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Uniform Standard or Emissions Trading?

Efficient coverage of installations in a GHG Emission Trading Scheme

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Core Message

- Covering all polluting sources in an emissions trading scheme may not be efficient!
- Target is relevant
- Transaction costs have to be taken into account

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Motivation

- Emissions trading schemes are designer markets and policy makers have to choose the coverage
- Australia, US and other countries are preparing to introduce emissions trading schemes
- Theory suggests: A broader coverage will most likely increase heterogeneity of abatement costs and increase efficiency gains from trading
- Lack of theoretical and empirical analysis in this area, decision on coverage seem mainly policy driven
- Lessons from EU Emissions trading Scheme coverage

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EU Emission trading system

- Cap and trade
- Started in 2005, current phase 2008-2012 (Phase II = Kyoto phase), Phase III (2013-2020)
- Covers around 12,000 installations from power generation & selected industries (only downstream), 2,083 Mt CO_2e 2008-2012

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EU ETS Coverage

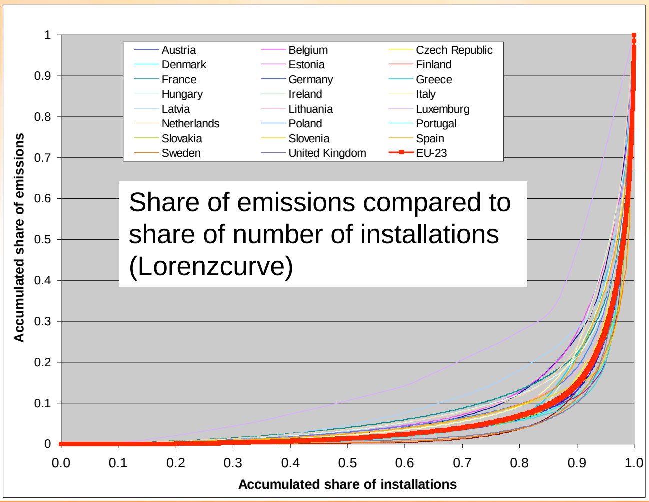
Annex I of the EU ETS Directive:

- **Energy activities**
  - **Combustion installations** rated thermal input **> 20 MW** (except hazardous or municipal waste installations)
  - **Mineral oil refineries**
  - **Coke ovens**
- Production and processing of **ferrous metals:** metal ore roasting or sintering installations, pig iron or steel including continuous casting (>2.5 t/h)
- **Mineral industry:** cement clinker (production capacity > 500 t/d), lime (> 50 t/d),
  glass (> 20 t/d), ceramic products (> 75 t/d, and/or kiln capacity >4 m^3, setting density per kiln > 300 kg/m^3)
- Industrial plants for the production of **pulp and paper** (>20 t/d)

Some countries (France and Netherlands) include other gases and sources e.g. N_2O

Emissions – Installations relation

Unequal distribution: 50 % of the installations covered emitted less than 1.4 % of the total emissions in 2005



Source: Data based on verified emissions from EU Registry

Related literature

- **Emissions trading**
  - Coase (1960) property right, Crocker (1966), Dales (1968) develop the idea of emissions trading in water context
  - Montgomery (1972) shows emissions trading schemes achieve same efficiency equilibrium independent from allocation method
  - All abstract from transaction costs
- **Emissions trading and transaction costs**
  - Theoretical analysis by Stavins (1995) shows initial allocation affects the final equilibrium if marginal transaction costs (trading costs) are non-constant
  - Empirical analysis on transaction costs by Foster and Hahn (1995); Dwyer (1992) and more recently by Betz (2003) and Jaraite et al. (2009)
- **Coverage**
  - Some consultancy reports assessing EU ETS Graus and Voogt (2007)

Research questions

- Is “broad coverage” an efficient approach when taking transaction costs into account?
- What is the “efficient” level of coverage?
- What are the factors determining the efficient coverage?

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Model introduction

- AIM: achieve an exogenously set cap (*C*) for a uniformly-mixed flow pollutant, such as greenhouse gas emissions, at minimum cost which is equal to maximise net social benefits
- Option 1: *all* installations emitting CO2 are to be covered by an ETS
- Option 2: *some* installations are covered by an ETS, and *others* by a uniform emissions standard

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Model (1)

- Option 1 (blanket coverage):

$$B^1(n) = \sum_{i=1}^{n}\left(TCR_i^{ST} - TCR_i^{ETS}\right)$$

- Option 2 (efficient coverage):

$$B^2(m) = \max_m \sum_{i=1}^{n} TCR_i^{ST} - \left(\sum_{i=1}^{m} TCR_i^{ETS} + \sum_{i=m+1}^{n} TCR_i^{ST}\right) = \max_m \sum_{i=1}^{m}\left(TCR_i^{ST} - TCR_i^{ETS}\right)$$

$1 \le m \le n$, and $i = 1,\ldots,$ m

s.t. $\sum_{i=1}^{n} a_{0i} = \sum_{i=1}^{n} e_i \le C$

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Model (2)

- Total Cost of Regulation (Standard)

$$TCR_i^{ST} = \int_{e_i^{ST}}^{e_i^{NR}} MAC_i(e_i)de_i + RC_i^{ST}$$

- Total Cost of Regulation (ETS)

$$TCR_i^{ETS} = \int_{e_i^{ETS}}^{e_i^{NR}} MAC_i(e_i)de_i + p_i \cdot \left(e_i^{ETS} - a_{0i}^{ETS}\right) + RC_i^{ETS}$$

$$p_i = p^* \pm t_i$$

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Data: Installations

- Installation-level data on verified emissions and allowance allocations for 2005 were available for the EU ETS
- Installations divided into 4 different groups for each sector:
  - Small
  - Medium
  - Large
  - Very large

Differentiation of installations

	Small emitter	Medium emitter	Large emitter	Very Large emitter
Sector	thousand tons of CO_2 emissions			
Cement and lime	48.54	218.62	544.79	2864.43
Combustion	4.62	14.85	52.66	12,497.63
Glass	15.24	34.47	72.84	592.75
Iron and steelworks	25.64	57.06	144.64	11534.47
Oil refining	157.69	574.11	1520.57	6266.75
Pulp and paper	6.59	18.40	43.22	421.19

Data: Abatement costs

- Data used: De Beer et al., 2001 and Hendricks et al., 2001
- Costs per tonne of emissions reduction and potential (%)
- Functional Form for estimation of Abatement costs:

$$MAC_i = e^{\beta_i A_i} - 1$$

$$TAC_i = \frac{1}{\beta_i}\left(e^{\beta_i A_i} - 1\right) - A_i$$

- Problem: negative abatement costs

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Abatement costs

	Small emitter	Medium emitter	Large emitter	Very Large emitter
Sector	β	β	β	β
Cement	0.842	0.187	0.075	0.014
Combustion	2.590	0.806	0.227	0.001
Iron and steelworks	1.649	0.741	0.292	0.004
Glass	1.646	0.728	0.344	0.042
Oil refining	0.0768	0.0211	0.0080	0.0019
Pulp and paper	2.853	1.022	0.435	0.045

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Transaction costs definition

- goes back to Commons (1934) and Stigler (1972), the latter compares transaction costs to frictions in the physical world.
- subsume all costs, e.g. costs of monitoring emissions on the side of the firm, as well as administration costs to the regulator, and also includes trading costs.
- Other way to define: all those costs related to an emissions trading scheme which are not directly related to the actual investment in abatement (e.g. equipment costs).

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Ongoing transaction costs

	Small installations ≤20 kt emissions		Medium installations 20 – 1,700 kt		Large installations ≥ 1,700 kt	
	ETS	Standard	ETS	Standard	ETS	Standard
Total Regulatory costs In thousand Euros per installation	21 (1.05)	14	35	24	82	68
Total Regulatory costs in k€/per kt emissions	1.05	0.7	0.021	0.014	0.008	0.007
Trading Costs4 (Euros / EUA)	0.025		0.025		0.006	
Fixed membership fee (thousand Euros per installation)					2.5	

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Results

Reduction target	**Total Cost Policy 1**	**Total Cost Policy 2**	**% saving**	**Number of installations efficiently covered in an ETS**
% per year	million € /year	million €/year	% per year	Number of installations out of 24
1	1.0	0.8	24.9	0
2	1.1	0.9	16.5	0
3	1.4	1.2	13.5	3
4	1.7	1.6	9.2	5
5	2.2	2.1	6.1	7
6	3.0	2.8	4.0	9
7	3.9	3.8	2.6	10
8	5.1	5.0	1.7	12
9	6.7	6.6	1.2	14
10	8.6	8.5	0.9	14

 Varying TC estimates and abatement costs showed results are robust

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Conclusions

- Blanket coverage only efficient if stringent reductions
- Heterogeneity in abatement costs does not outweigh small reduction potential due to low baseline emissions
- Phasing in sectors over time when targets get more stringent as in New Zealand bill is more efficient
- Transaction costs are high and difficult to reduce much especially for small emitters since some costs are fixed costs, therefore small emitters are more efficiently covered by standard
- EU ETS Phase 3 will make changes: introduction of an additional emission threshold of 10,000 tons of CO2 equivalent per year (excluding emissions from biomass) if thermal input does not exceed 25 megawatts
- Leaving installations uncovered may cause perverse incentives, therefore not recommended

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Thank you very much for your attention!

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Comments

- How can you explain the price *development (low price at the end)*?
- How can we show market power in permit market?
- How can we ensure that permit market become more efficient?

Eshel (2005) Journal of Regulatory Economics, 28:2, p. 205–223

- to maximize social welfare, the allocation of rights among agents should balance the marginal inefficiency in the market for rights, weighted by the effect of the allocation on the volume of rights traded, with the marginal inefficiency in the product market, weighted by the effect of the allocation on the volume of output traded.
- To do so we need information about the volume of rights traded by regulated firms and the relative power of the firms in the product market and in the market for rights.

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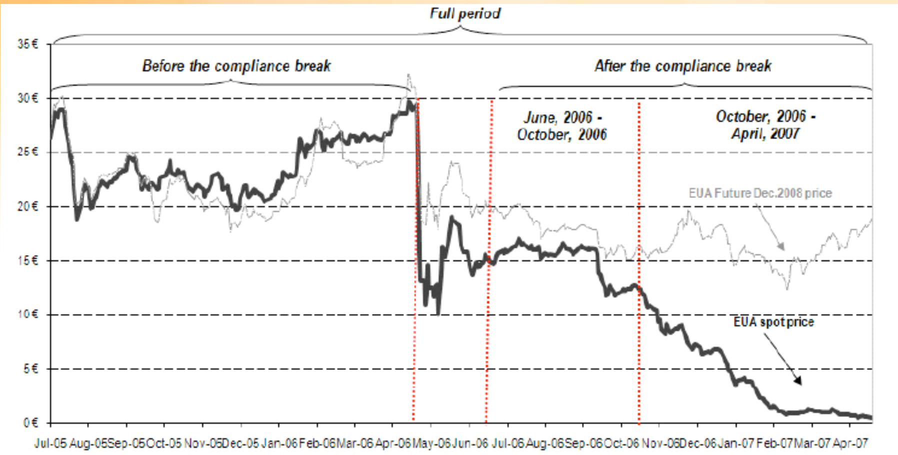
EU ETS permit price development



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