Economics 5250/6250 Dr. Lozada
Fall 2010 Final Exam

This exam has 67 points. There are seven questions on the exam; you should work all of them. The number of points for each question varies substantially: the least important questions are worth 6 points each and the most important is worth 16 points.

Put your answers to the exam in a blue book or on blank sheets of paper. The figure for the exam appears after the questions.

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.

You have **2 hours** (that is, until 12:30PM) to finish this test.

Good luck.

Answer all of the following questions.

1. [**6 points**]

The University of Utah has a "Renewable Energy Campaign" in which you can buy carbon offsets. These work by investing in renewable energy (in this case, wind energy); for example, by paying $3, you can buy 1 megawatt-hour ("MWh") of wind energy, enough to offset about 1400 pounds of carbon emissions. The program is described on a web page under `facilities.utah.edu` which says in part:

> You don't have to be formally associated with a participating department, or even the University of Utah, to donate to this fund. Any individual can use this mechanism, for example to offset their use of electricity or other fossil fuel at home. The donations all go to the same fund to generate new power from renewable sources....
>
> Because of the large scale of this program, the cost ($3/MWh) is very low compared to the many other similar programs throughout the nation. In fact the cost per MWh of wind electricity is more than six times cheaper than typical schemes. Furthermore, because donations are made to the University, contributions are tax deductible.

The price comparison given in this quotation is correct. For example, the University of Utah's price is cheaper than all but 2 of the 120 places to buy carbon offsets which are listed in `carboncatalog.org`, and I am not sure how trustworthy the 2 cheaper places are. (The University of Utah's price per ton of carbon is about $4.25 without the tax deduction and about $2.85 with it.) To offset 1 ton of carbon using the "Blue Sky" program run by Rocky Mountain Power, the local electric company here, costs more than $25.

However, the U's program is not at all well-known, even in Utah; it is not listed in `carboncatalog.org`. What does that imply about consumer rationality in particular, and neoclassical economics in general? As a (small) part of your answer, contrast the implications of this for neoclassical economics, with the implications of this for some other school of economic thought.

2. **[8 points]** In the first big international conference on the environment, held in Stockholm, Sweden in 1972, the delegations of most developing countries took the position that environmental problems were "luxury problems" that primarily concerned rich nations, while for the developing nations themselves, environmental problems were much less important than poverty.

   Argue that there was something incorrect in that position.

3. **[12 points]** Suppose an exhaustible resource industry follows the Hotelling Rule. Compare its the time path of extraction (that is, quantity extracted in each year) with a low versus a high discount rate. (As with all the other questions on this exam, you have to thoroughly explain your answer.) You may simplify by assuming no extraction costs and a competitive industry.

4. **[16 points]** In discussing one part of fisheries economics, the equation

$$\delta = F'(x)$$

   was quite important.

   (a) What part of fisheries economics does it pertain to?
   (b) What does the equation mean?
   (c) What does the equation imply for "socially optimal extinction?"
   (d) Why might some economists consider the phrase "socially optimal extinction" problematic?

5. **[6 points]** The US Clean Air Act defines "Best Available Control Technology" as follows:

   > The term "best available control technology" means an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under this chapter emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility.... [`http://www.law.cornell.edu/uscode/42/7479(3).html`]

   Argue that this definition of the phrase "Best Available Control Technology" is unexpected.

6. **[10 points]** Compare "grandfathering" and auctions in the context of a Marketable Permit ("Cap and Trade") pollution control regime. Comment on the advantages and disadvantages of each.

7. **[9 points]** Attached to this exam are a paragraph from page 64 of your textbook and a figure from the page before that paragraph. Argue that:

   (a) The third sentence of the paragraph ("But, the laws of thermodynamics imply...") is incorrect. Perhaps the easiest way to do this is to give an example (perhaps a historical example) of a "non-polluting product."

   (b) The last sentence of the paragraph ("Calls for 'no pollution'...") is incorrect.

4.3 ALTERNATIVE DEFINITIONS OF POLLUTION

Popular literature on pollution, and sometimes the scientific literature too, speaks of 'eliminating' pollution. The above discussion explains why the typical economic prescription does not embrace this idea. In Figure 4.1 the elimination of pollution can only be achieved by not producing the polluting good at all. But, the laws of thermodynamics imply that there can be no such thing as a non-polluting product. Hence to achieve zero pollution we would have to have zero economic activity. Calls for 'no pollution' thus appear illogical.

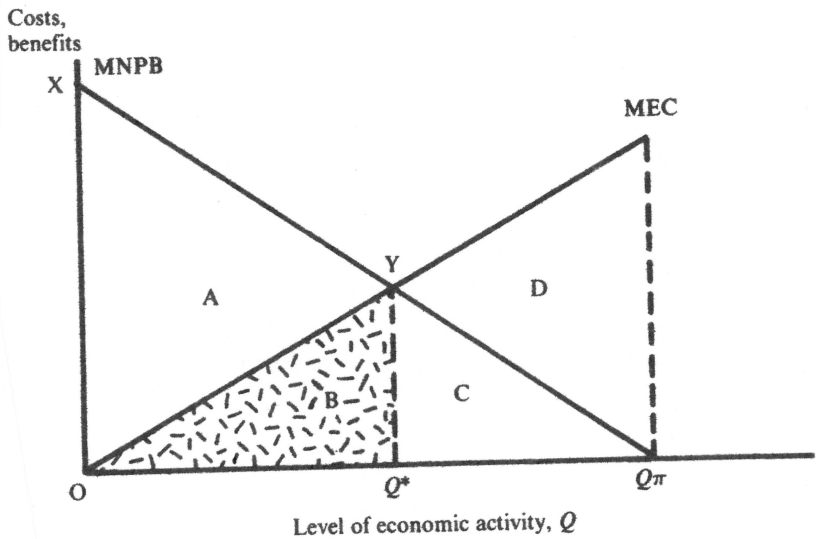


Figure 4.1 Economic definition of optimal pollution.

Answers to Econ. 5250 Final Exam, Fall 2010

① A simple interpretation of consumer rationality would be that consumers choose the lowest-cost method of obtaining a good or service. They are clearly not doing this with respect to buying carbon offsets. This observation contradicts this interpretation of consumer rationality. Neoclassical economics in general posits rational agents; the humanistic or institutional schools of economic thought do not, and so they would seem to be more consistent with this observation.

A neoclassical economist might respond that rational consumers faced with a high cost of gathering information (about the cost of buying carbon credits) might generate a wide dispersion of prices, because they rationally choose to limit the amount of time they spend searching for the lowest price. This position essentially admits that a humanistic or institutional description of economic reality is true, but supplies a neoclassical rationale for it.

(2)

Environmental problems cause more immediate, direct harm to poorer people because they cannot afford to buy (perhaps partial) solutions to those problems. Impure drinking water, for example, will make them ill, while richer people could buy safer water to drink. For another example, deforestation will require them to spend more time gathering fuelwood, while richer people could purchase fuelwood or an alternate fuel. As a final example, governments of rich countries will be able to mitigate the effects of global climate change to a much greater extent than governments of poorer countries.

(It's true that rich and poor nations can have different types of environmental problems. Unsafe drinking water, for instance, is primarily a problem of poor not rich nations, while greenhouse gas emissions is primarily caused by rich not poor nations.)

③ The Hotelling Rule is

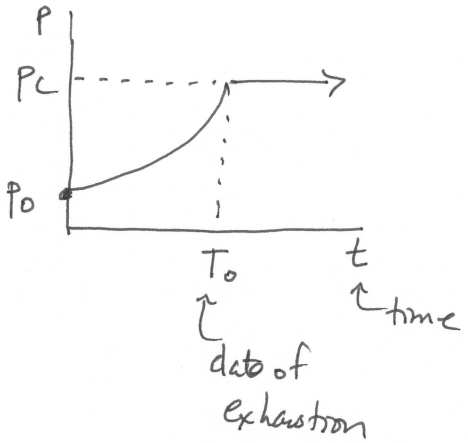
$$MR_{t+1} = (1+\delta)\, MR_t$$

where MR is marginal profit and δ is the discount rate. $MR = MR - MC$, with MR being marginal revenue and MC being marginal cost. If there are no extraction costs (clearly an unrealistic assumption), then $MC = 0$. If there is perfect competition, $MR = P$ (which is price). Under those two assumptions, the Hotelling Rule becomes

$$P_{t+1} = (1+\delta)\, P_t :$$

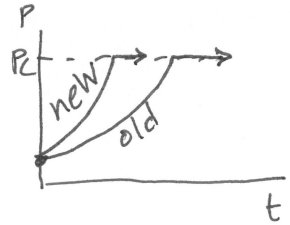
so "price rises at the rate of interest" (or "the rate of discount").

Let P_c be the "choke price," that is, the price above which quantity demanded equals zero. The price path looks like



[Technically, it needn't look exactly like this after T_o, but that's not important for us.] At T_o, the stock of resource is exhausted.

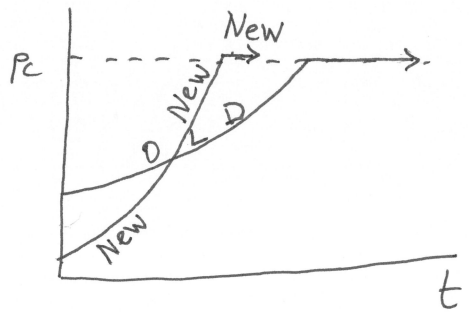
If δ were higher,* P_o could not remain the same, because if P_o remained the same, the new price path would look like this, and



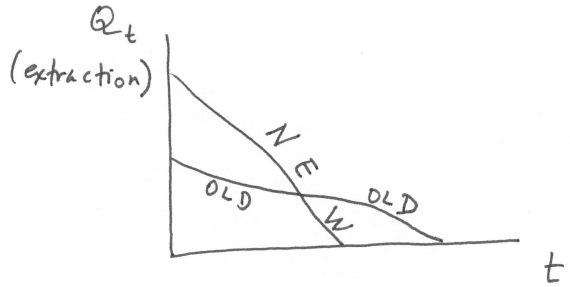
* the price path becomes steeper, so

this higher price at each date would cause quantity demanded to be lower at each date, and hence quantity supplied to be lower at each date (because in equilibrium, quantity demanded equals quantity supplied); meaning incomplete exhaustion of the resource, which is not profit-maximizing.

To fix this, the new P_0 must be below the old P_0:



Thus:



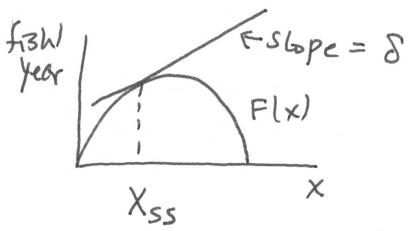
old: low δ
new: high δ

(4)

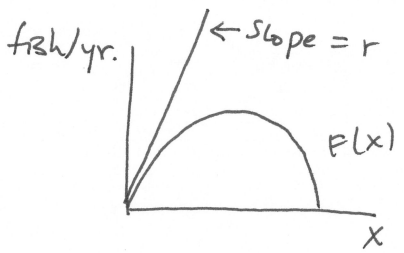
$$\delta = F'(x)$$

- δ: discount rate (interest rate)
- F': the derivative of F
- $F(x)$: excess of births over natural deaths
- x: stock size of fish

This characterizes the net-present value-maximizing steady-state private-property fishery; perhaps $\delta = F'(x_{ss})$, where "ss" denotes "steady state," is a better notation.



If $F(x)$ is logistic ($F = r x (1 - \frac{x}{K})$), we showed in class that F' reaches its greatest value at $x = 0$, and there, $F' = r$:



[Optional: $F = rx - \frac{r}{K}x^2 \Rightarrow F' = r - \frac{2r}{K}x$, which is greatest at $x = 0$, when $F' = r$.] So $F'(x) \leq r$. If $\delta > r$, it is impossible to make $\delta = F'(x)$, because that would imply $r < \delta = F'(x) \leq r$, and r cannot be strictly less than itself. For slopes $\geq r$, $x_{ss} = 0$: "socially optimal extinction."

This extinction is only "socially optimal" if the only value anyone in society places on fish is as food. If the fish has existence value for anyone, or if its extinction would adversely affect another species someone cares about, then the analysis must be expanded to take that into account.

(5)

In everyday language, "Best Available Control Technology" ("BACT") would mean exactly what it says: firms would need to use the best control technology in existence. In the US Code, the regulator is supposed to take costs into account as well, and presumably not require adoption of the "best" technology if it is too costly. Furthermore, while the Code says "the maximum degree of reduction... which... is achievable," that cannot be what it means, because by shutting down, any facility can achieve zero emissions. Implicitly, BACT must be permitting sufficient profits for the firm not to shut down.

(6) In "grandfathering," marketable permits are given for free to polluting firms (typically in proportion to how much they polluted). So the government gets no money and firms receive a valuable new asset.

In auctions, the government sells the permits to the firms, so the Government gets money from the firms.

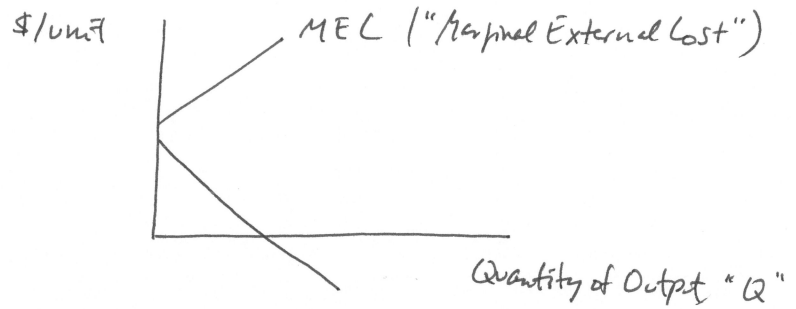
Obviously firms like grandfathering more than auctions, because they get richer in the former and poorer in the latter.

[optional: The amount of pollution can be the same in the two systems, so there are no implications for efficiency, only for distribution.]

(7)

a) The tools and jewelry used by prehistoric man were non-polluting (for all practical purposes). Even primitive agriculture (before irrigation) was close to non-polluting. See also the end of part (b)'s answer.

b) Consider:



Here the socially optimal Q is zero, so zero pollution is socially optimal. (In this example, it is true that "the elimination of pollution can only be achieved by not producing the polluting good at all." But in examples having 

that is not true.)