

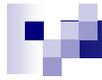
Sanction Design in Emissions Trading Programs

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Outline

- Motivation
- Background
- Sanctions in existing Emissions Trading Scheme (ETS)
- Experimental Method
- Experiment on Sanction Design in ETS



Motivation

- Investment decision of market players are influenced by price uncertainty
- Sanction design in emissions trading can induce uncertainty that affects investment decision
- We have a number of existing emissions trading schemes with different sanction design
e.g. price cap in NSW GGAS, make-good provision (offset) in EU ETS.
- Question:
How does different sanction design affect compliance rate and market performance?

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Background: Emissions Trading

- In theory, the use of this market based instrument as an environmental policy has the advantages of:
 1. Equalising abatement costs for a given environmental target
 2. Provide dynamic incentive for innovation, diffusion and adoption of better technologies (Milliman & Prince, 1989)
 3. High degree of environmental certainty (cap and trade)
 4. Relatively low administration cost
- The success of emission trading depends on its enforcement mechanism

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Background: The Economics of Enforcement

The economics of enforcement in ETS

Assumed that setting penalties, monitoring, and sanctioning of penalties are costless, perfect compliance will be achieved when:

$$b(e, \alpha) - p(l - l^0) < \pi f(v)$$

$$v = e - l$$

Where

$b(e, \alpha)$ firm's profit function, given emissions level (e) and technology (α)

p price of permit

l number of permit held

l^0 initial number of permit

π audit probability

$f(v)$ constant penalty rate given the violation level (v)

Marginal Penalty of Violation > Marginal Cost of Compliance

In practice:

when permit price uncertainty is very high firms may choose to violate and pay a fixed penalty rate

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Sanctions in Existing ETS

Schemes	Pollutants	Sanctions	Compliance
US Acid Rain	SO ₂	Penalty \$2963/ton (2004) + offset 1:1	100% (2005)
US OTC	NO _x	Quota reduction at 3:1	Over 99% (2006)
LA RECLAIM	NO _x , SO ₂	\$500/violation/day, determined by court	84% - 97 % (1994-2003)
EU ETS	CO ₂	€40 (rising to €100 in 3 yrs) + offset 1:1	Very high
NSW GGAS	CO ₂ , CH ₄ , N ₂ O, PFCs, HFCs, SF ₆	A\$16 incl. taxes	1% carried-fwd shortfalls
Denmark	CO ₂	\$6/ton	Very low in a particular year
Chile	PM	Penalty fee	Low, then high
Proposed Australia National ETS	6 major GHGs	safety valve emissions fee	-

Does high compliance rate correlate to optimal market performance?

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Experimental Method (1)

- Why experiment?
 - We cannot measure the realised cost savings as we have no information about true marginal abatement costs
 - Thus we cannot measure the effects of sanction design on market performance
- Advantages experimental methods (Davis & Holt 1993)
 1. Replicability
 2. Control
- Limitation of experimental methods
 - The value of laboratory methods in economics
 - The laboratory environment is simpler than the actual market of interest
- Important note: Experiment is not a panacea!

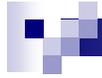
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Experimental Method (2)

Existing experiments on Enforcement in Emissions Trading

Sources	Research Questions	Treatment Variables	Market Design
Cason & Gangadharan 2006	Interaction of three issues facing regulators: the impact of banking, uncertainty on emissions, and the enforcement and compliance with regulations	Correlated or uncorrelated emissions shocks Banking and no banking Dynamic enforcement	Risk neutral Imperfect compliance
Murphy & Stranlund 2007	Determinants of compliance choices under competitive emissions trading and fixed emissions standards	High or low audit probability High or medium penalty rate Uniform or non-uniform initial allocation Low or high firms' marginal benefits	No trading quota Imperfect compliance
Murphy & Stranlund 2006	Direct and indirect effect of enforcement on compliance and emissions decisions	High or low audit probability Medium or low penalty rate Uniform or non-uniform initial allocation Low or high firms' marginal benefits	No trading quota Imperfect compliance

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Experiment on Sanction Design in ETS (1)

Research Questions:

Assumed that monitoring and sanctioning is 'perfect' and known by the participants

1. How will different penalty mechanisms affect firms' compliance rate in emissions trading programs?
2. How will different penalty mechanisms influence market performance with regard to the realised cost savings?
3. What are the factors that determine firms' compliance decision and investment level?

Focus of sanction design:

1. Fixed penalty rate
2. Offset mechanism
3. Mix of fixed penalty rate and offset mechanism

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Experiment on Sanction Design in ETS (2)

1. Fixed penalty rate

- Provide incentive and clearer signal for firms in choosing their abatement levels and exploit the opportunities of permits trading.
- Can function as a safety valve in situations where market prices become too high and volatile (McKibbin Wilcoxon's hybrid approach)
- The question: What is the level of penalty which can still both ensure perfect compliance and encourage optimal abatement levels?

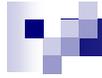
2. Offset mechanism

- Ensures environmental goal is achieved as it reduces the number of permits in the market and thus the emissions.
- Introduce uncertainty as a form of penalty because the future price is unknown.

3. Mix of Fixed Penalty Rate and Offset Mechanism

- Double penalty?

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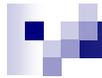


Experiment on Sanction Design in ETS (3)

The effect of auction as an allocation mechanism

- Auction price will give clearer indication of firms' marginal abatement costs which are unknown to the regulator
- Tying the penalty rate to an auction price might be a solution which would
 - reveal firms' marginal abatement costs
 - ensures that the fixed penalty rate will always be higher than the market price hence inducing firm compliance.
- Might have impacts on the bidding strategy because of the uncertainty of the penalty rate before the auction and the penalty rate changes over time.

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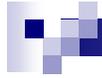


Experiment on Sanction Design in ETS (4)

Treatment Variables in our experiment

Penalty Design	Trading Institution		
	Grandfathered allocation	Auctioned allocation	Penalty linked to auction
Fixed penalty rate - Low level (slightly above equilibrium price) - High level	√ √	√ √	√
Offset mechanism - Low level (1:1.5) - High level (1:3)	√ √	√ √	-
Mix of fixed penalty and offset - Low level - High level	√ √	√ √	√

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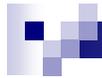


Experiment on Sanction Design in ETS (5)

Intuitions:

- Optimal market efficiency induced by fixed penalty rate will be achieved when penalty rate is set very close to equilibrium
- High level offset mechanism will yield lower market efficiency
- Penalty design with auction will yield higher market efficiency
- Combined fixed penalty & offset will yield lower market efficiency

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Thank you!

We invite your comments and questions

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