Economics 3250 Dr. Lozada
Spring 2016 Exam 2

This exam has 25 points. There are six questions on the exam. Most of the questions are worth 4 points, but one is worth 5 points.

Put your answers to the exam in a blue book or on blank sheets of paper.

You have the entire class period (that is, until **1:10pm**) to take this test.

Answer the questions using as much precision and detail as the time allows. Correct answers which are unsupported by explanations will not be awarded points.

Answer all of the following six questions.

1. **[4 points]**
   (a) Illustrate how a social planner would determine the socially-optimal level of a pollution tax (technically, a tax on production of a polluting output), using a graph with output on the horizontal axis and "dollars per unit of output" on the vertical axis.
   (b) Illustrate how a social planner would determine the socially-optimal level of a pollution tax (technically, a tax on non-abatement of pollution), using a graph with abatement on the horizontal axis and "dollars per unit of abatement" on the vertical axis.
2. **[4 points]** In class we gave a numerical example showing that a tradeable permit system for pollution control (a "cap-and-trade" system) was more efficient than a pollution "standard," which is a type of "command-and-control" policy. *Why,* intuitively, is that conclusion true? In other words, what basic reason underlies the conclusion that cap-and-trade is more efficient than command-and-control? In answering this question, you do not need to provide a complete numerical example like we did in class, but using some hypothetical or illustrative numbers (or, if you want, variables such as "x" or "c," defined as you wish) would be useful. You should include a definition of the term "efficient" as it is used in economics and thus as it is used in this question.
3. **[4 points]** Using a graph with the size of a fish population (the "stock size") on the horizontal axis and "births minus natural deaths" on the vertical axis, illustrate the difference between "maximum sustainable yield" and "sustainable yield." Give examples, using your graph, of where the two things are not the same. Explain why the points you claim illustrate "maximum sustainable yield" or "sustainable yield" actually do illustrate those things.
4. **[5 points]** Define the Hotelling Rule and illustrate the Hotelling Rule using a graph. Explain its consequences for the rate of extraction over time.

5. **[4 points]** Comment on the following passage from page 251 of your textbook:

> "It is conceivable that the pursuit of self-interest within a regulatory framework will secure sustainable development. But, the moral case for the environment remains, and it shows through in business approaches to the environment. It shows as *commitment*—which we might define as a concern for the environment which cannot be explained in terms of the self-interested motives discussed previously. *Proving and measuring* commitment are difficult, maybe impossible. But it isn't easy to understand some corporate approaches to the environment unless commitment exists."

6. **[4 points]**

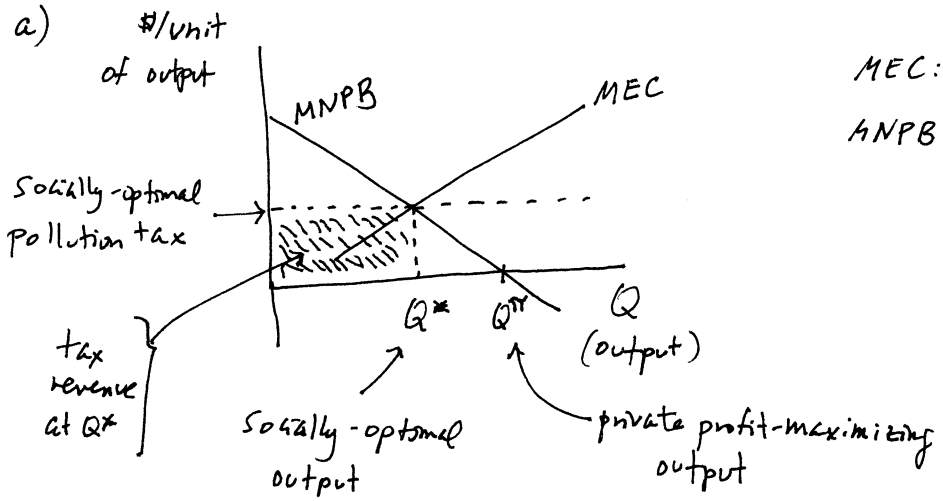
   (a) What is the difference between a materials levy, a product charge, and a waste disposal charge?

   (b) Of the three economic incentive instruments mentioned in part (a), which one may the most difficult to enforce (in the sense of the government being able to catch violators) in the United States? Why?

Answers to Econ. 3250 Exam 2, Spring 2016

(1)

a)



MEC: marginal external cost

MNPB: " net private benefit

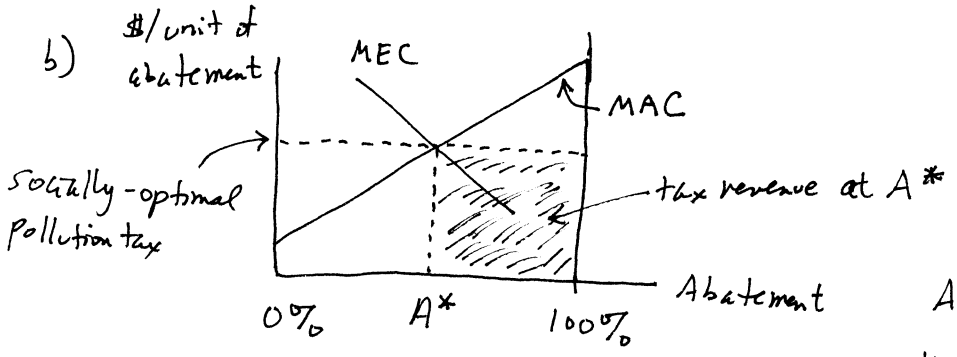
Society wants Q produced if and only if its MEC < MNPB (which leads to a desire for Q*).

Firms will produce those Q for which MNPB > pollution tax.

(MNPB: private benefit of Q; pollution tax: additional cost of Q)

So the firm will produce Q*.

b)



MAC: marginal abatement cost

MEC: as in (a)

As abatement ↑, abatement becomes more costly at the margin, so MAC is upward-sloping.

As abatement ↑, pollution ↓, so its MEC can be assumed to ↓-sloping.

Society wants to engage in abatement when and only when its cost, MAC, is less than the damage caused by pollution, MEC. This leads to A*.

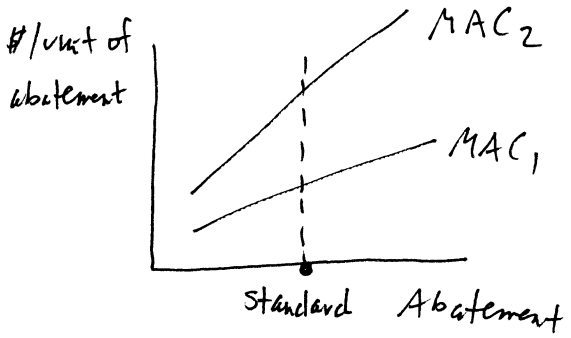
Firms will produce using those A for which MEC > MAC. So the firm will produce at A*.

(MEC: benefit of ↑ abatement; MAC: cost of ↑ abatement)

Answer to Question 2.

If firms are identical in the ease with which they abate pollution, the tradeable permits and standards are equally efficient. (The term "efficient" implies, in this context, that there is no lower-cost way of achieving the same level of pollution. In general in economics, "efficient" means Pareto Optimal, that is, there is no way to make anyone (say, pollution victims or polluters) better off without hurting someone else (say, polluters or pollution victims).) So efficiency gains will occur in the context of at least two firms, one with high marginal abatement costs ("MAC") and one with lower MAC.

To illustrate, suppose the two firms have MAC_1 and MAC_2, as shown in the graph below. If both have to abate equally, then at that point, $MAC_1 < MAC_2$. Next, suppose one unit of abatement switches from Firm 2 to Firm 1. Total abatement is unchanged, so total pollution is unchanged, so pollution victims are indifferent between the old and new situation. Firm 1's costs have increased by MAC_1—say, \$10. Firm 2's costs have decreased by MAC_2—say, \$16. So both firms could be made better off if Firm 2 paid Firm 1 anything between MAC_1 and MAC_2. For example, if Firm 2 paid Firm 1 \$12, Firm 2 would be better off by \$16 − \$12 = \$4, that is, its abatement cost savings minus its payment to Firm 1. Firm 1 would be better off by \$12 − \$10 = \$2, that is, its payment from Firm 2 minus its increased abatement costs. So the original situation, of equal pollution abatement, is not "Pareto Efficient" (which is a synonym for "Pareto Optimal" and a synonym for "efficient").



Answer to Question 3.

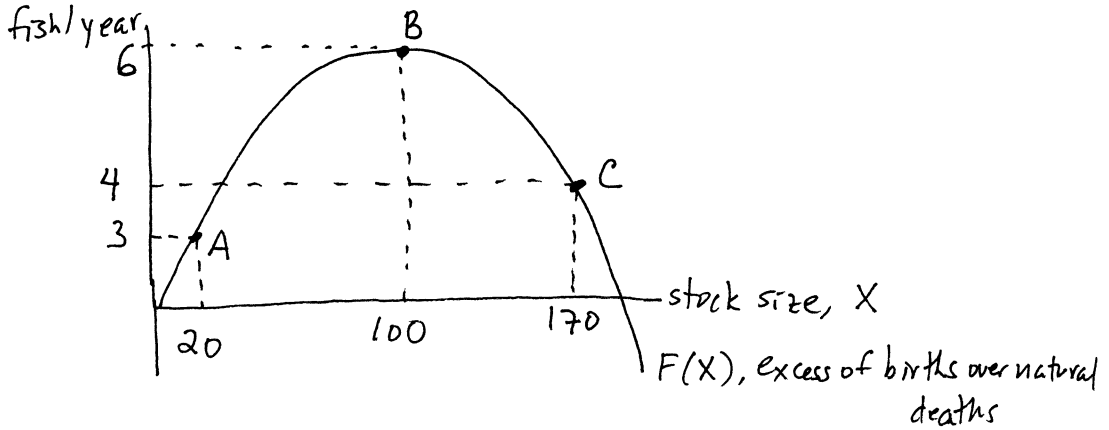
At point A, the stock size is 20 and the "excess of births over natural deaths" is 3. If there were no human intervention, at the end of the year, the population would have grown by 3, making the end-of-year population 20 + 3 = 23. Now suppose humans kill 3 fish that year. Then the end-of-year population would be the initial 20, plus 3 from natural growth, minus 3 because of humans, for a total of 20, which is the same as the beginning-of-year population. So a sustainable population size of 20 is achievable with a "harvest" ("sustainable yield") of 3, which is at point A.

At point C, the stock size is 170 and the "excess of births over natural deaths" is 4. If there were no human intervention, at the end of the year, the population would have grown by 4, making the end-of-year population 170 + 4 = 174. Now suppose humans kill 4 fish that year. Then the end-of-year population would be the initial 170, plus 4 from natural growth, minus 4 because of humans, for a total of 170, which is the same as the beginning-of-year population. So a sustainable population size of 170 is achievable with a "harvest" ("sustainable yield") of 4, which is at point C.

So already we have two different sustainable yields, 3 at point A and 4 at point C.

At point B, the stock size is 100 and the "excess of births over natural deaths" is 6. If there were no human intervention, at the end of the year, the population would have grown by 6, making the end-of-year population 100 + 6 = 106. Now suppose humans kill 6 fish that year. Then the end-of-year population would be the initial 100, plus 6 from natural growth, minus 6 because of humans, for a total of 100, which is the same as the beginning-of-year population. So a sustainable population size of 100 is achievable with a "harvest" ("sustainable yield") of 6, which is at point B.

Clearly, then, $F(X)$ also graphs sustainable yield versus stock size, and the *maximum* sustainable yield is only at point B, where $F(X)$ reaches its maximum.

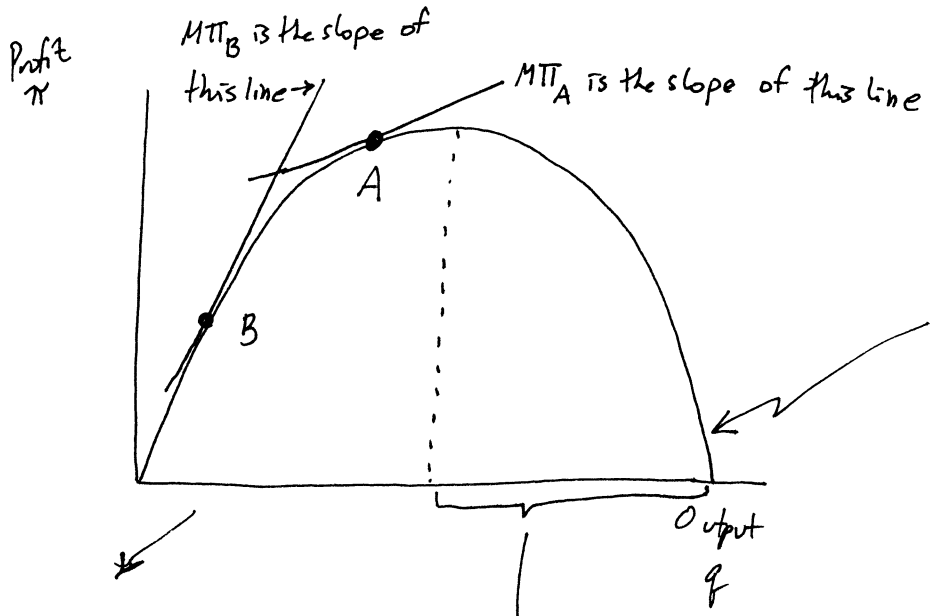


④

The Hotelling Rule says that, for exhaustible resource firms, marginal profit should rise at the rate of interest (or the firm's rate of time discount):

$$\underbrace{MR_{t+1}}_{\text{marginal profit}} = (1+r)\,MR_t$$

(MR_{t+1}: date $t+1$; r: rate of time discount; MR_t: date t)



This is a fairly generic graph of how output affects profit. It is not particular to an extractive firm.

I've drawn tangent lines at points A and B, and described the corresponding marginal profit. Since the tangent line to B is steeper than the tangent line to A, $MR_B > MR_A$. The Hotelling Rule says MR needs to rise with time. So MR_B happens after MR_A. Since B has smaller q than A, the fact that B occurs later than A means that quantity gets smaller as time passes.

In this region, $MR < 0$. The firm will never want to operate here, because if it were operating here, by slightly decreasing output it would simultaneously increase profit and increase the amount of resource it could extract in the future. Since both of those are good for the firm, it would want to decrease output: so it would not be content with being in this region.

Optional

Answer to Question 5.

Since the beginning of this class, we have assumed that the only things firms do is to follow "the pursuit of self-interest." This is a standard assumption in most traditions of economic thought (for example: Neoclassical, Marxist, and Institutional). If a firm did not pursue its self-interest, it is likely it will be driven out of business by those of its competitors which do pursue their self-interest.

The viewpoint taken in this paragraph is, accordingly, quite unorthodox. This paragraph claims that firms sometimes do things "which cannot be explained in terms of... self-interested motives." A firm's engaging in "green" actions is easy to explain within standard approaches to economics if those actions benefit the firm in some way, such as generating good will from consumers or employees, or such as saving the firm waste disposal costs, or enabling it to technologically leapfrog over its competitors. When "green" actions do not benefit the firm in any way, standard approaches say the firm does not undertake them. This paragraph says that sometimes firms do undertake them.

If that is true, traditional approaches say it will be temporary: inexperienced managers who do not understand how the market works may naïvely adopt such a non-profit-maximizing "green" approach, but their management strategy will only exist for a short time before it is out-competed and driven out of business.

Therefore, during lecture, I took the position that this paragraph from the book was poorly thought-out.

I can think of two ways to defend the book. The first is to note that in practice, it may not be easy to determine if a particular "green" initiative will be profit-maximizing or not. The second is that in practice, a non-profit-maximizing "green" initiative may survive if its effect on profit is small and if the company which undertakes it has other advantages in the marketplace which allow it to survive even if its profit is not as large as possible, but is merely *close to* "as large as possible."

Answer to Question 6.

(a) A materials levy is a tax on the inputs to production: for example, a tax on the cardboard used to make a product's container or shipping box. A materials levy is paid by the producer (though its ultimate burden may be shared by the consumer).

A product charge is a tax on the output of production. It might be high for a product whose proper disposal or recycling is difficult, and lower for products which are easy to properly dispose or recycle. It is collected by the final seller, though its ultimate burden may be shared by the consumer.

A waste disposal charge is a tax on throwing things away: for example, the "tipping fee" at a landfill.

(b) Waste disposal charges are probably the most difficult to enforce.

Materials levies are relatively easy to enforce because the only monitoring which has to be done is at factories, which are rather few in number.

Product charges are also relatively easy to enforce because although they need to be collected at points of sale, which are more numerous than factories, there are still not very many points of sale, and points of sale are already closely monitored to ensure adherence to sales tax laws (in the USA—and excepting the US states of Oregon, Montana, Delaware and New Hampshire, which impose no sales tax).

Waste disposal charges at landfills are easy to collect (since there are not many landfills, and many landfills are operated by the government anyway), but if people dispose of waste in illegal ways, such "dumping" can be very difficult to detect, because it can be done by anyone (so the number of potential violators is extremely large), anywhere (so the number of potential places of violations is extremely large).