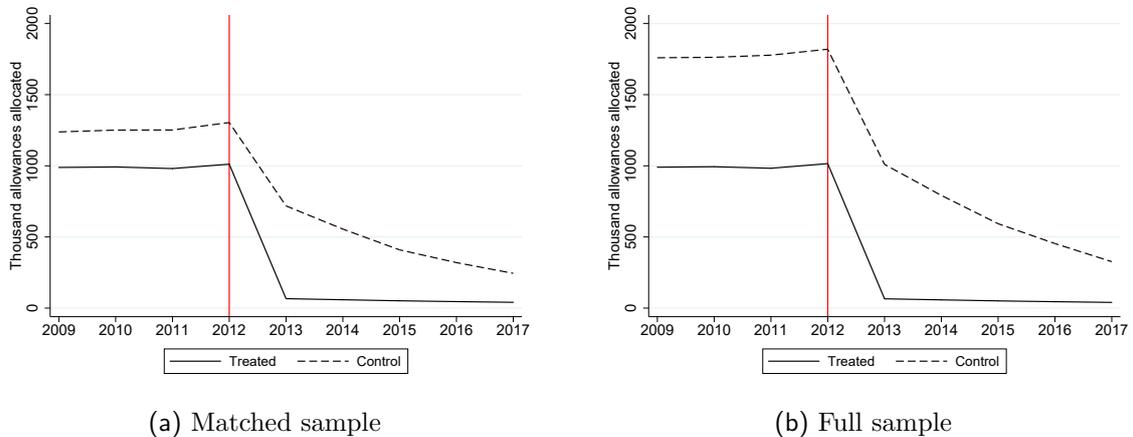


Figure 2: Installation-level allowance allocations, by treatment status

Note: The y-axes show the average number of allowances allocated, by treatment status. Y-axes are on the same scale for better comparability.

#### A.4. Net electricity exports from control to treatment groups

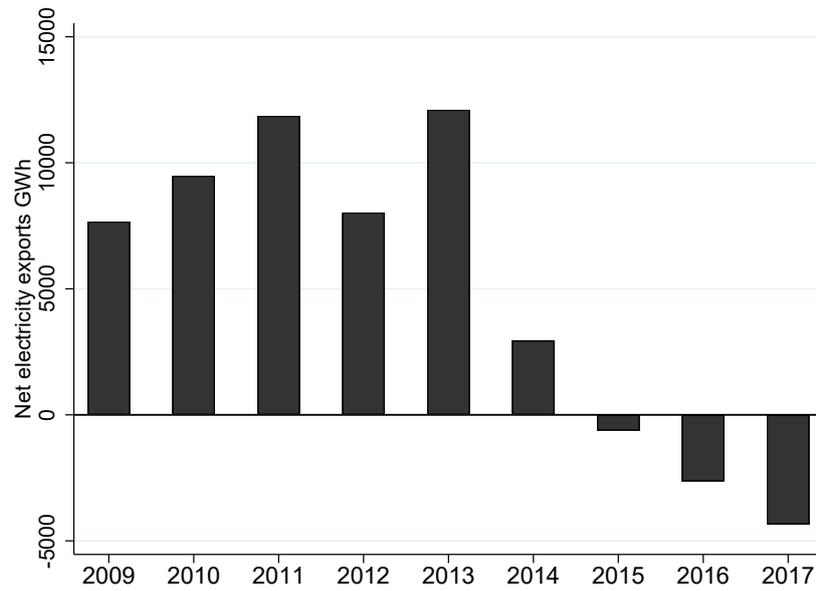


Figure 3: Net electricity exports from control to treatment groups

Source: Eurostat.

## A.5. Heterogeneity in firm-level emissions by size, full sample

Table 2: Small and non-small emitters, full sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Small emitters			Large emitters		
1(Auctioning of allowances)	-0.196 (0.098)	-0.226 (0.110)	-0.206 (0.105)	-0.062 (0.043)	-0.107 (0.046)	-0.107 (0.046)
ln(Renewable energy)		-0.123 (0.160)	-0.134 (0.140)		-0.122 (0.077)	-0.190 (0.067)
ln(Electricity consumption)		1.959 (0.950)	3.315 (0.915)		0.556 (0.464)	1.157 (0.402)
Net electricity exports		0.002 (0.003)	0.002 (0.003)		0.002 (0.001)	0.003 (0.001)
ln(GDP)		-2.380 (1.322)	-3.369 (1.010)		-0.575 (0.278)	-0.885 (0.274)
EUA price			0.0004 (0.008)			0.0004 (0.003)
Coal price			0.027 (0.015)			0.010 (0.005)
Gas price			-0.008 (0.006)			-0.003 (0.002)
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	N
F-test leads (p-value)	0.01	0.04	0.001	0.50	0.37	0.37
Obs	864	864	864	2,601	2,601	2,601
No. firms	96	96	96	289	289	289
R <sup>2</sup>	0.942	0.943	0.942	0.976	0.976	0.976

Notes: OLS regressions of the natural log of firm-level emissions on a policy dummy switching from 0 to 1 after the start of the treatment period for treated firms, in 2013. Samples are divided into small and non-small emitters. Small emitters are defined as being below the 25th percentile of the distribution of firms' 2009 emissions. Non-small emitters are defined as being at or above the 25th percentile of the distribution of firms' 2009 emissions. Specifications (1) and (3) include the policy dummy, firm fixed effects and year fixed effects. Specifications (2) and (5) additionally control for country-level electricity market outcomes and GDP. Specifications (3) and (6) add allowance prices and fuel prices, while not controlling for year fixed effects. All regressions include F-tests of joint significance of switching on the policy variable in each pre-treatment year. The number of firms indicates the number of unique firms in each sample. Robust standard errors clustered at the firm level are in parentheses.

## A.6. Treatment effect dynamics by firm size

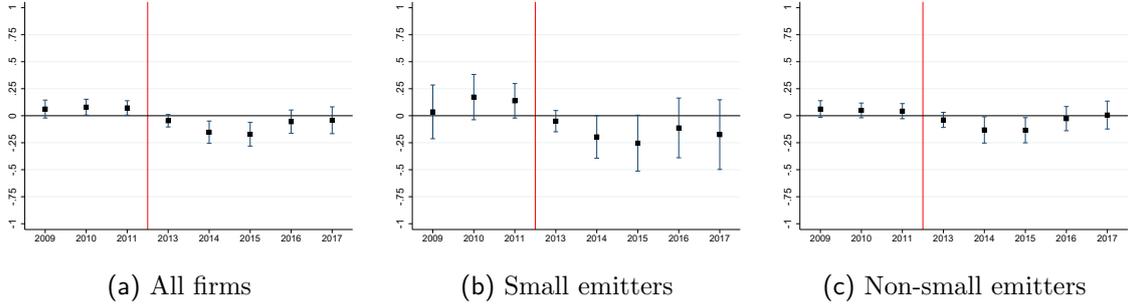


Figure 4: Treatment effect dynamics, full sample

Notes: OLS regressions of the natural log of firm-level emissions on a policy dummy switching from 0 to 1 in every pre and post-treatment year, country-level electricity market outcomes,  $\ln(\text{GDP})$ , firm fixed effects and year fixed effects. Treatment effects and 95% confidence intervals are depicted on the y-axis, using robust standard errors clustered at firm level to construct confidence intervals. The vertical line in each panel indicates 2012, the end of the pre-treatment period. 2012 is the baseline year. Number of observations full sample: 3,465; number of firms full sample: 385. Number of observations small emitter subsample: 864; number of firms small emitter subsample: 96. Number of observations non-small emitter subsample: 2,601; number of firms non-small emitter subsample: 289.

## A.7. Installation-level results by fuel type and parent firm type

Table 3: Installation-level results by fuel type, single-installation vs. multi-installation firms

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Full sample				Matched sample											
	Single coal	Single gas	Multi coal	Multi gas	Single coal	Single gas	Multi coal	Multi gas	Single coal	Single gas	Multi coal	Multi gas	Single coal	Single gas	Multi coal	Multi gas
1(Auctioning of allowances)	0.021 (0.054)	-0.087 (0.125)	0.112 (0.083)	-0.051 (0.148)	-0.006 (0.070)	0.008 (0.160)	0.092 (0.100)	0.059 (0.121)								
Country-level controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Global controls	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Installation FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F-test leads (p-value)	0.45	0.02	0.001	0.55	0.94	0.11	0.01	0.19								
Obs	720	1,980	1,395	1,314	648	3,348	1,602	1,512								
No. installations	80	220	155	146	57	200	130	98								
R <sup>2</sup>	0.983	0.972	0.963	0.947	0.978	0.966	0.960	0.934								

Notes: OLS regressions of the natural log of installation-level emissions on a policy dummy switching from 0 to 1 after the start of the treatment period for treated installations, in 2013. All regressions include the policy dummy, installation fixed effects, year fixed effects and further control for country-level electricity market outcomes and GDP. F-tests of joint significance of switching on the policy variable in each pre-treatment year. The number of installations indicates the number of unique installations in each sample. Robust standard errors clustered at the firm level are in parentheses.