

Environmental Economics – Lecture 4

Regulation under imperfect information

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Perman et al (2011) ch 7, Weitzman (1974)



Review last lecture

1. Criteria for choosing emission control instruments
2. Voluntary approaches
3. Command-and-control measures
4. Incentive-based instruments
 - ▶ Undifferentiated vs differentiated taxes
 - ▶ Taxes and subsidies



Criteria for choosing emission control instruments

Table 6.1 Criteria for selection of pollution control instruments

Criterion	Brief description
Cost-effectiveness	Does the instrument attain the target at least cost?
Long-run effects	Does the influence of the instrument strengthen, weaken or remain constant over time?
Dynamic efficiency	Does the instrument create continual incentives to improve products or production processes in pollution-reducing ways?
Ancillary benefits	Does the use of the instrument allow for a 'double dividend' to be achieved?
Equity	What implications does the use of an instrument have for the distribution of income or wealth?
Dependability	To what extent can the instrument be relied upon to achieve the target?
Flexibility	Is the instrument capable of being adapted quickly and cheaply as new information arises, as conditions change, or as targets are altered?
Costs of use under uncertainty	How large are the efficiency losses when the instrument is used with incorrect information?
Information requirements	How much information does the instrument require that the control authority possess, and what are the costs of acquiring it?

Preview this lecture

Regulation under imperfect information

1. Regulator does not know the firm's "type"
 - ▶ Prices vs. Quantities
 - ▶ Revealing private control cost information
2. Regulator does not know the firm's action
 - ▶ Midnight dumping and deposit-refunds
 - ▶ Audits and Enforcement
 - ▶ Dynamics and Commitment



Prices vs. Quantities

The regulator goal is to max net benefits $B'(M) = D'(M)$ (achieve PO). Question of instrument choice: tax or tradable permits?



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Setting:

- ▶ Firms max profits $\rightarrow f'(m) = \tau$ or $f'(m) = p$.
- ▶ Consumers are passive
- ▶ Genuine uncertainty:
 - ▶ Marginal abatement costs are uncertain
 - ▶ True type revealed after regulator acts, before firms act
- ▶ Asymmetric information
 - ▶ Firms, not the regulator, know abatement cost functions
 - ▶ Firms act after the regulator



Prices vs. Quantities

- ▶ Price instruments (tax)
 - ▶ Keep control of values (marginal abatement costs)
- ▶ Quantity instruments (permits)
 - ▶ Keep control of quantities (emission levels)
- ▶ What is worst:
 - ▶ To lose control of abatement costs?
 - ▶ To lose control of emission levels?



Prices vs. Quantities

- ▶ Taxes (prices) are preferred when marg benefits are relatively steeper than marg damages.
 - ▶ Intuition is that a wrong realized emission price has large consequences for the firm's cost
- ▶ Permits (quantities) are preferred when marg benefits are relatively flatter than marg damages.
 - ▶ Intuition is that wrong realized emissions have large consequences for the environment
- ▶ Note: Implicit assumption: slopes are known, levels uncertain
- ▶ Note: Damage uncertainty immaterial for instrument choice



Revealing private control cost information

- ▶ Firms have an incentive to exaggerate abatement costs under a permit system
- ▶ Firms have an incentive to understate abatement costs under a tax system
- ▶ A hybrid system, coupling marketable permits with subsidies for emitting less than permitted, will induce telling the truth about abatement cost



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Midnight dumping and Deposit-refund system

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Midnight dumping and Deposit-refund system

- ▶ Standard approach to discourage waste creation is to tax waste disposal at the marginal social cost of disposal.
- ▶ May create incentives to “midnight dump”
- ▶ Solution is to tax waste creation and subsidize safe disposal



Audits and Enforcement

- ▶ Before, we assumed that firms choose $m \in [0, \bar{m}]$.
- ▶ Now firms may choose any m , but if $m > \bar{m}$, they face the risk of being fined.
- ▶ Denote audit probability by q and let penalty if being caught be a function $P(m)$
- ▶ Firms maximize expected profits:
$$\pi(m) = f(m) - b - \tau m - E[P(m)] = f(m) - b - \tau m - qP(m)$$
- ▶ Whether or not to violate depends on whether cost of complying exceed expected cost of punishment. Degree of violation depends marginal penalty.
- ▶ Harsh punishment enforces regulation, but harsh punishment may not be feasible / desirable



Dynamics and Commitment: The price of flexibility

Consider the following two period pollution problem:

Today, the regulator estimates the marginal damages so that it sets a quota $M_1 = \bar{M}$. Next year, a new estimate of the damages will arrive. With probability θ it is the same as in the first period so that $M_2 = \bar{M}$. With probability $(1 - \theta)$ damages are lower, so that $M_2 = 2\bar{M}$.

The firm has two choices: It can either abate by reducing production at cost 60 when $M_t = \bar{M}$ and at cost 30 when $M_t = 2\bar{M}$. Alternatively, it can make an irreversible investment in cleaner technology at cost 50 per period (no reduction of production is needed, the investment can be made in period 1 or in period 2).

- ▶ What is the *ex ante* optimal strategy of the firm?
- ▶ What is the price of flexibility?



Dynamics and Commitment: The “ratchet effect”

- ▶ Firms may have the opportunity to undertake costly investment that reduces abatement cost in the long run.
- ▶ If the regulator can commit to not changing regulations, firms will find it in their interest to invest and optimally adapt to the regulation
- ▶ If the regulator cannot commit, firms may not want to invest in fear of a subsequent tightening of the regulations once investment is in place
- ▶ Commitment is rare because:
 - ▶ it may be politically infeasible
 - ▶ it may be very costly to design long-term plans
 - ▶ it prevents adaption to new information



Key concepts this lecture

- ▶ Prices vs quantities: The preference for one or the other instrument depends on the relative steepness of the marginal damage and benefit functions
- ▶ Private control cost can be elicited by a hybrid instrument
- ▶ Midnight dumping may be prevented by an adequate system of deposit taxes and refund subsidies
- ▶ Firms may find it in their best interest to violate existing regulations, approving potential punishment
- ▶ The expectation of a “ratchet effect” may prevent firms from undertaking cost-saving investments



Preview next lecture: Valuation

NB: next lecture is on Feb 26, next week is skiferie

1. Theory

- ▶ Categories of environmental benefits
- ▶ WTP and WTA

2. Practice

- ▶ Stated preference methods
 - ▶ The method of “contingent valuation” (CV)
 - ▶ Discussion: (<http://www.aeaweb.org/articles.php?doi=10.1257/jep.26.4>)
- ▶ Revealed preferences
 - ▶ Travel cost method
 - ▶ Hedonic pricing
 - ▶ Production function based techniques

