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Economics of Environmental Policy

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Take Home Exam 2
Spring 2014

Due by 5:00 pm on Monday 4/28 if submitted on paper or by midnight if sent by email.
Do not open this exam until you are ready to begin.

Instructions

1. Please write your answers on regular paper. You do NOT need to type your answers.

2. Write your **SUID** on your exam. Please **DO NOT** write your name.

3. There's no hard time limit but try to do it in one sitting of no more than about 3 hours.

4. Show all your work. Answers without supporting work will receive little or no credit.

5. The exam is "open book/open notes": you are welcome to refer to your notes, to the exercises and their answer sheets, or to readings listed on the syllabus.

6. It is NOT "open friend": you must do the exam yourself MAY NOT talk with anyone about it until after the due date.

7. Please do not use Google: you can use materials that you already have on hand but please don't go hunting for more.

8. Using a spreadsheet is OK as long as you attach a printout showing the details of your calculations. However, you should have no problem doing the exam with a calculator.

Question 1: Multiple Source Pollution

A regulator wants to reduce pollution from three firms. The initial emissions and the marginal costs of abatement for the firms are given below, where each *Q* is the corresponding firm's quantity of abatement:

Firm	Initial Emissions	MCA
1	600	$MCA_1 = 2 * Q_1$
2	200	$MCA_2 = 5 * Q_2$
3	200	$MCA_3 = 10 * Q_3$

The marginal benefit of total abatement, Q_T, is given by $MBA = 900 - Q_T$.

(1) Compute the efficient total amount of abatement and the amount that should be done by each firm. What is the total cost of abatement at this allocation?

(2) Suppose the regulator wishes to use an emissions tax to control the pollutant. What should the tax rate be? What will the total cost of the policy be to each firm, including both abatement costs and tax payments?

(3) Suppose instead the regulator wanted to use a tradable permit policy that would achieve the efficient level of pollution while keeping each firm's share of total compliance costs equal to its share of initial emissions (i.e., firm 1 should pay 60% of the total cost). What would the equilibrium permit price be? How many permits should be initially distributed to each firm?

Question 2: Effects of a Price Collar Policy

A pollutant is currently uncontrolled and 2000 tons are being emitted. The marginal benefits and marginal costs of abatement are believed to be the following:

$$MBA = 1000 - \left(\frac{1}{10}\right) * Q_a$$
$$MCA_e = 200 + \left(\frac{9}{10}\right) * Q_a$$

(1) Determine the efficient amount of abatement, the efficient amount of pollution, and the marginal cost and marginal benefit of abatement at that point provided that the curves above are correct.

The regulator would like to use a price collar policy to control the pollutant and establishes a regime with the following features: (a) the initial quantity of permits distributed is equal to the efficient amount of pollution from part 1, (b) the price of additional permits that can be purchased from the government is set to the expected marginal cost from part 1, and (c) the regulator agrees to maintain a floor price of $810 in the market by buying up excess permits, if necessary.

(2) Suppose the actual marginal costs of abatement turn out to be higher than expected: $MCA_H = 470 + (9/10) * Q_a$. Please determine the equilibrium price of a permit and the number of extra permits purchased from the government, if any.

(3) Finally, now suppose that instead the actual marginal costs of abatement turn out to be lower than expected: $MCA_L = (9/10) * Q_a$. Please determine the equilibrium price of a permit and the number of surplus permits purchased by the government, if any.

Question 3: Banking and Borrowing

A regulator wishes to control cumulative emissions over three periods (0, 1 and 2) using a tradable permit system. In the absence of the policy, total emissions over the three periods are expected to be 7000. The regulator would like to reduce that to 4200 and plans to distribute permits as shown in the table below, which also gives each period's initial emissions and its marginal abatement cost curve. The interest rate between the periods is 100%.

Period	Initial Emissions	MCA	Allocated Permits
0	1000	$MCA_0 = 2 * Q_0$	700
1	2000	$MCA_1 = 2 * Q_1$	1000
2	4000	$MCA_2 = 2 * Q_2$	2500
Total	7000		4200

Please compute the following information for each of the three cases below: (a) the price of a permit in each period; (b) the number of permits that are banked, borrowed or repaid in each period, if applicable; (c) each period's total abatement cost; and (d) the present value of abatement costs.

(1) No banking or borrowing.

(2) Full banking and borrowing.

(3) Banking is allowed but borrowing is not.

Question 4: Exhaustible Resource with a Backstop

Consider the allocation of an exhaustible resource across three generations. The following information is available about demand and MEC in the three periods:

Period	Demand	MEC
0	WTP0 = 1000 – 2*Q0	600
1	WTP1 = 2000 – 1*Q1	400
2	WTP2 = 4000 – 1*Q2	200

Initially, there are 4300 units of the resource available. The interest rate between generations is 100%.

(1) Please calculate the equilibrium royalty, extraction cost, price and quantity that would occur in each period, and summarize your results in a table.

Now suppose that a backstop is available at a marginal cost of $600.

(2) Please calculate: the new equilibrium royalty, extraction cost, price and quantity in each period, summarizing your results in a second table. Finally, calculate the total amount of the resource produced via the backstop.