Resource & Environmental Economics Field Examination

June 2020

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. The Paris Accord sets up a fund to support projects in developing countries that seek to achieve climate mitigation and/or adaptation.

    a) For reasons of economic efficiency, is such a fund be needed?

    b) What are the economic implications of restricting the use of funds only in select countries?

    c) How would you recommend determining who should contribute to the fund and how much?

2. Two firms are the only sources of smog-creating ozone emissions in a localized air shed. Before controls are imposed, the firms emit $e_1 = 200$ and $e_2 = 100$ units of ozone respectively. The firms' total cost of abatement can be written $AC_1 = 20q_1 + (q_1)^2$ and $AC_2 = 20q_2 + \frac{1}{2}(q_2)^2$, where q_i is abatement by firm i.

A regulator has decided that emissions are too high. The regulator knows with certainty that the total benefit from abating below the initial emission levels is $TB(Q) = 220 \cdot q - \frac{1}{2}q^2$ where $q = q_1 + q_2$.

a) Find the socially optimal levels of abatement, q_1^* and q_2^*.

b) Suppose that the regulator has decided to employ a permit-trading scheme. The firms behave competitively in the permit market. How many permits should the regulator issue in order to achieve the optimal level of emissions? What will be the equilibrium permit price and the trading outcome? How should the permits be distributed among the two firms to achieve the social optimum?

c) Suppose the regulator's assessment of the benefits is uncertain: $TB(Q) = 220 \cdot q - \frac{1}{2}q^2 + \varepsilon$, where ε is a random variable with mean zero and finite support. Discuss how and why the uncertainty would (or would not) lead to a change in the optimal regulatory approach.

d) Return to the case of certainty in part a and b. Suppose that Firm 2 has market power in the permit market and can choose both the price and quantity of the permits it buys or sells, though Firm 1 . The initial allocation of permits is proportional to initial emissions; i.e. if the optimal level of emissions is e^*, then Firm 1's initial allocation is $\frac{200}{100 + 200} \cdot e^*$ permits, and Firm 2 receives the remainder. Find the equilibrium outcome in this situation. Discuss why it differs (or does not differ) from the solution you found in part b. Will market power lead to a loss in social welfare?

3. The COVID-19 pandemic dramatically reduced economic activity around the world, which led to a reduction in some of the associated environmental damages. In this question you will think about how to value such unanticipated environmental benefits.
   a) Which valuation approach would you choose <u>and why</u>?

   b) Outline some (hypothetical) specifics of your chosen valuation strategy. That is, tell us how you would implement your approach.

   c) Discuss two challenges of your chosen approach and how (in which direction) each one might bias your value estimate.

4. The Texas Railroad Commission (RRC) oversees oil and gas extraction in the state. Its mission is to be a good steward of natural resources and the environment, while supporting the state's economic vitality.
    a) The chairman of the RRC wants to know how to extract the state's reserves of oil and gas optimally. Outline a general model of optimal extraction for the state.

    b) What are the important parameters in the model and how do they affect the optimal extraction path (i.e., speed of extraction)?

    c) Many companies compete to develop Texas's oil and gas resources. Before a firm can drill a well, it must lease a sizeable tract of land from mineral owners, so firms first compete for mineral leases, which typically expire after three years unless a well is drilled. Discuss how such competition is likely to affect the actual extraction path of oil and gas, compared to the optimal path you outlined in part a.

5. The Texas Railroad Commission (RRC) is the only regulator of the Texas oil and gas industry. Its mission is to be a good steward of natural resources and the environment, while supporting the state's economic vitality. The RRC is facing a law suit from an environmental interest group for not protecting the environment by allowing too much oil and gas extraction and flaring. You are a judge deciding this case.

    a) Upon reviewing the evidence, you decide that the RRC <u>was not</u> fulfilling its environmental mandate. What remedy do you recommend in order to make sure that the oil and gas industry does not benefit at the expense of the environment?

    b) Upon reviewing the evidence, you decide that the RRC <u>was</u> fulfilling its environmental mandate, and was acting in the benefit of all Texas residents. What assumptions and evidence might lead you to this conclusion?