

### Criteria for Evaluation Environmental Policies

1. Besides having different impacts on people at different income levels, environmental policies could also have varying impacts in different regions of a country. How might a federal policy, applied uniformly across a country, have different impacts on different regions?
2. Suppose we adopt a regulation requiring that all new cars have catalytic converters installed to reduce tailpipe emissions. Explain how this could have a beneficial impact in the short run but a less beneficial impact in the long run.

### Decentralized Policies

3. One of the major problems in applying the Coase Theorem in practice is the existence of high transactions costs. Propose an approach that a third party could institute which would reduce these costs sufficiently so that the bargaining process could proceed. How likely is the solution to be efficient and why?
4. Accidents with trucks carrying cow renderings are fairly common in Marietta. Suppose regulators enact a rule requiring that the perpetrators of such an accident be liable for a sum equal to the average damages of all such accidents in the industry. Would this lead trucking companies to take the socially efficient amount of precaution against such accidents? Explain.
5. Pollution on the lake.
  - a) You own a house on a lake; a factory that produces hot dogs is also on the lake. No one else uses the water. The factory values the right to dump leftovers in the lake at \$700; you value the clean water at \$500. From society's perspective, should the factory be allowed to dump in the lake or should you be allowed to keep the water clean?
  - b) The factory starts dumping in the lake. You take the firm to court and win the right to the lake. The factory still wants to dump in the lake. What sort of arrangement is likely to occur? Who gains income from the court's decision: you or the factory? Is the final outcome in keeping with what is best from society's perspective?
  - c) Suppose that when you took the company to court, the company won the right to dump in the lake. You still do not want the factory to dump in the lake. What sort of arrangement is likely? Who gains from the court's decision?
6. A factory's production process creates sludge which pours into a river. This sludge makes it difficult to fish in the river, increasing the costs of the local fishermen by \$6000. The factory can install a water filter system for \$4500, and the fishermen can utilize a weighted fishing net system (to get under the sludge) for \$3750. Both systems would remedy the sludge damage to the fishermen.
  - a) Suppose transactions costs are zero. If the factory is not liable and can continue to produce sludge, what outcome do you predict and why?

- b) Suppose transactions costs are zero. If the factory is assigned liability for sludge damage, what outcome do you predict and why?
- c) Now suppose transactions costs preclude the possibility of private bargaining between the factory and fishermen. If a pollution tax is levied on the factory with the proceeds given to the fishermen, then what outcome do you predict and why?
- d) How do your answers to parts (a), (b), and (c) change if the cost of the water filter system was \$3500?
- e) Discuss the results of parts (a), (b), (c), and (d) in terms of the Coase Theorem.

### **Command and Control**

- 7. Environmental protection programs are frequently designed to require all polluters to cut back emissions by a certain percentage. What are the perverse incentives built into this type of program?
- 8. If emission standards are ruled out because of, for example, the impossibility of measuring emissions (as in nonpoint-source emissions), what alternative types of standards might be used instead?
- 9. Under a strict command-and-control framework, abatement standards are set equally across polluters. Assume the total abatement target is set at 30 units and show the cost implications using three graphs, each of a different polluter with a unique MAC curve drawn to depict a "low-cost abater," a "moderate-cost abater," and a "high-cost abater." On each graph, identify the abatement level corresponding to a uniform standards approach and how the level of MAC at that point and the area corresponding to TAC.
  - a) Now, refer directly to your model and explain what would happen qualitatively to the abatement levels of each firm if the equimarginal principle of optimality were used and explain intuitively why this would be cost-effective.

### **Incentive-based Policies**

- 10. Explain how emission charges solve the equimarginal problem.
- 11. When emission charges are put into effect, who ultimately ends up paying for them? Is this fair?
- 12. Given a societal marginal abatement cost function of  $MAC = 100 - 3E$  and a societal marginal damage function of  $MD = 2E$ , find the optimal level of pollution and the per unit pollution tax that would achieve it.

13. In 1989, 30 states had instituted taxes on the disposal of hazardous wastes, either at landfills, incinerators, or both. At the same time, federal legislation (RCRA) was making land disposal of hazardous waste much more difficult for firms. Hillary Sigman conducted an interesting study in which she looked at the variation in tax rates across the states to address two questions:
- \* What impact did the taxes have on the quantity of waste generated?
  - \* What impact did the taxes have on the choice of disposal method by firms?
- Sigman looked at a class of compounds called chlorinated solvents, used primarily for cleaning metals. Some of the data provided in her study are reproduced below.

Table A: Data on Chlorinated Solvent Wastes

Selected States	Tax Rate on Land Disposal (1989 \$/ton)	Tax Rate on Incineration (1989 \$/ton)
California	\$170.69	\$0.00
Connecticut	15.00	15.00
Idaho	21.00	1.00
Tennessee	5.00	2.50
Wisconsin	0.50	0.00
Vermont	112.00	56.00
Average (30 states)	26.95	10.73
Percent of Waste Disposed (1987-1988)	2%	25%

Table B: Disposal Costs for Selected Hazardous Wastes (1987 \$/ton)

Land Disposal	\$ 97 - 166
Incineration	\$320 – 700
Treatment	\$ 62 – 285
Recovery	\$ 95 - 237

- a) Based on the data in Table A, do you think the taxes would be more likely to discourage incineration or land disposal?
- b) Suppose it was found that overall chlorinated solvent waste production was lower at plants in Vermont than in Tennessee. Could we simply conclude that the higher taxes were responsible? If not, what other factors would you want to control for to find out the true effect of taxes on waste production?
- c) Suppose that the tax rates in Table A were tripled or quadrupled. If government monitoring and enforcement capabilities were inadequate, is it possible that such a move might generate worse hazardous waste pollution problems that we currently have? How?

## Tradable Discharge Permits

14. Two plants are emitting a uniformly mixed pollutant called gunk into the beautiful sky over Tourist-Town. The city government decides that it can tolerate total emissions of no more than 100 kgs of gunk per day. Plant G has marginal abatement costs of  $100 - 4x$ , and is currently polluting at a level of 25, while plant K has marginal abatement costs of  $150 - y$ , and currently pollutes at a level of 150. ( $x$  and  $y$  are the level of emissions at each plant.)
- What is the cost-effective pollution level for each plant if total pollution must equal 100? Suppose the city government knows marginal abatement costs at the two plants. In this case could the city obtain cost-effective pollution abatement using a CAC approach? If so, how?
  - In reality, why might the city have a hard time getting this information? What are the two "incentive-based" policies that could be used to get a cost-effective abatement of pollution to 100 units, without knowing the MC of the two firms? Be specific. Discuss two advantages each method has over the other.
  - Suppose the authorities are considering a tradeable emission permit system in which they give half the permits to each firm, or a tax system. If both systems work perfectly, how much will firms have to pay, in total, for pollution abatement under the two schemes? (Assume permits sell at a price equal to the tax.) Could this explain why Tourist-Town would be more likely to adopt a permit give-away system?
  - Suppose the marginal benefits of pollution abatement in Tourist-Town are constant and equal to \$64. (Each unit of pollution abatement brings in one more tourist, who spends \$64.) Is 100 units of pollution, obtained cost-effectively, an efficient level? If not, will efficiency be achieved through more or less pollution? Why?
15. Assume that a society is composed of two polluters, with the marginal abatement costs of polluters 1 and 2, respectively, equal to:
- $$MAC_1 = 18 - E_1$$
- $$MAC_2 = 12 - 2E_2$$
- where  $MAC_1$  refers to the marginal abatement costs of polluter 1 and  $E_1$  refers to the level of emissions of polluter 1.
- What is the unregulated level of pollution for each polluter?
  - Suppose each polluter must reduce their emissions by 50%. What is the total abatement cost of this policy?
  - Find the total level of emissions that would be generated if a per-unit pollution tax of \$4 were imposed. (Hint: Remember that efficiency requires the equimarginal principle to be met.) What is the total abatement cost of this policy? Perform the same exercise for taxes of \$6 and \$8.
  - Find the market price of a marketable pollution permit if pollution was limited to 12 units through the issuance of marketable pollution permits. (Use the hint from above and the fact that  $E_1 + E_2$  must equal 12.) What is the total abatement cost of this policy?
16. Summarize the theoretical advantages and disadvantages of standards-based CAC policies versus pollution taxes versus transferable pollution permits. What information and enforcement resources do regulators need under each approach? How does each approach affect R&D into pollution control technologies? If pollution control objectives are subsequently revised, how easy is it to meet these revised objectives under each approach? If incentive-based pollution control policies are more efficient, why aren't they more common?