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Penalty Design in Emissions Trading Scheme

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Agenda

- Motivation
- Research questions
- Methodology
- Results from theoretical model
- Experimental design

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Motivation

- Emissions trading has become a very important regulatory tool in dealing with environmental issues in general and climate change in particular
- Huge scale of the market: estimated $64 billion of traded allowances in 2007 (World Bank 2008)
- Emissions trading aims to reach environmental target with the least cost possible, and penalty is an important market design element to achieve the goal
- Existing emissions trading schemes use different penalty forms, but very little information is known about their effects on market efficiency
- Context of Australia: Carbon Pollution Reduction Scheme in 2011 (hopefully), will use price cap as a penalty form. The price cap is set at $40 and annually increased by 5% in real terms (White Paper) → questions on the effects of price cap in compromising the emissions target as well as market efficiency

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Existing and Future ETS related to Climate Change

Penalty Type	Schemes	Pollutants	Sector coverage	Penalty Details	Compliance
Fine only (Fixed Penalty Rate)	NSW GGAS	6 GHGs	Electricity generators	A$16 incl. taxes	1% carried-fwd shortfalls
	Denmark 2000-2003	CO_2	Electricity producers	€5.3/ton	Very low in a particular year
	Chile	PM	680 sources emitting >1000m3/h	Penalty fee	Low, then high
	LA RECLAIM	NO_x,SO_2	311 facilities emitting >4 ton NO_x	$500/violation/day, determined by court	84% - 97 % (1994-2003)
Make-Good Provision	US OTC	NO_x	2579 units of power plants and large combustion sources in eastern US	Quota reduction at 3:1	Over 99% (2006)
Mix	US Acid Rain	SO_2	3456 electric generating units	Penalty $2963/ton (2004) + MGP 1:1	100% (2005)
	EU ETS	CO_2	Major installations	€40 (rising to €100 in 3 yrs) + MGP 1:1.3	Very high
	Australian CPRS 2010	6 major GHGs	Stationary energy, transport, fugitive emissions, industrial processes, waste and forestry sectors at the start	Price cap $40 increased by 5% annually	-
	RGGI (seven Northeastern states) 2009	CO_2	Fossil fuel electricity generators above a size threshold of 25MW in	Safety valve / price cap, linked to CDM	-
	WCI (7 Western US States and 4 Canadian Prov.s) 2012	6 major GHGs	electricity generation, commercial and industrial combustion, and industrial process emissions	MGP 1:3 + state penalty	-
	UK Carbon Reduction Scheme	CO_2	Large non-energy intensive business and public sector entities that are not covered by the EU ETS	Safety valve / price cap, linked to EU ETS	-
	New Zealand ETS	6 major GHGs	Forestry 2008, all sectors by 2013	Penalty NZ$60 + MGP 1:2	-

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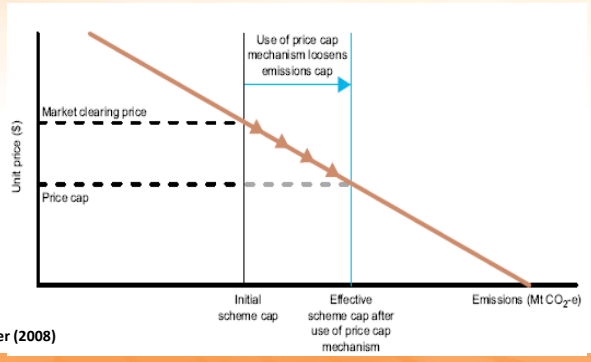
Price cap

- **Price cap is a mechanism for setting the maximum cost of compliance under the scheme**
- **If the permit price rises above the price cap, then price cap becomes with 2 implications:**
  - **Firms can still comply by buying permit from government at the triggered price (increasing effective supply of permits)**
  - **Firms are temporarily released from surrendering the required number of permits, hence firms are still under compliance.**



Green Paper (2008)

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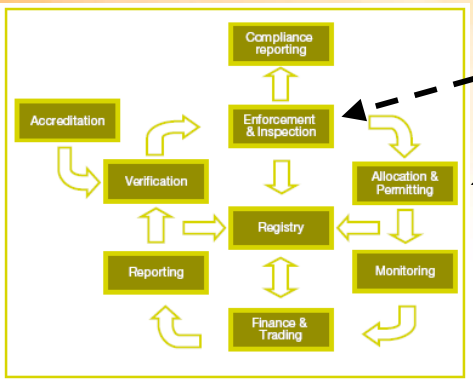
Emissions Compliance Processes



Penalty design: penalty form and level

Initial allocation of permits

Emissions Compliance Processes Reference Model
(PriceWaterhouseCoopers 2007)

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Research questions

- How does penalty design affect compliance strategy & market performance?
  - Penalty form :
    - Fixed Penalty Rate (FPR) or fixed fine, which can be set as a price cap
    - Make-Good Provision (MGP)
  - Compliance strategies: Investment in abatement measures & permit trading
  - Measures of market performance: Market price, Trading volume, Market efficiency : the actual over the theoretical cost saving, Convergence path of permit prices to equilibrium
- How does initial allocation influence market performance under different penalty form?
- Implication on the policy design of efficient & effective penalty in ETS

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Methodology

- **Theoretical approach**
  - Simple, two-period, perfect competition model
  - Result from theoretical work will be the hypothesis for the experiments
- **Laboratory experiment**
  - Incentivized decision-making
  - Reasonings:
    - Actual efficiency is difficult to measure with field data
    - An ETS will only have one penalty design and it is difficult to make comparison across different schemes due to differences in other design elements
    - With experimental method, we can have more control over laboratory environment & variables and try to isolate the effects of a change in one variable

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Results of Theoretic Model

- Initial allocation mechanism should not affect compliance decision
- The effect of levels of penalties:
  - As long as the penalty rate (*f*) is kept above the permit price (*p*), or the thus Make-Good Factor is kept greater than one, firm will find it optimal to comply by holding a number of permits or making investment in abatement measure, regardless of the level.
- The effect of the form of penalties:
  - Consistent results are obtained from both forms of penalties
  - With increasing penalty rate or increasing Make-Good Factor, and before the critical level of penalty is reached:

    Violation rate is decreasing, investment in abatement technology is increasing, and the production level with the current technology is decreasing
  - After the critical level of penalty is reached: all variables will reach its optimal levels
- Efficiency is maintained regardless of the penalty form and as long as the critical penalty level is reached

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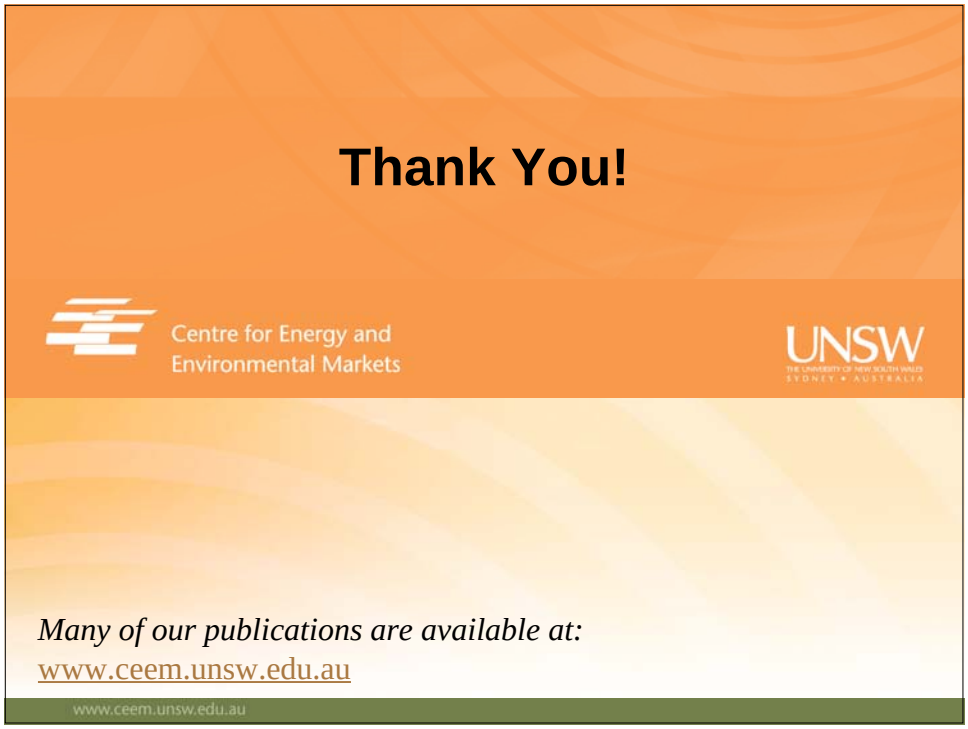
Experimental Design

- 6 treatments related to 3 treatment variables:
  - Penalty forms,
  - Penalty levels, and
  - Initial allocation rule (grandfathering or auction)
- Key market design:
  - Repeated rounds of market game, each with 2 sub periods.
  - A group of players in each treatment cell, comprising of net buyers and net sellers, who are differentiated by their Marginal Abatement Costs.
  - Trading institution: double auction
  - Banking and borrowing are not allowed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