Resource & Environmental Economics Field Examination

January 15, 2015

Instructions:

- You have 4 hours to complete the exam. This time commences at the end of the 15-minute reading period during which no writing is allowed.

- Please use your assigned "alpha letter" on every page to identify your exam. Do not use your name or social security number. Write on only one side of the page leaving at least one inch margins. Number each page, and make sure the pages are in order.

- You have four questions to answer.

1. There are various possible measures of scarcity of natural resources.

    a. Why do we want a measure of scarcity that has economic content in it?

    b. Offer at least three potential economic measures of scarcity and explain which of these you believe to be the best measure, and why, in terms of signaling actual scarcity of the resource.

    c. Firms engaged in production of a nonrenewable resource sometimes search the planet for more of the stuff. What is a logical economic rule for optimal searching? How does this relate to finding a good measure of scarcity for the resource, and what are some problems that arise for a society trying to use signals from firms' search processes to measure social scarcity.

2. A large proportion of the population in many countries, including the U.S., lives in coastal areas. Ocean proximity offers positive benefits while exposing these populations to risks of storm surge and hurricanes or typhoons.

    a. Lay out a simple optimal economic model of housing location which factors in the probability that the home will be damaged by a hurricane. Assume home insurance against storms is not available.

    b. Adjust the model to allow for self-protection and self-insurance. Explain how the insights from the model have changed from the simple model of part a.

    c. Some economists believe we might be able to use housing market transaction data to shed light on subjective probabilities that home owners have for hurricane damage. What are subjective probabilities? First, how would your model in part b differ by allowing for subjective probabilities (SPs) to play a role, if at all? Second, how might you go about this analysis of revealing the SPs?

3. A recently emerging problem is ocean acidification. As atmospheric CO_2 rises, more is absorbed into the ocean, thereby moving the ocean pH level to a more acidic state that

    -   causes coral bleaching – destruction of coral reefs;

    -   makes it more difficult for marine-calcifying organisms like corals and oysters to form shells and reefs; and

    -   alters supplies of food for fish species and reduces fish stocks.

    Describe the features of a study that would value reductions in CO_2 so as to capture impacts on reef visitation, recreational fishing, oyster supplies, and wild fish catch. Be sure to describe the conceptual economic model that would motivate your analysis, the data that would need to be gathered, and methods that would be employed.

4. The following graph depicts West Texas intermediate crude future oil prices over the last ten years. Over the past several months crude oil futures have dropped from over $100/barrel to less than $50/barrel. Five reasons for this decline are:

- U.S. oil production is booming due to fracking,

- Saudi Arabia is maintaining production levels,

- Asian demand for oil has fallen,

- the U.S. dollar is strong – making oil more expensive for other countries, and

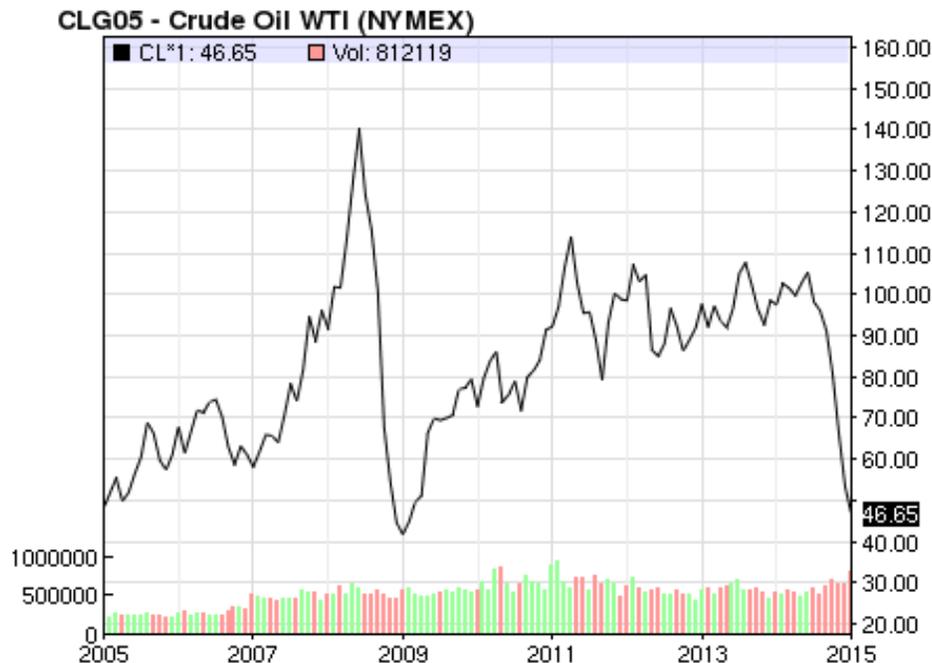- Libya and Iraq are producing oil again.

Figure 1. End-of-day Futures Price Quotes for Crude Oil WTI (NYMEX)

a. Starting with a simple (undergrad econ level) short-run graphical model that can explain the recent price drop, discuss how this short-run model would be affected by the incorporation of the following two major conceptual ideas for exhaustible natural resources: Hoteling's Lemma and Hubbert's Peak Oil Curve. Briefly present each idea. Do either of these ideas help explain the trend in oil prices depicted in the graph above? Why or why not?

b. Several models of the oil industry's market structure, ranging from a perfectly competitive market to a monopoly, have been proposed. Suppose all five reasons given above are contributing to lowered prices. Focus on Saudi Arabia's role with the following additional information: Saudi Arabia is a low cost producer with costs per barrel below $40, and at prices below $60 it is not profitable for U.S. fracking producers to operate. Provide an argument (perhaps aided by graphics) for the type of market structure that would support the recent price drop.

5. China is a nation in which multiple environmental and natural resource problems are tightly connected. China's air quality is terrible, largely because of emissions from coal-fired power plants. These emissions are a main reason that China is now the leading source of greenhouse gas emissions in the world. China is also facing significant water problems in terms of both quantity and quality, which are related since the damages associated with water pollution increase as water becomes scarcer. Energy-water issues are related because one of the heaviest uses of water is for thermoelectric power.

   a. Briefly discuss whether the Chinese situation is representative of international concerns about the energy-water nexus.

   b. Suppose that you are tasked with developing a socially efficient price for water to be used by China's electric power sector and a socially efficient price for electricity to be sold by this sector. Explain everything you would want to include in these prices.

   c. How would you expect the efficient prices for water and electricity of part b to differ from the prices that would arise in perfectly functioning markets in which water is treated as an open access resource? How would the efficient prices differ from the prices that would arise in a perfectly functioning market in which the rights to water are well defined, enforced, and transferable? Why?