Econ 493w   **Environmental Economics**   Fall 2012
WVU   **Review Sheet 1**   R. Congleton

1. Identify and/or Define:

   a. Positive Statement   l. Coase Theorem
   b. Marginal Cost   m. Cap and Trade
   c. Consumer Surplus   n. Effluent
   d. Short Run Profit   o. Discount Rate
   e. Social Net Benefit   p. Present Value
   f. Externality   q. Probability
   g. Market Failure   r. Expected Value
   h. Commons Problem   s. Cost Benefit Analysis
   i. Prisoner's Dilemma   t Effluent Density
   j. Pareto Superior Move   u. Command and Control
   k. Pigovian Tax   v. Government Failure

2. Use marginal benefit and marginal cost curves to depict a setting where:

   a. an externality generating activity (for example, pollution) is over produced in unregulated markets

   b. an externality generating activity (for example, picking up trash) is under produced in unregulated markets

   c. an externality generating activity is produced at the Pareto efficient level in unregulated markets

   d. In which of the above may the externality be considered a form of pollution? Explain.
   [Be sure to carefully label all relevant details in each of your diagrams.]

3. Discuss how a Coasian contract might potentially solve an externality problem.

   a. Develop an externality diagram, and note the existence of unrealized potential gains to trade at the independent adjustment equilibrium (e.g. unrealized social net benefits).

   b. Show that and explain why at the social net benefit maximizing state (the Pareto Optimal state), there are no further gains from trade.

   c. How would the presence of positive transactions costs affect your analysis?

   d. Discuss how the assignment of property rights determines the direction of compensating money payments between the affected parties.

   e. Are their any real world examples of "Coasian contracts" that are used to address environmental problems?

4. Use a 3x3 game matrix to characterize the "tragedy of the commons" for a two-person commons.

   a. What in your game matrix, if anything, distinguishes this tragedy from the standard prisoner's dilemma problem?

   b. Public policies that address commons problems change the payoffs of the commons game.
      • Show how user fees can solve the dilemma. (That is, modify the payoffs by subtracting the appropriate user fee (F) to produce a Pareto optimal outcome. How large does F have to be to solve the problem?)
      • Analyze how quotas (use entitlements) can solve the problem.

   c. Develop an example in which the payoffs (outputs) are based on a production schedule and so there are more than three possible strategies. Characterize the payoffs and outcomes with a game matrix.
      • Use this approach to show that not every commons has a commons problem.
      • (Hint, try a production schedule that has constant returns rather than diminishing returns.)

d. Explain why solutions to the commons problem tend to become more difficult as the number of commons users increases.

e. Discuss how privatization can solve a broad subset of commons problems.

f. Draw a 3x3 commons problem and show how user fees (or fines) can solve the problem illustrated.

g. Explain why private firms and clubs often provide common resources for their members. Do they face commons problems similar to those developed in class? If so, what steps do they take to solve them?

5. Pigovian solutions.
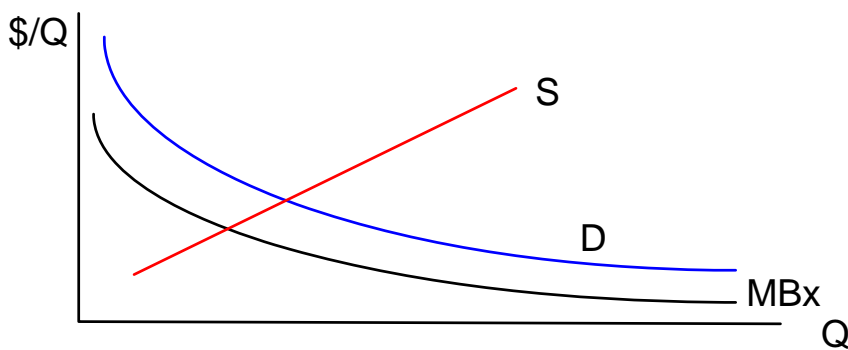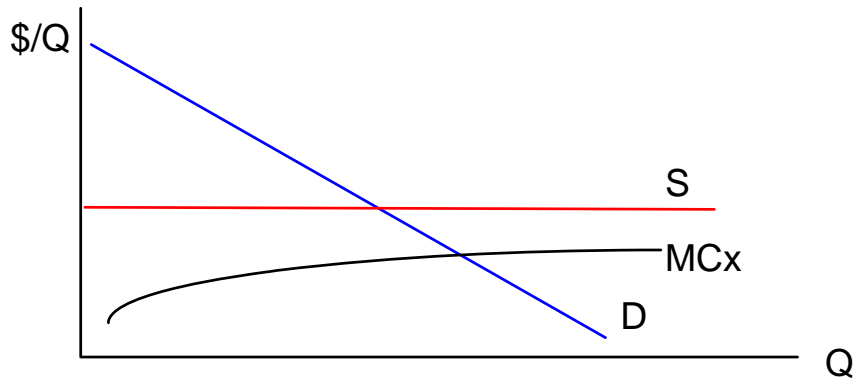
a. Show how a Pigovian tax can be used to internalize the externality problems above (and in your answer to 3a).

  • [If you have used an external marginal cost diagram, repeat using a negative external marginal benefits curve for a small number settings.]

b. Develop an example where a Pigovian subsidy rather than a tax is required to solve an externality problem, as with green space or the use of emissions reducing equipment.

  • What difficulties might one encounter in setting Pigovian taxes and subsidies--ignoring political problems that might arise?

c. One advantage of Pigovian taxes or effluent charges, in principle, is that they may easily be adjusted to "search" for the Social Net Benefit maximizing level of output.

  • Discuss how this property might help to over come some of the informational problems associated with achieving Pareto optimal pollution levels.

d. Repeat a and b using your own demand and supply curves. Try out cases with different slopes.

  • How do the slopes of the supply and demand curves affect the size of the tax or subsidy required to internalize the externality?

    e. Repeat a and b using marginal benefit curves.

    f. Use Pigovian taxes or subsidies to address the externality problems below.

6. Draw two diagrams that illustrate how an ideal marketable effluent permit (cap and trade) system operates.

    a. (Label all important details.)

    b. Show that a cap and trade system (effluent rights market) can achieve a pollution output target at a lower cost than a (uniform) effluent emissions mandate. .

      • (Hint: an effluent market diagram can be used to illustrate the advantages over uniform regulation of emissions by assuming that the same number of permits are initially given to all firms in the industry, but that one cannot exchange them under the uniform regulation regime.)

    c. Discuss briefly any other advantages and limitations that a marketable (tradeable) permit system might have.

    d. How does the initial allocation of permits (grandfather vs. auction) affect your diagrams and conclusions?

7. Expected value and present value exercises:

    a. Suppose that there are three possible damage levels associated with an effluent: 100, 200, and 300, and that they are equally likely. What is the expected damage?

    b. Suppose that there are three possible damage levels associated with an effluent: 0, 200, and 2000, and that the low damage outcome occurs with probability 0.8, the middle damage outcome with probability, 0.15 and the high damage outcome with probability 0.05. What is the expected damage?

    c. Suppose that the damages of interest are longer term, for example over 25 years away, rather than immediate. Assume that there are two possibilities, (1) no damages and (2) damages of $2 million every year for 25 years.

      • If the discount rate is 0.10, what is the present value of the damages associated with the bad outcome?

      • If the discount rate is 0.05, what is the present value of the damages associated with the bad outcome?

    d. Suppose that the discount rate is 0.5, and the probability of the good outcome ($0/year) and the bad outcomes ($2 million/year) are the same. What is the expected present value of the damages for a 25 year planning horizon?

    e. Given your answer to "d," what is the highest price that a rational person would pay to eliminate this environmental risk? Explain your logic and the limits (if any) of your conclusion.

      •

8. The cost of a regulatory scheme is a combination of the initial costs of establishing the regulation, private adjustments to the regulation, and the day-to-day costs of enforcement. Calculate the long term (infinite) present value of the following programs.

    a. Suppose that the initial "setup" cost is 500, the enforcement costs are 100 per year, the private capital costs are 150 per year and the flow of benefits is 300 per year. Assume that the discount rate is 5%/year. What is the present discounted value of the net benefit stream?

    b. Suppose that the initial cost is 100, the enforcement costs are 150 per year, the private capital costs are 175 per year, and that the benefit is a single "lump sum" that is realized in twenty five years. If the interest rate is 5%/year, what is the lowest benefit that makes the project worth while?

    c. Repeat a, but assume that the benefits are realized with probability 0.5, instead of with certainty.

9. Discuss the relative merits of Pigovian taxes, tradable permit systems, and command and control solutions to environmental problems. Show how such methods can be used and evaluate their relative effectiveness.

a. First, show how Pigovian taxes and subsidies can solve the problems in the output markets.
b. Second, show how Pigovian taxes and subsidies may address the problem in the "effluent" domain. (This will require drawing new diagrams.)
c. Third, in the same effluent domain, show how a cap and trade system can address the problems, and note the savings of a cap and trade system over a mandate system (untradable caps).
d. Discuss why the price of pollution permits in "c" tend to be the same as the Pigovian tax in "b."
e. Discuss how Coasian contracts could be used to solve effluent problem(s) in settings in which transactions costs are low.
  • (Assume that the problem involves an effluent dumped into a river, which affects the quality of drinking water and fishing downstream.)
  • (Consider both the case in which the polluter and that in which the persons affected by the externality initially control the output or effluent of interest.)

10. Given the MB curves below, derive each person's demand for gasoline.

•
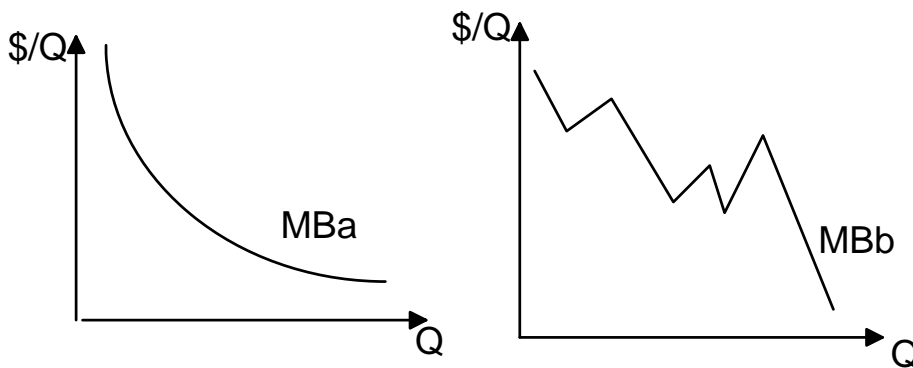
Appendix: Additional Environmental Puzzles and Problems

•

11. Compare and contrast policy decisions on environmental regulations and the distribution of personal income that might be made under the following normative theories:
  • (i) Social Net Benefit Maximizing,
  • (ii) Pareto Efficiency,
  • (iii) Contractarian
  • (iv) Utilitarian, where social welfare is the sum of individual utility levels,
  • (v) Green.

12. Suppose that the market for Gasoline has the following supply and demand curves:
$$Qd = 100 - 2P \qquad\qquad Qs = 100P$$
a. Find the equilibrium price (that which sets supply equal to demand).
b. Find the effect on output and prices for a 20 cent per gallon excise tax.
c. Suppose that the $MCx = 30P$. Find the Pareto optimal level of gasoline consumption.
d. Find the optimal Pigovian tax on gasoline.
e. Draw a graph of your solution and label all important details.

13. Suppose that Amex produces a waste product that is water soluble and that its current disposal methods endanger the local ground water. Amex saves $2,000,000/year by using this disposal method rather than one which does not endanger the ground water.

 a. What is the present discounted value of this waste disposal technology to Amex if the interest rate is 8%? if it is 5%?

 b. Suppose that an environmental law is passed that requires firms like Amex to adopt a more costly but less polluting technology. If the fine imposed is $2,000,000, what probability of detection and conviction will cause Amex to adopt the cleaner technology to its current one on purely economic grounds if its discount rate is 4%?

 c. Suppose that there is only a 10% chance that Amex's current waste disposal method will pollute the local ground water, and that the cost of implementing the law described in "b" is $500,000 per year. What damage level must be associated with polluted ground water to make the environmental law and enforcement apparatus a policy which increases social surplus if the discount rate is 5% and the probability of conviction is 10%?

14. Suppose that environmental science has characterized a probability function over five environmental states of the world: ideal (I), just fine (J), O.K. (K), moderately miserable (M), and noxious (N). Assume that the value (in dollars) of these states to the persons of interest are estimated to be: I = 100, J = 70, K = 50, M = 30, and N = 0.

 a. Calculate the expected environmental quality (in dollars) if P(I) = .1, P(J) = .2, P(K) = .4, P(M) = .2 and P(N) = .1.

 b. Calculate the expected environmental quality for the case where P(I) = .2, P(J) = .2, P(K) = .2, P(M) = .2 and P(N) = .2.

 c. Calculate the expected environmental quality for the case where P(I) = .1, P(J) = .2, P(K) = .2, P(M) = .3 and P(N) = .2.

 d. Rank order these settings. Is it possible to say anything about cases i and ii?

 e. Repeat assuming that the probabilities are all equal, p=0.2.

15. Discuss briefly how you would attempt to assess the costs and benefits of unregulated global warming.

 a. Are emissions of green house gases examples of externalities.

 • Are they always negative externalities?

 b. How would you take account of uncertainties involving the science and damages associated with predicted warming?

 • How does the maximum, minimum, average, and median level of risk aversion affect your conclusions?

16. Suppose that world population is 6 billion.

 a. What population growth rate will cause population to double in twenty years?

 b. in fifty years?

 • (Hint: the compound interest formula can be used as a growth formula.)

 c. How does population growth affect the political demand for environmental regulation?

 • Is your answer affected by whether per capital income is rising or falling?

 • Is your answer affected by the rate of technological improvement?

17. It has been argued that a sufficiently competitive market for local government services would induce each local government to provide the Pareto optimal level of public services for its residents because citizens can "vote with their feet."

a. Explain how local pollution standards would be set in a Tiebout environment.

b. Would standards be uniform across communities? (Explain why not.)

c. Suppose that the bulk of the direct effects of air pollution are local but that each locality's local pollution levels has modest affects on all other communities.

   • Are there now Coasian contracts that might be signed among communities?

d. Should there be a national pollution standard in this case according to conventional (SNB) welfare analysis? Explain.