Economics 5250/6250 Dr. Lozada
Fall 2015 Final Exam

This exam has 67 points. There are six questions on the exam; you should work all of them. Each question is worth 11 points, except the first question, which is worth 12 points.

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

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. Therefore, even if you think something is "obvious," do not omit it. If you omit anything, you will not get credit for it. You get credit for nothing which does not explicitly appear in your answer. If you have questions about the adequacy of an explanation of yours during the exam, ask me.

Answer all of the following six questions.

1. **[12 points]** Show that the steady-state supply curve in an open-access fishery has a "backward-sloping" portion (that is, a portion in which steady-state supply falls when the market price of the fish goes up). You may assume standard logistic growth of the fish species.

2. **[11 points]** Attempts to find Hotelling-Rule behavior in data from exhaustible resource industries have, in general, failed. There are two competing explanations of this. Describe these two explanations and explain why one results in a rather optimistic view of future resource scarcity while the other does not.

3. **[11 points]** How could the Coase Theorem's conclusions fail if at least one of the parties acts "strategically," sometimes refusing to accept an offer that would be in his or her short-run best interest? Why might someone act that way?

4. **[11 points]** On a graph, show the loss in social surplus resulting from a pollution tax if the tax-setting authority mistakenly thinks the marginal external cost curve ("MEC") is below where it actually is.

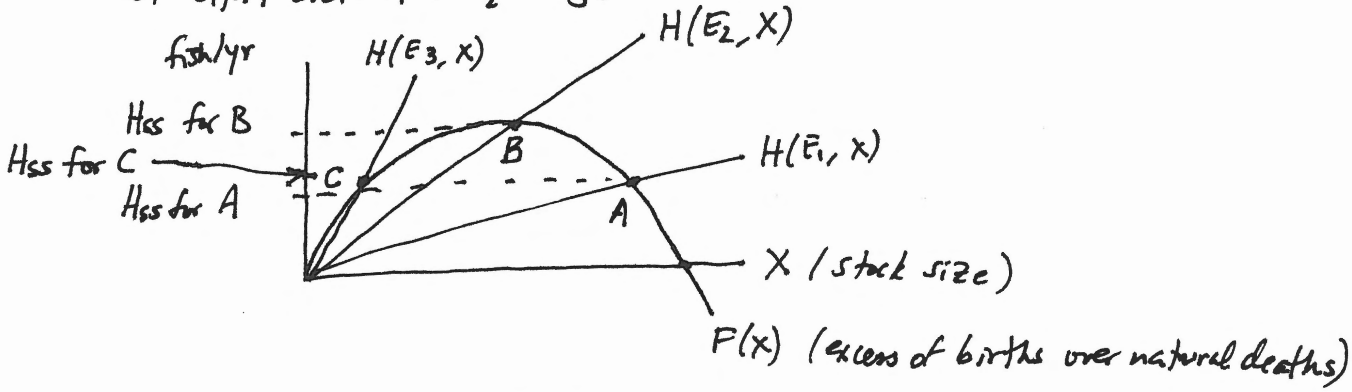
5. **[11 points]** Discuss the following passage which appears in your textbook:

   > [...a Best Practicable Environmental Option is] the outcome of a systematic consultative and decision-making procedure which emphasizes the protection and conservation of the environment across land, air, and water. The BPEO procedure establishes, for a given set of objectives, the option which provides the most benefit or least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term.

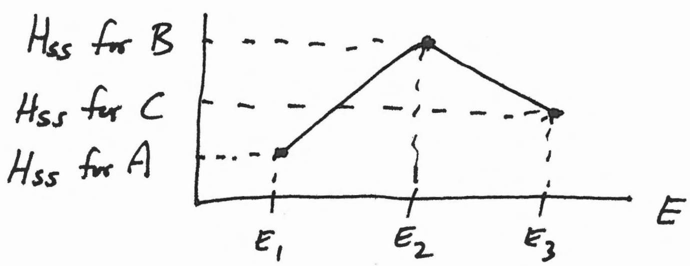
6. **[11 points]** Contrast the notion of entropy as representing "disorder" with the equation $\Delta S = \Delta H/T$ where ΔH is heat flow and T is the absolute temperature. Give an example showing how the equation can explain a physical process.

Answers to Econ. 5250 Final Exam Fall 2015

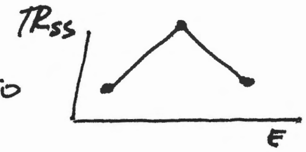
① Let effort levels $E_1 < E_2 < E_3$.



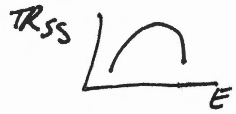
$H(E, X)$ is harvest. For fixed E, H is increasing in X (more fish in the ocean $\Rightarrow$ greater catch, all else held equal). Steady state is defined as "nothing changes with time," so in the steady state, $\dot{X} = 0$. But $\dot{X} = F(X) - H$, so in the steady state, $F(X_{ss}) = H_{ss}$. Such points are shown by A, B, and C. So



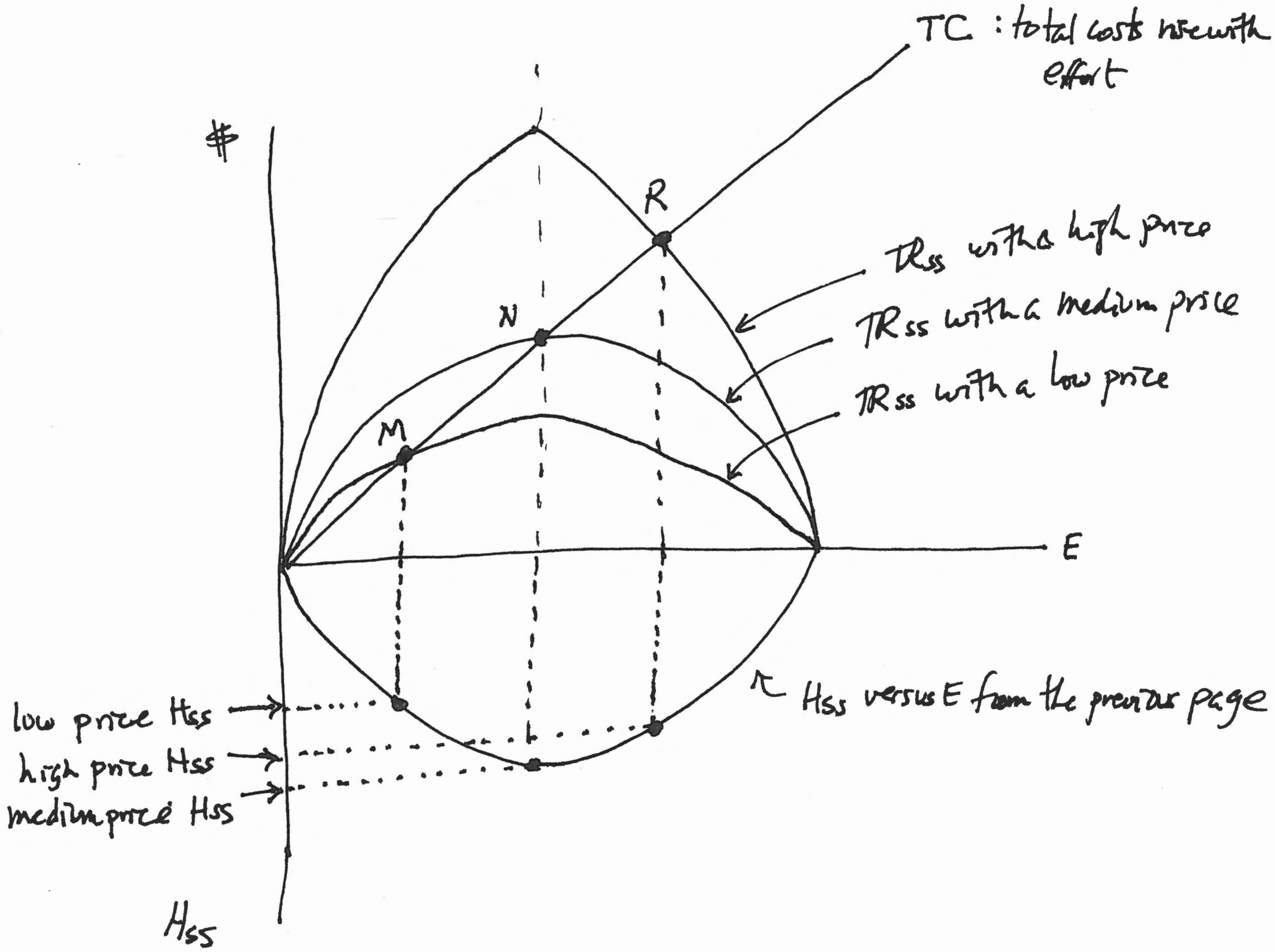
(H_{ss} for C might be below H_{ss} for A.)



For a fixed price p, total revenue TR_{ss} is p times H_{ss}, so in our example, or approximately



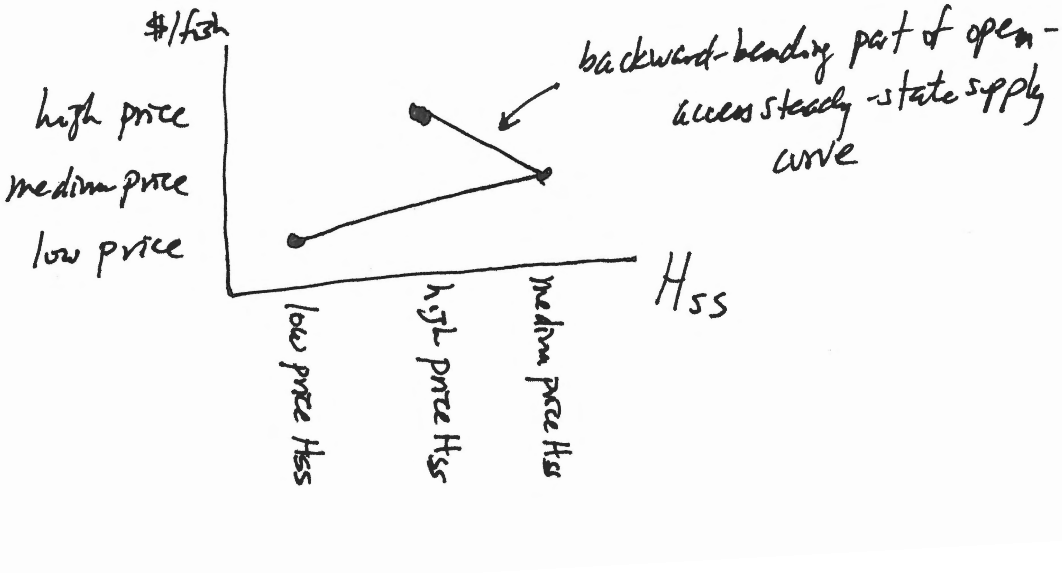
. Then



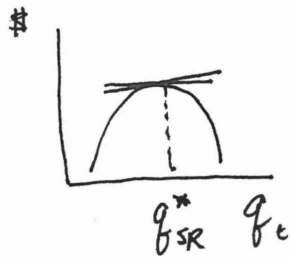
In open access, $\pi = 0$ (else entry or exit would occur), so $TR_{SS} = TC$, as

steady state

at points M, N, and R. From the bottom part of the diagram:



(2) Explanation # 1:



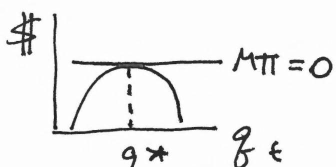
Let q^*_{SR} be the short-run profit-maximizing level of extraction. If the resource stock were very large, the Hotelling Rule could be valid and in operation but marginal profit $M\Pi_t$ would be very small (very close to zero). In this case, both sides of

$$M\Pi_{t+1} = \underbrace{(1+\delta)}_{\text{discount rate}} M\Pi_t \quad \text{(the Hotelling Rule)}$$

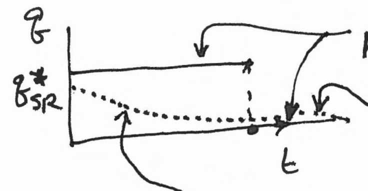
would be very small (very close to zero), and might look statistically equal to zero.

So in this explanation, $M\Pi \approx 0 \Rightarrow$ stock size is large.

Explanation # 2:



In this explanation, firms do not maximize the present discounted value of profit, but they instead maximize short-run profit. So until they run out of the resource, they set $q_t \equiv q^*_{SR}$, so $M\Pi \equiv 0$. (The identity symbol, $\equiv$, means the left-hand side is equal to the right-hand side forever or for a very long period.) The net-present-value-maximizing plan would have $M\Pi > 0$, and thus $q_t < q^*_{SR}$:



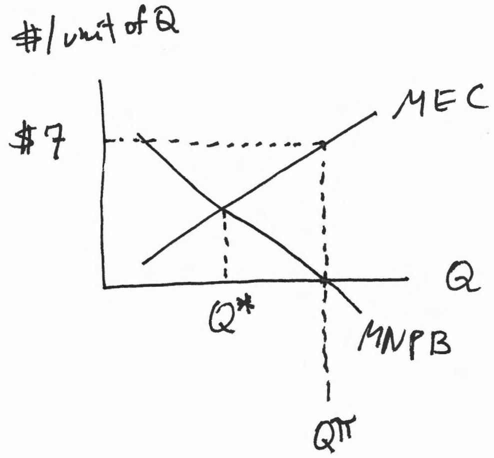
plan that maximizes short-run profit

[dotted curve] plan that maximizes the present discounted value of profit

Hence the plan being followed extracts the resource too quickly.

It follows that Explanation #1 gives an optimistic view of future resource scarcity while Explanation #2 is more pessimistic.

③



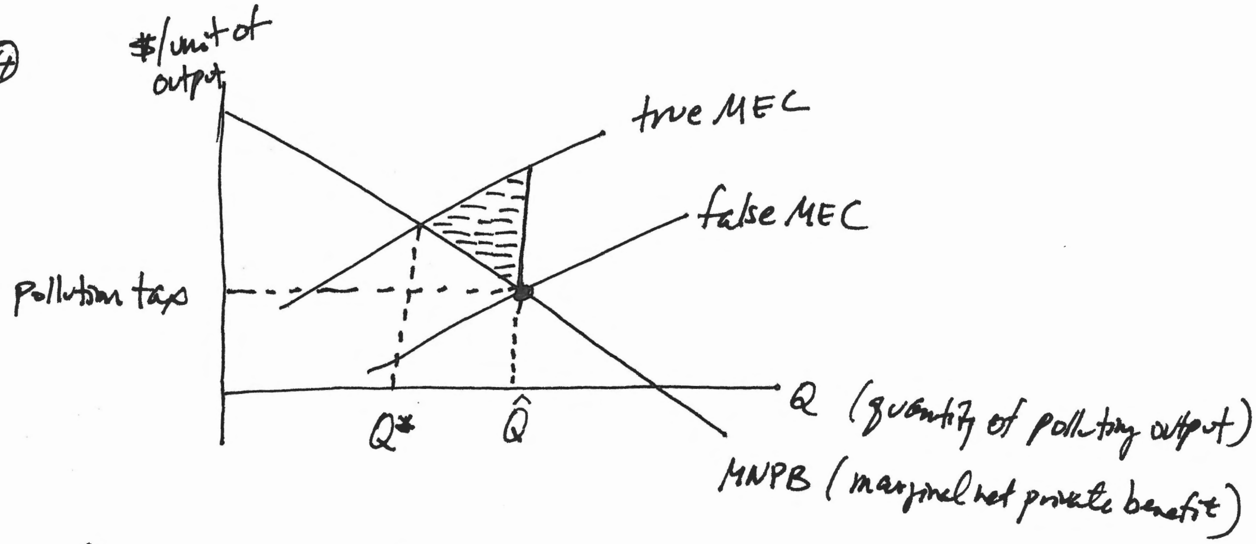
MEC: marginal external cost

MNPB: marginal net private benefit

Suppose these curves look as in the diagram on the left, and suppose the polluting firm has the property right to pollute. In the standard Coase Theorem interpretation, the output begins at Q^π but does not stay there, because pollution victims are willing and able to pay their MEC (\$7) to the firm to reduce pollution, and the firm is willing to accept as little as \$0 to reduce pollution. "So," the standard story goes, pollution victims will pay the firm something between \$0 and \$7 in return for Q being reduced by (say) one unit. Such mutually-beneficial trading continues as long as MEC > MNPB, that is, it continues until Q^* (which is the socially optimal Q).

However, either (or both) parties may realize there will be multiple bargains made and thus may want to cultivate the image of being a tough bargainer, or may want to fool the other party about the true location of the MNPB or MEC curve. For example, at Q^π, the firm may reject an offer of \$0.25 from the pollution victims, hoping the victims will counter with a higher offer, either because the victims now think the polluter is a tough bargainer, or because they are fooled into thinking that the MNPB curve at Q^π is greater than zero. If the victims do not make a counter-offer, the opportunities for bargaining are lost and output stays at Q^π, so the social optimum is not reached.

4



The government sets the pollution tax at "pollution tax," where MNPB equals where the government thinks MEC is. The firm responds by producing at $\hat{Q}$ (beyond which MNPB < pollution tax, so it won't produce). The loss in social surplus, as compared with the optimal quantity Q^*, is given by the hatched area, because those units should not be produced (they have MEC > MNPB), yet they are because the tax was set too low.

(5)

Economists object to the imprecision of definitions like this.

line 3: what does "emphasizes" mean? It does not presumably mean "maximize," otherwise "maximize" would have been used: but then what does it mean?

line 4: What if one could clean up one of these three (say, water) at the expense of another one (say, land)? How could such tradeoffs be made?

line 5: Does this mean the "given set of objectives" are not what is described in the first sentence? If so, what are the objectives?

line 7: "as a whole": same problem as that raised by line 4.

line 7: "acceptable cost": acceptable to whom?

lines 7-8: "in the long term as well as in the short term": But what if making things cleaner in the long term requires making them dirtier in the short term? How would such tradeoffs be made? Or what is an acceptable short-term cost in return for a long-term environmental benefit?

(6)

$\underbrace{\Delta S}_{\text{change in entropy}} = \frac{\Delta H}{T}$ has nothing to do with "disorder," at least not in any straightforward way. (I argued that it has nothing to do with disorder in any way.*) A simple illustration of the Second Law of thermodynamics ($\Delta S > 0$ in a closed system) is heat flowing <u>from</u> a hot sidewalk <u>to</u> an ice cube placed on it:

$$\Delta S = \Delta S_{\text{sidewalk}} + \Delta S_{\text{ice cube}} = \frac{-\Delta H}{T_{\text{hot}}} + \frac{\Delta H}{T_{\text{cold}}}$$

$$= \Delta H \left(\frac{-1}{T_{\text{hot}}} + \frac{1}{T_{\text{cold}}} \right) > 0 \text{ since } T_{\text{hot}} > T_{\text{cold}}.$$

If heat were to flow <u>to</u> the hot sidewalk <u>from</u> the ice cube,

$$\Delta S = \Delta S_{\text{sidewalk}} + \Delta S_{\text{ice cube}} = \frac{+\Delta H}{T_{\text{hot}}} + \frac{-\Delta H}{T_{\text{cold}}}$$

$$= \Delta H \left(\frac{1}{T_{\text{hot}}} - \frac{1}{T_{\text{cold}}} \right) < 0 \text{ since } T_{\text{hot}} > T_{\text{cold}},$$

which violates the Second Law requirement that $\Delta S > 0$. In this way, the Second Law "explains" why an ice cube placed on a hot sidewalk will melt. (Note that "disorder" plays no role in this example.)

* Going into all the details of this is OK but not required.