Environmental Economics – Lecture 5

Regulation under imperfect information

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Review last lecture

Incentive-based instruments

1. Taxes and subsidies
2. Tradable permits
3. Undifferentiated vs differentiated taxes
4. Taxes and subsidies when number of firms is endogenous
5. Double dividend hypothesis
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
Regulator does not know the firm’s “type”
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?
Prices vs. Quantities

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Setting:

- Firms max profits $\Rightarrow f'(m) = \tau$.
- 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

Figure 7.3 Uncertainty about abatement costs – costs overestimated

Loss when licenses used
Loss when taxes used

Emissions, M
Prices vs. Quantities

Figure 7.5 Uncertainty about abatement costs – costs overestimated

Emissions, $M$

$M^t$, $M^*$, $L^H$
Prices vs. Quantities

Figure 7.7 Uncertainty about damage costs – damages underestimated

Emissions, M

MD (true)
MD (estimated)
MC (true)

M*
L

ECON 4910, L5 9/18
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
Regulator does not know the firm’s action

Midnight dumping and Deposit-refund system

- Standard approach to discourage waste creation is to tax waste disposal at the marginal social cost of disposal.
Regulator does not know the firm’s action

Midnight dumping and Deposit-refund system

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- May create incentives to “midnight dump”
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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
Midnight dumping and Deposit-refund system

Pant alt. Alltid.
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:
\[
\pi(m) = f(m) - b - \tau m - \mathbb{E}[P(m)] = f(m) - b - \tau m - qP(m)
\]

Whether or not to violate depends on whether cost of complying exceed expected cost of punishment. Degree of violation depends on marginal penalty.

Harsh punishment enforces regulation, but harsh punishment may not be feasible / desirable.
Dynamics and Commitment: The “ratchet effect”

Figure: http://www.photo-dictionary.com/phrase/6353/ratchet-wrench.html
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.
Environmental R&D  

Requate (2005), Hoel (2010)

1. Abatement cost that depend on (endogenous) technology

2. Socially efficient amount of R&D

3. Can a market regulated by taxes or quotas achieve the first-best?

4. A distinct “environmental innovation” policy?