Assessing the impact of the EU ETS using firm level data

Jan Abrell, Anta Ndoye Faye, Georg Zachmann

The EU Emission trading scheme (EU ETS)

- **Incentivise the most economic mitigation efforts by**
  - Capping carbon emissions
  - Making carbon permits a tradable good
- **Six years of experience with the ETS enable and the discussion around future market arrangements motivate an empirical assessment of:**
  - its effectiveness (did it deliver reductions)
  - its impact on the firm's performance (added value, profit margin, employment)

Literature

- **Effectiveness: Ellerman and Buchner (2006), Grubb and al. (2009), Ellerman and al. (2010)**
  - Results: main reduction of emission took place between 2004-2005
  - Drawback: Short period analysis (2 or 3 years), lack of counterfactual

- **Competitiveness: Demailly and Quirion (2008), Anger and Oberndorfer (2008)**
  - Results: modest competiveness losses in the first phase
  - Drawback: Static analysis, sector specific or country specific, lack of counterfactual

Our contribution

- **First to use a matched European firm-level data set on company performance, initial allocation and emissions**
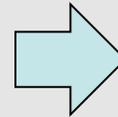
This allows to study:

- **impact of the initial allocation on emission reduction**

- **Impact of the shift from the first phase (2005-2007) to the second phase (2008-2012)**

- **effect of the EU ETS on the profits, employment and value added of participating companies**

The two phases of the EU ETS

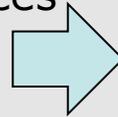- **2005-2007: trial phase (first phase)**
  - Grandfathering of allowances
  - No banking

  → emissions in the regulated sectors increased by 2 % due to a high cap and the import of offsets

- **2008-2012: second phase**
  - Mainly Grandfathering of allowances
  - Banking

  → Tighter cap, the amount of allowances distributed was reduced from 2007 to 2008 by about 11 percent

Daily Closing Price EUA spot

01/07/2005 · 01/01/2006 · 01/07/2006 · 01/01/2007 · 01/07/2007 · 01/01/2008 · 01/07/2008 · 01/01/2009 · 01/07/2009 · 01/01/2010 · 01/07/2010

ETS emissions by country

Phase I ... Phase II ... Crisis year
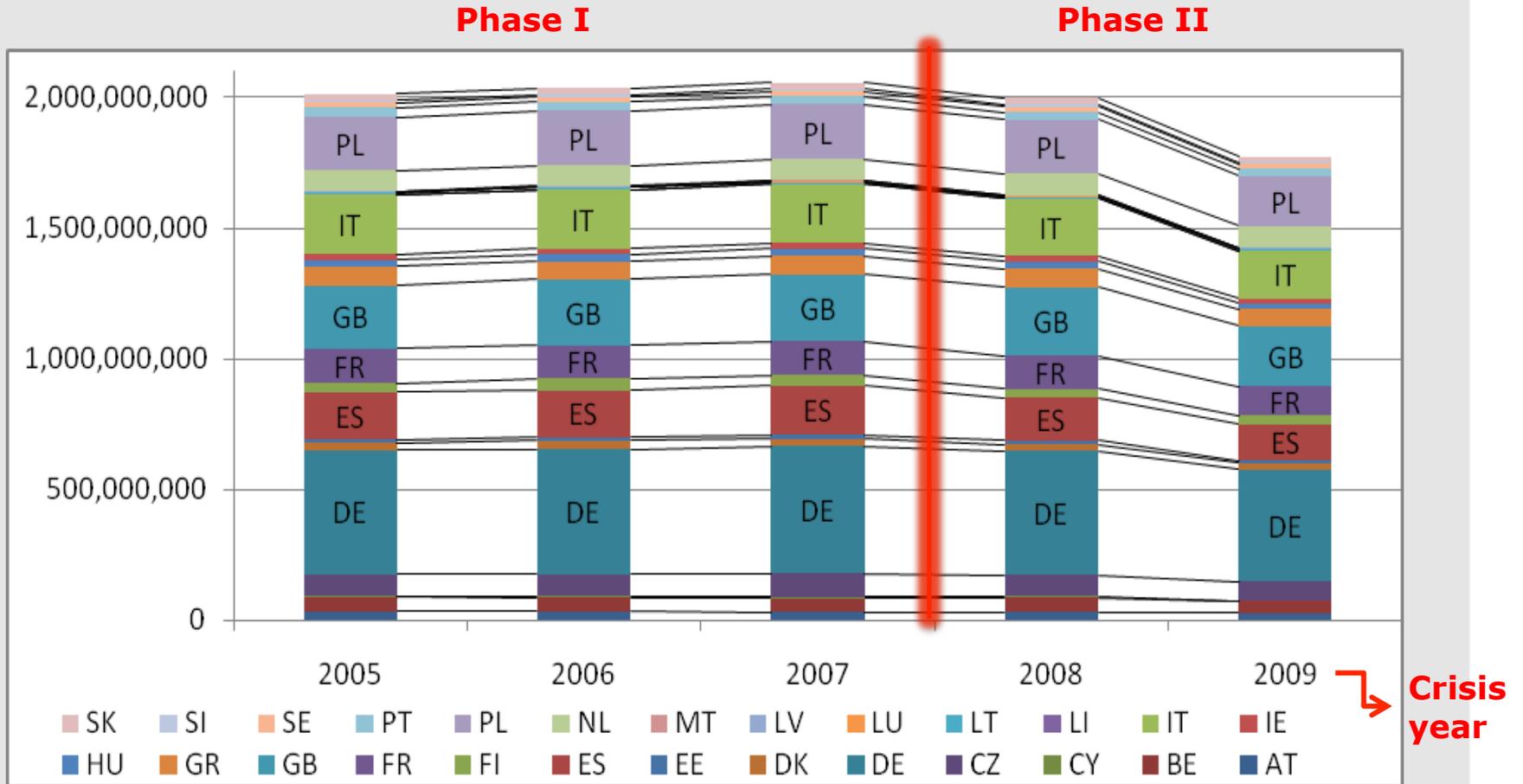
Data

- **CITL emission data**
  - Allocated emissions 2005-2008
  - Verified emissions 2005-2008
  - Allocation factor: the quotient of free allocation of emissions allocated to the verified emissions

- **AMADEUS**
  - Profit Margin, Employment, Turnover, Added Value, Fixed Capital

- **Both sets matched via adresses**
  - For 13000 CITL installations we got 2101 AMADEUS companies (3696 installations), representing 59% of the emissions

- **Company level data allows us to:**
  - Control emission reductions for company performance
  - Analyse whether being included in the ETS had an effect on company performance

Effectiveness of the EU ETS

- **Our goal is to analyse whether companies changed their emission reduction strategy from 2005-2006 to 2007-2008**

- **We estimate the following equation in third difference**

$$y_{it} = \alpha_0 + \alpha_1 d_{it} + \alpha_2 cv_{1,it} + \alpha_3 cv_{2,it} + \varepsilon_{it}$$

$$t = 2005, 2006, 2007, 2008$$

- **=> thus, we analyse the change in speed in emission reduction between the first and the second phase**

Result 1: The tighter cap in Phase II was effective

Dependant variable	Growth rate of emissions (2008-2007) - Growth rate of emissions (2006-2005)
Phase dummy	**-0.036**(0.015)**
changes in turnover	**0.191***(0.028)**
Adj R-squared	0.17
	Significance: * at 10%, ** at 5 % and *** at 1%. Standard errors are reported in brackets

- Difference in emissions reduction growth between 2005-2006 to 2007-2008 was **6.33%** in our sample
- When controlling for economic activity 3.6% remain and are highly significant =>
- **The tighter cap in Phase II was effective** since emissions decrease not explained by other factors

Result II: initially underallocated companies reduce more

Dependant variable	Growth rate of emissions (2008-2007) - Growth rate of emissions (2006-2005)	
	(2)	(3)
Sample	Initially underallocated companies AFi 2005 <1.15	Initially overallocated companies AFi 2005 >1.15
$\widehat{\alpha_1}$	-0.034*** (.01)	0.002 (.03)
changes in turnover	0.19***(.04)	0.21***(.04)
adj R-squared	0.21	0.23

- Interpretation1: Output based allocation => poorest performers had the lowest AF but were able to reduce most; But: grandfathering in the first phase and control for sectors
- Interpretation2: firms that have to buy allowances reduce more

Result III: emission reductions strongly correlate to allocation reduction

Dependant variable	Growth rate of emissions (2008-2007) - Growth rate of emissions (2006-2005)	
	(4)	(5)
Sample	Firms with strongest decrease in allowances Δ AFi 07-08 <-.08	Firms with least strong decrease in allowances Δ AFi 07-08 >-.08
$\widehat{\alpha_1}$	-0.063**(.02)	-0.02 (.02)
changes in turnover	0.14**(.04)	0.35***(.04)
adj R-squared	0.20	0.40

- Those companies that announced to reduce production between 2007 and 2008 received less allowances and emitted less in 2008. This is unlikely to explain our findings, as we (1) control for changes in economic activity of companies and (2) ignore installations that were absent in any year.
- Interpretation2: inefficiency of the carbon market

Result IV: Strong sectoral differentiation in reduction

	Paper and paper products 416 firms	Non-metallic minerals 806 firms	Basic metals 159 firms	Electricty heat 660 firms
Phase dummy	-0.029(0.027)	**-0.087***(0.025)**	**-0.095*(0.049)**	-0.001(0 .038)
changes in turnover	**0.154**(0.077)**	**0.299***(0.058)**	0.089(0.126)	**0.136**(0.06)**
Adj R-squared	0.13	0.27	0.71	0.21
Significance: * at 10%, ** at 5 % and *** at 1%. Standard errors are reported in brackets				

- Non metallic minerals and basic metals carried out the main reduction effort
- No significant effect of moving to a tighter cap for energy and paper sectors
- Interpretation: ETS worked in incentivizing emission reduction were it was cheapest

Impact of EU ETS on the firm performance

- **Impact of the EU ETS on firm added value, employment (labour size) and profitability (profit margin)**

- **With a matching procedure based on a propensity score, we construct a control group in order to assess this counterfactual effect**

- **The following two period fixed effect model (before and after treatment) is then estimated in first differences:**

$$y_{it} = \alpha_0 + \alpha_1 d_{1,it} + \alpha_2 d_{2,it} + \alpha_3 x_{it} + \alpha_4 cv_{it} + \varepsilon_{it}, t = 0,1$$

$$\Delta y_i = \alpha_1 + \alpha_2 \Delta d_{2,i} + \alpha_3 \Delta x_i + \alpha_4 \Delta cv_i + \Delta u_i$$

$$\hat{\alpha}_2 = \Delta \bar{y}_T - \Delta \bar{y}_C$$

Profit Margin: Allocation had an effect on the profit margin

Dependent variable	Profit margin	
Total Sample		
Period	(1)= 2004-2005	(2)= 2004-2008
Impact of EU ETS	-0.53 (0.45)	**-0.51 *(0.37)**
Changes in employment	**-0.59*(0.32)**	-0.52(0.32)
Changes in turnover	**3.91***(0.21)**	**3.67***(0.21)**
Adj R-squared	0.58	0.62
Under allocated firms (AF<1)		
Impact of EU ETS	-0.22 (0.31)	**-1.95 *(1.11)**
Changes in employment	-0.42(0.43)	-0.34(0.43)
Changes in turnover	**2.61***(0.27)**	**2.54(0.27)**
Adj R-squared	0.51	0.52
Over allocated firms (AF>1)		
Impact of EU ETS	**2.14* (1.25)**	**2.32 *(1.29)**
Changes in employment	**-0.95**(0.50)**	**-0.87*(0.49)**
Changes in turnover	**5.29***(0.35)**	**5.07***(0.34)**
Adj R-squared	0.58	0.64

Overallocated firms have benefited from the ETS in terms of profitability

Underallocated firms did lose

Overall effect surprisingly negative

Results indicate that emission cost are not fully passed through

Conclusion

- **Emission reduction efforts were increased in the second phase**

- **Initial allocation mattered for emission reduction efforts** (being short on allocation increased reduction effort)

- **Initial allocation mattered for the profitability of the covered firms**

- **Full auctioning might help reducing emissions but reduce company profits**