Being a New Entrant or an Incumbent Matters Emissions Abatement and the EU ETS

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The EU ETS

Cap and Trade System. The European Emissions Trading Scheme (EU ETS) is world's first market of greenhouse gases (GHGs) emissions permits.

- EU ETS is a market-based regulatory instrument which aims to the reduction of CO2 emissions with the introduction of a "cap" and tradable permits, which provide the permission to pollute a unit of CO2eq.
- Introduced in 2005 (now, 4th phase) and covers:
  - 31 countries
  - about 11,000 plants and manufacturing installations + aviation sector.
- Empirical evidence on its efficacy is growing in the last years.
  - cost-effectiveness
  - mechanisms

Scopes of EU ETS

- Correction of the famous global market failure *at least cost*: global polluting emissions (creation of markets of GHGs emission permits)
- **direct goal:** Mitigation of climate change (reduction of emissions)
- **channel** Incentives to encourage abatement and adaptation of cleaner production technologies

All the scopes should be reached without negatively affecting economic performances of firms covered by the policy. (Art. 1 87/2003/CE)

This paper

- Impact of EU ETS on abatement decisions of plants.

  How? Using the exogenous shock led by the 2013 policy change

  RQ Do stricter environmental policies encourage emissions abatement?

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  RQ Do stricter environmental policies encourage emissions abatement?
- Sectors that experienced the cut of FA (treated) vs the control sectors $\rightarrow$ Diff-in-Diff approach

Main messages:

1. The presence of free allowances encourage the entry of dirtier producers
2. Novel emission intensity indicator, which reveals accurately the abatement status (emissions per output unit) = proxy of cleaner production
3. Role of new entrants vs incumbents in emission intensity paths at macro-sectoral level

Related literature and contributions

1 **The EU ETS impacts on environmental and economic outcomes**

a) Wagner, Martin et al. 2020; Colmer et al., 2023; Löschel et al., 2019; Gerster et al. 2020; Klemetsen, Resendahl, Jakobsen 2016; Calel, 2020; Dechezleprêtre et al., 2023; A. Dechezleprêtre, 2017; Martin et al., 2016

→ Focus on free allowances and intra-EU ETS study

b) F.M. d'Arcangelo and G. Pavan ,2020; Calel and Dechezlepretre, 2016

→ Novel emission intensity indicator as proxy of plants productivity

c) Barrows et al., 2024

→ DiD justified as methodology

2 **Change in permit exchange design and potential greener choices: why is it interesting?**

Zaklan, 2023; Hintermann, 2015; Liski and Montero, 2011; Hahn and Stavins, 2011; Liu et al. 2012; Ambec et al., 2023; Cicala et al., 2022; Porter and Linde, 1995-1996

→ Coasian argument discussion

→ The presence of FA fosters entry of dirtier producers

Coasian Argument - discussion

- Using an implication of the Coase theorem, the market equilibrium of the cap-and-trade system is cost-effective independently on the initial allocation of allowances (Colmer et al., 2023).
- This argument is true under a set of conditions, such as:
  1. absence of transaction costs
  2. income effect
  3. third-party impacts
  4. **market power**

  which are arguably excludable in the context of the EU ETS and its firms (Hintermann, 2015; Zaklan, 2023).

Phase III Amendment

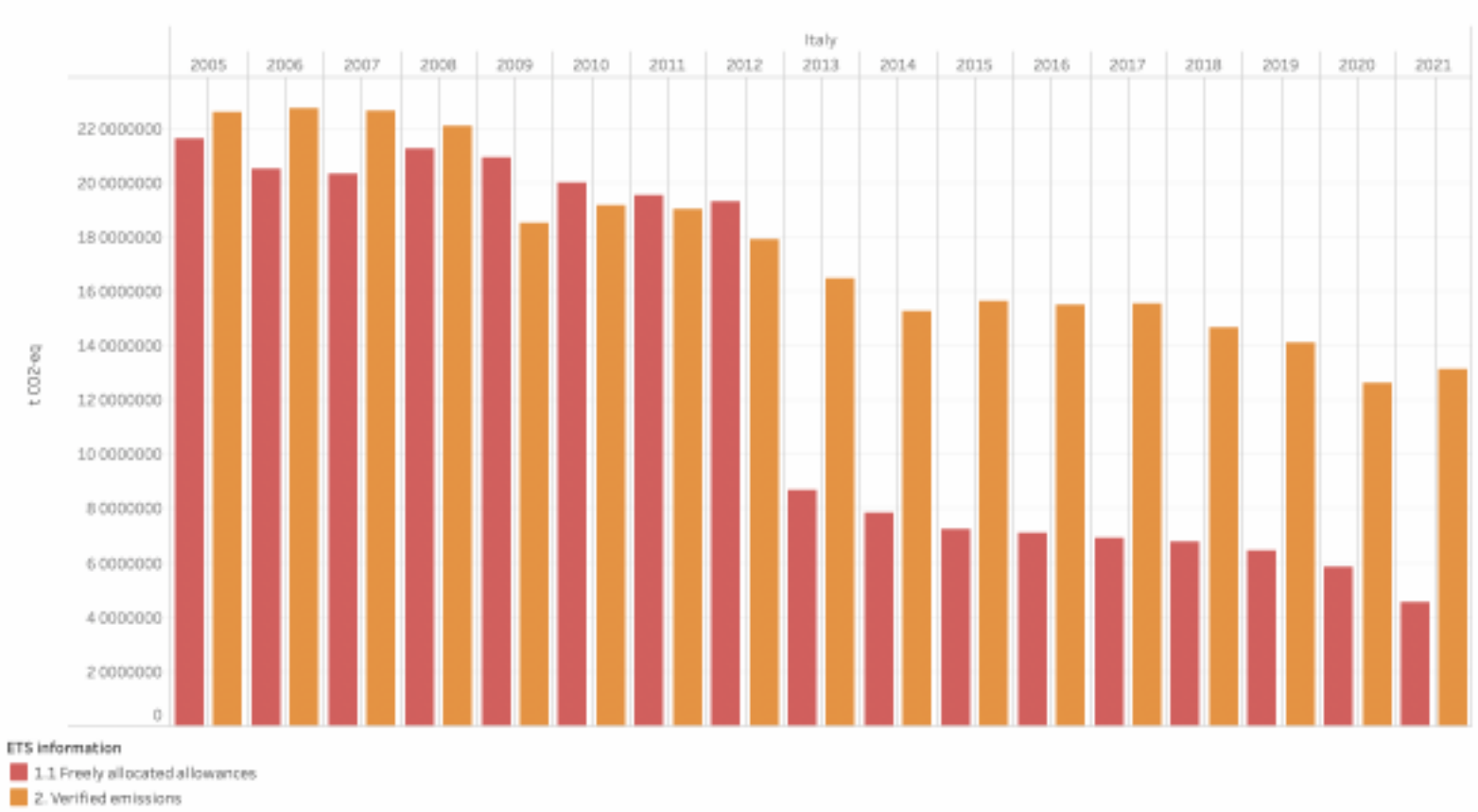
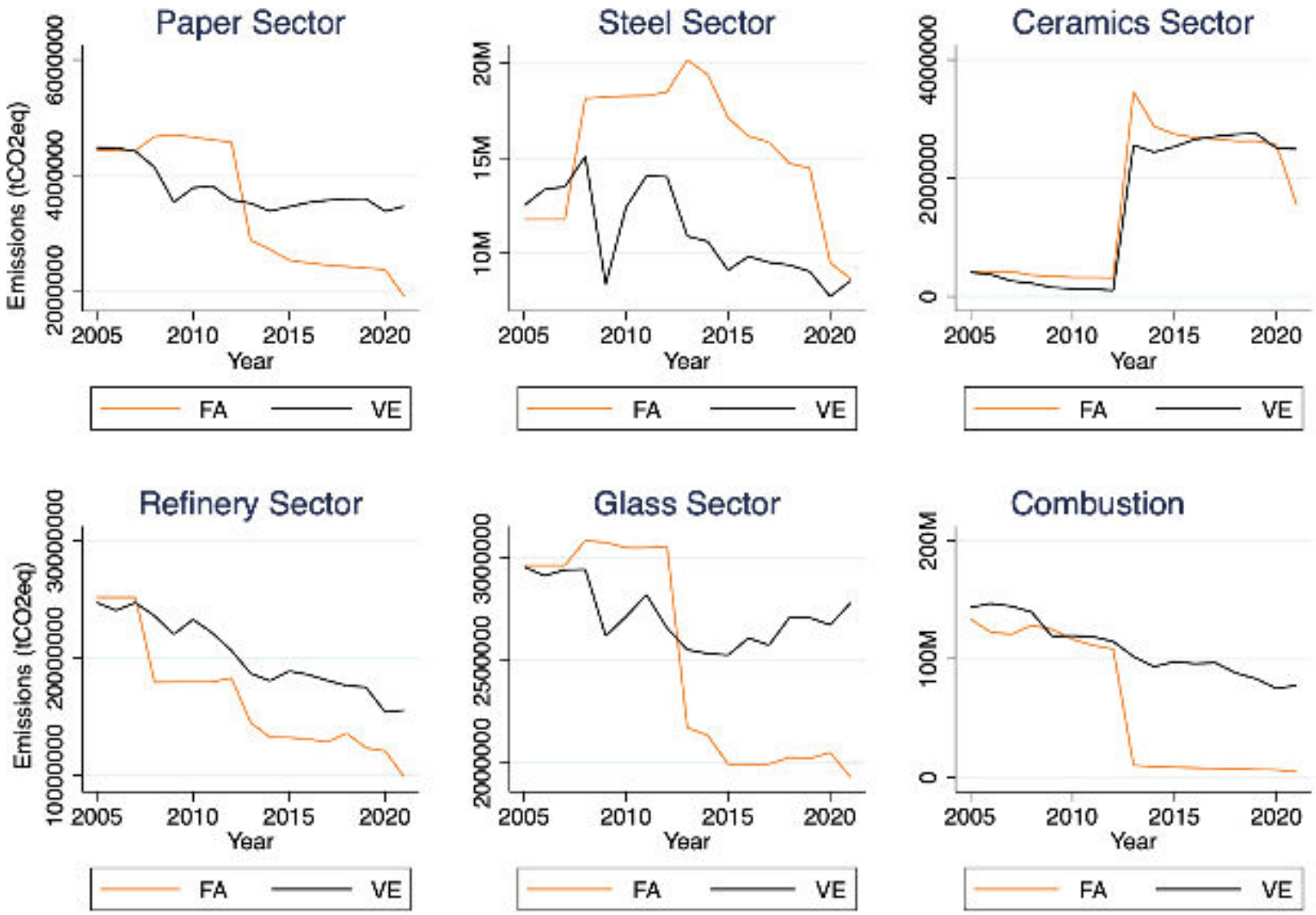


Figure: Free allowances and verified ETS emissions in Italy, all sectors.

Source: European Environment Agency data viewer

FA provision heterogeneity by sector (EEA)



Treated and Control groups

Macro sector	NACE (Rev.2)	Section	Sectorcode
Agrifood (T)	10 and all its subsection	C	7
Agrifood (T)	11 and all its subsection	C	7
Ceramics (C)	23.20	C	3
Ceramics (C)	23.31	C	3
Ceramics (C)	23.32	C	3
Ceramics (C)	23.41	C	3
Ceramics (C)	23.49	C	3
Ceramics (C)	23.62	C	3
Ceramics (C)	23.70	C	3
Ceramics (C)	23.99	C	3
Glass (T)	23.11	C	6
Glass (T)	23.12	C	6
Glass (T)	23.13	C	6
Glass (T)	23.14	C	6
Glass (T)	23.19	C	6
Paper and Wood (T)	16 and all its subsection	C	1
Paper and Wood (T)	17 and all its subsection	C	1
Paper and Wood (T)	18.12	C	1
Refinery (C)	19 and all its subsection	C	4
Steel (C)	24 and all its subsection	C	2
Steel (C)	25 and all its subsection	C	2
Steel (C)	26.11	C	2
Steel (C)	27 and all its subsection	C	2
Steel (C)	28 and all its subsection	C	2
Textile (T)	13 and all its subsection	C	13
Thermoelectric (T)	35 and all its subsection	D	14

Table: Sectors and NACE codes.

Data

- The EUTL platform (verified emissions by plant, free allowances).
- European Environment Agency (EEA) data (sectoral aggregation)
- Italian Registry of the EU ETS (2008-2019). Access based on ISPRA-DiSES Convention.

Macro-sector	n.plants	#plants obs	Percent	avg. emissions*	avg. prod. value*	avg. #employees
Paper	183	1,752	27.17%	29945.44	166515.3	392.4713
Steel	106	882	14.12%	163553.6	565382.1	1091.753
Ceramics	156	820	13.27%	22029.96	89501.09	336.2133
Refinery	19	172	2.90%	1115998	3.06e+07	19166.4
Glass	59	530	8.93%	52783.2	319130.5	830.7064
Food	127	805	13.56%	17059.85	518722.3	1280.972
Textile	8	49	0.83%	13590.8	90468.56	456.7105
Thermoelectric	165	1,141	19.22%	665668.9	3025942	1812.469
Total	823	5,936	100%			

Methodology

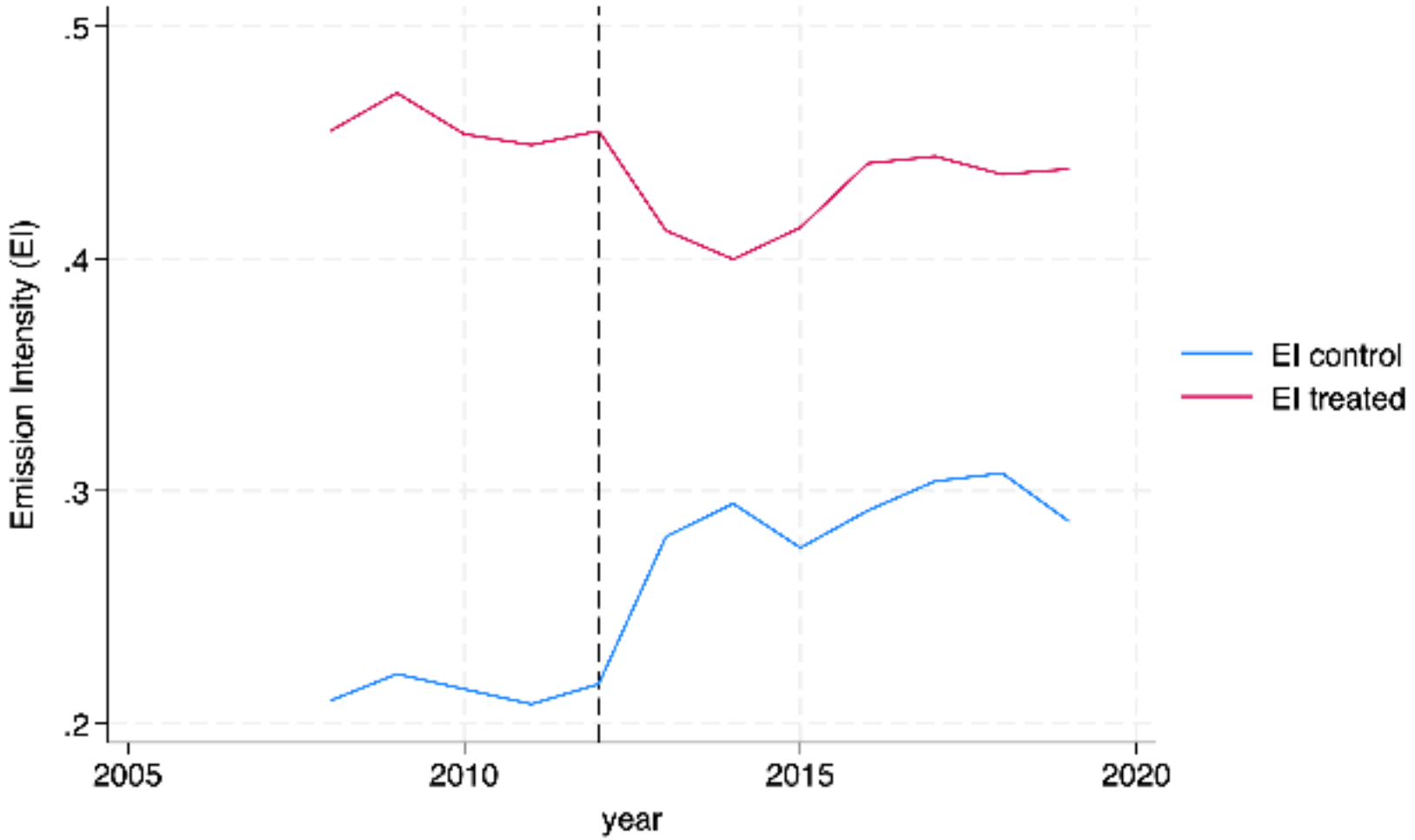
- Analysis at sectoral level of the effect of the cut of free allowances proposed in the EU ETS modification for the Phase III. details
- Variable of interest: Emission Intensity: $EI_{i,t} = e_{i,t}/q_{i,t}$
- Treated vs control sectors. sectors

$$EmissInt_{i,t} = \beta_0 + \beta_1 did + \beta_2 T + \beta_3 POST + \epsilon_{i,t}$$

- Model 2

$$EmissInt_{i,t} = \beta_1 did + \beta_2 new\#T + \lambda_t + \lambda_s + \epsilon_{i,t}$$

Findings - Emission Intensity in Treated and Control groups

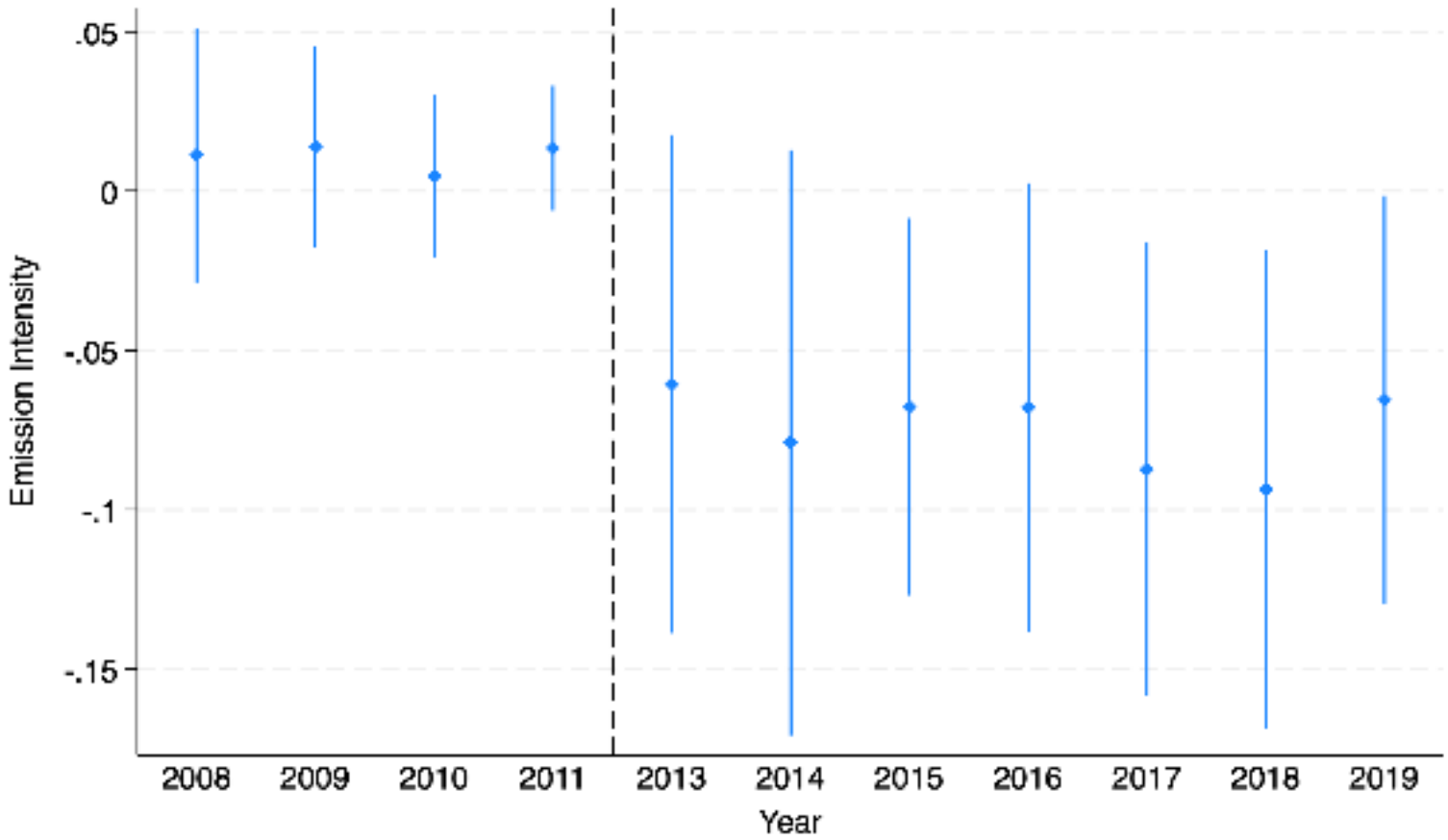


Findings - Diff in Diff

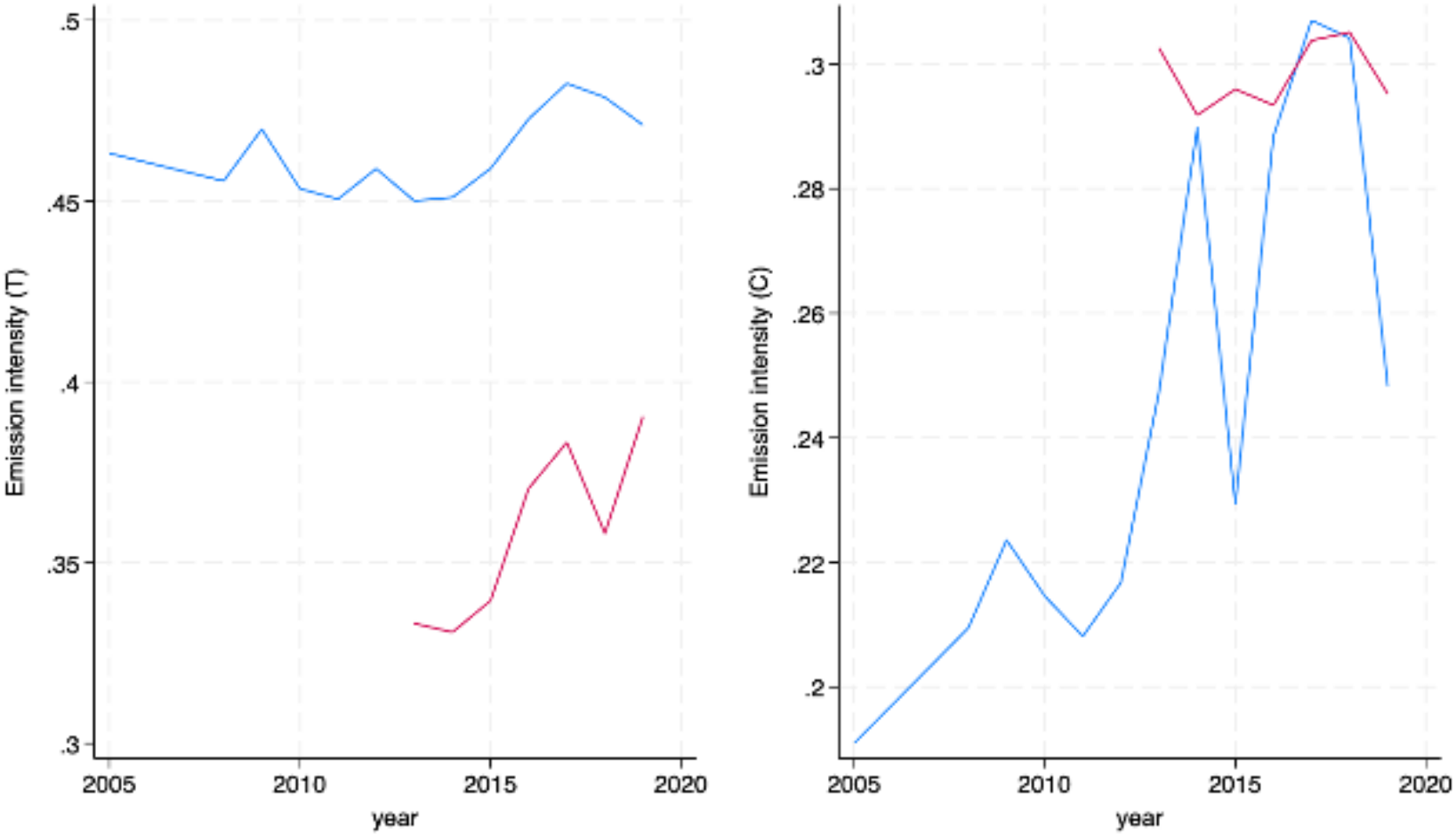
VARIABLES	(Baseline) EmissInt	(Model 1) EmissInt	(Model 1b) EmissInt	(Model 1c) EmissInt	(Model 1d) EmissInt	(Model 2) EmissInt	(Model 2b) EmissInt	(Model 2c) EmissInt
did	-0.0514***	-0.0495***	-0.0831***	-0.0516***	-0.0503***	-0.0742**	-0.0520***	-0.0519***
	(0.0159)	(0.0161)	(0.0308)	(0.0161)	(0.0159)	(0.0300)	(0.0161)	(0.0161)
T	0.243***				0.253***			
	(0.0386)				(0.0398)			
POST	0.0646***	0.0638***			0.0646***			7,060
	(0.0142)	(0.0143)			(0.0142)			(1.546e+08)
new_T					-0.0389	-0.0523**	0.0276	0.0276
					(0.0378)	(0.0249)	(0.0600)	(0.0600)
Constant	0.225***	0.387***			0.225***			
	(0.0319)	(0.00531)			(0.0319)			
Time FE			✓	✓	✓		✓	✓
Sector FE			✓	✓			✓	✓
Plant FE		✓	(C)	✓	✓			✓
Observations	5,936	5,936	5,936	5,884	5,936	5,936	5,884	5,884
R-squared		0.005	0.275	0.876		0.276	0.876	0.876
Number of AUT	823							

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Event Study


.05
0
-.05
-.1
-.15
Emission Intensity
2008
2009
2010
2011
2013
2014
2015
2016
2017
2018
2019
Year

Findings - Role of New Entrants



Emission intensity paths in the treated (left) and control (right) groups. emission intensity of the incumbent plants vs new entrants.

Conclusions

- *Do stricter environmental regulations encourage the adoption of greener technologies?*
  Not at plant level: incumbent plants did not reduce their emission intensity. At macro-sectoral level, it happens due to the new entrants - less carbon intensive in the treated sectors.
- *Does the provision of FA have an impact on abatement choices?*
  The presence (absence) of free allowances fosters the entry of dirty (cleaner) producers, without directing altering the abatement decisions of incumbents.

Next steps

a. Theory model on entry and exit; new entrants and incumbent
b. Exit mechanism and impact
c. Treatment intensity
d. Further robustness checks

Thank you for your attention!

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Theoretical Framework - Benchmark

- Following the model of Ambec et al., 2024, the benchmark has 2 conditions: (i) the incumbent cannot invest in greener tech

$$\pi = [p - c(\theta)a - \tau(1 - a) + \alpha\tau]q \tag{1}$$

$\tilde{\theta}_i$ s.t. $\pi = 0$
(ii) Differently, the new entrant has an entry cost F to pay:

$$\pi = [p - c(\theta)a - \tau(1 - a) + \alpha\tau]q - F \tag{2}$$

With $F > 0$, I find that $\tilde{\theta}_e < \tilde{\theta}_i$.

Theoretical Framework - Benchmark II

- Following the model of Ambec et al., 2024, the benchmark has 2 conditions: (i) the incumbent cannot invest in greener tech

$$\pi = [p - c(\theta)a - \tau(1-a) + \alpha\tau]q \tag{3}$$

$\tilde{\theta}_i$ s.t. $\pi = 0$
(ii) Differently, the new entrant has an entry cost F to pay, which increases when $\downarrow \alpha$:

$$\pi = [p - c(\theta)a - \tau(1-a) + \alpha\tau]q - F(1-\alpha) \tag{4}$$

With $F > 0$ and $1 - \alpha > 0$, I find that $\tilde{\theta}_e < \tilde{\theta}_i$.

Appendix

The Porter Hypothesis

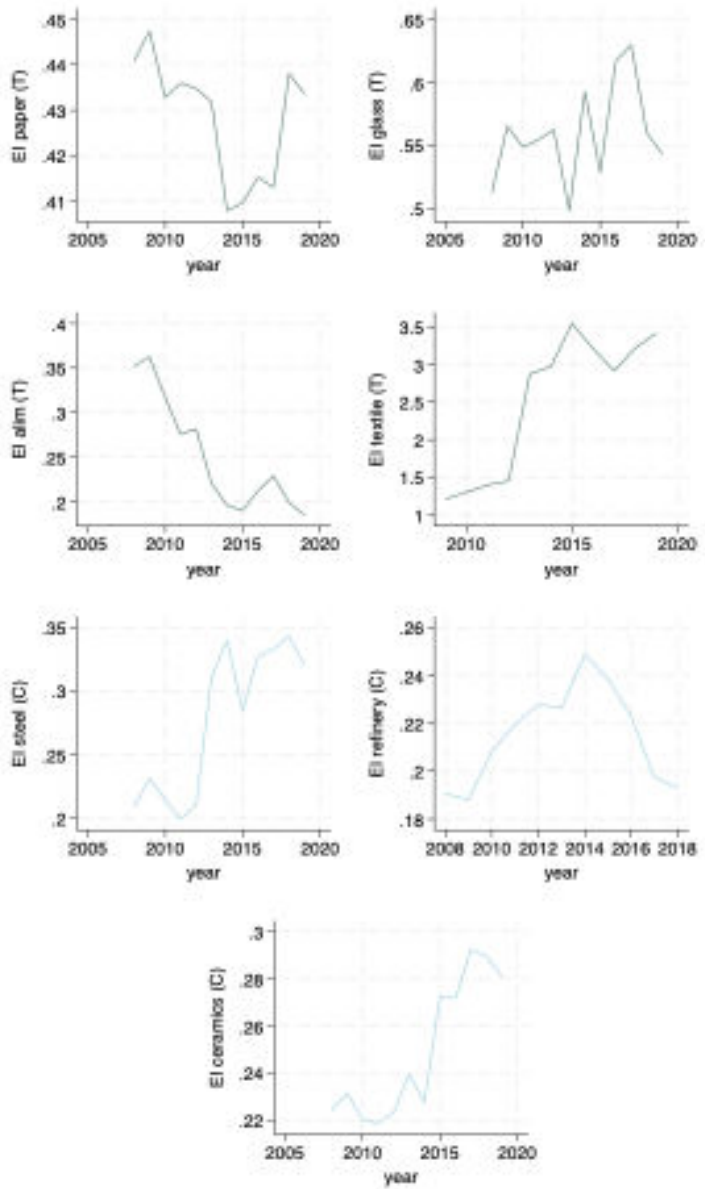
- The effects of environmental regulation on innovation has an extensive economic literature, but with contrasting results (Yu & Zhang, 2022; Ambec et al., 2013)
- **Porter Hypothesis:** firms covered by environmental regulation can potentially gain benefits through the innovation channel, and the consequent boost in productivity (Porter & Linde, 1995; Porter 1996).
  $\Rightarrow$ Climate policies are beneficial for their environmental, social and economic outcomes (social desirability and political support)

E "Porter effect" generally not supported by the empirical literature, with some exception (e.g., Jaffe & Palmer, 1997)

T Theoretical formulation of the PH (Ambec & Barla, 2002) shows that regulation can lead firms to innovate ($\uparrow$ investments in R&D and profits due to $\uparrow$ productivity).

- **Reverse PH:** does a lenient policy context foster the entrance of dirtier producers?

EI support - path in different sectors

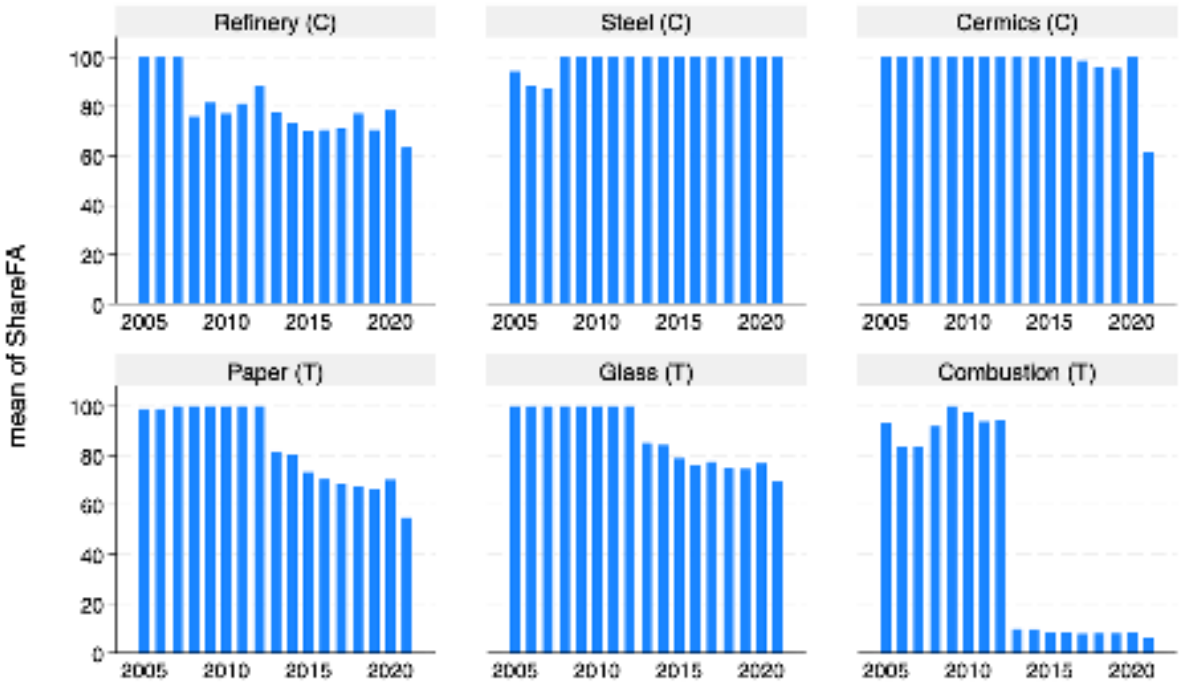


back

Treated and Control Sectors

- **Treated Sectors.** Sectors that experienced a significant cut in their free allowances provision in the beginning of the Phase III (2013) caused by the EC Directive 2009. These sectors are: combustion (thermoelectric, agrifood, textile) paper and glass.
- **Control Sectors.** These sectors did not experienced a signifcant change in their FA. Control sectors are: ceramics, refinery, steel.

back



Number of Plants

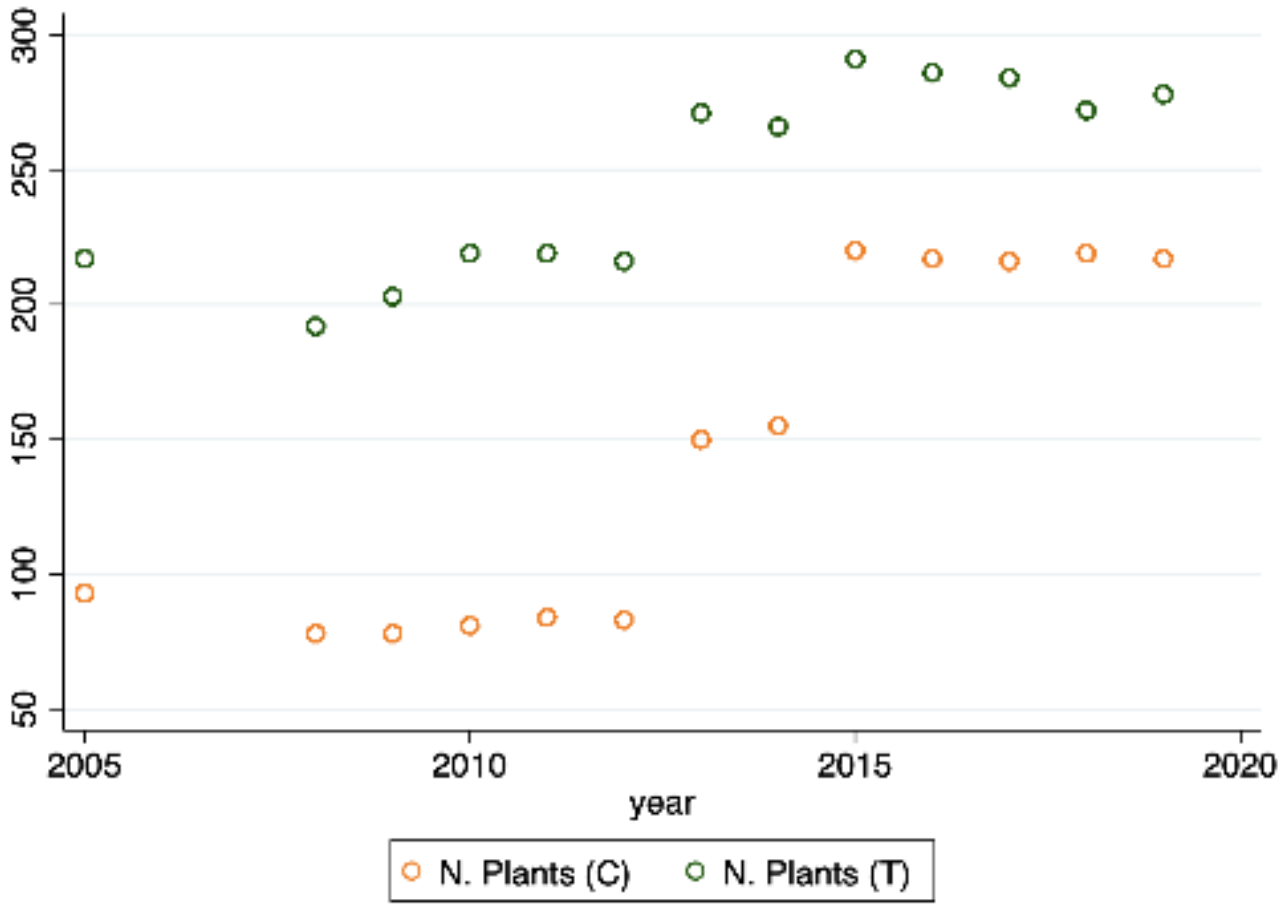


Figure: N. plants in the treated and control groups, excluding thermoelectric.

Robustness checks

1. Quantity paths:
   - increasing for the treatment and control group overall ✓
   - increasing for the incumbents, a part for ceramics and glass ✓
   - for each sector overall - TO DO
2. Does a particular sector drive the results? No ✓

Quantity for the control and treatment groups, excluding thermoelectric.