Resource Economics Preliminary Examination

September 6, 1996

You have until 8:15 to read the exam and ask any clarification questions. You then have until 12:15 (four hours) to complete this examination. Exams will be collected promptly.

Part I: Answer all of the following three questions

1. Suppose that y_t is the amount of a mineral ore extracted in period t; α_t is the fractional mineral content of ore extracted in period t; p is the constant price of the mineral faced by a price-taking mine in all periods; $c(y_t)$ is the total cost of extracting and processing ore in each period ($dc/dy_t > 0$); and d is the discount rate. [The ore amount (y_t) times the fractional mineral content (α_t) is the amount of the mineral produced.] Assume that the profit-maximizing mine maximizes net present value in resolving its mining decisions and that the mine can extract no more than Y total units of ore over its infinite planning horizon.

   a. Characterize the optimal "cut-off grade" of ore (mineral content fraction) in each period for the profit-maximizing mining enterprise.

   b. A severance tax is a charge placed on each unit of ore extracted. Relative to the no-tax case, how is the optimal cut-off grade for a profit-maximizing mine affected by a severance tax? What is the effect on the amount mined?

   c. A royalty tax is a percentage charge on gross revenue. Relative to the no-tax case, how is the optimal cut-off grade for a profit-maximizing mine affected by a royalty tax? What is the effect on the amount mined?

   d. An income tax is a percentage charge on net income when net income is positive. Relative to the no-tax case, how is the optimal cut-off grade for a profit-maximizing mine affected by an income tax? What is the effect on the amount mined?

2. Suppose that technology is now available whereby solar collectors can be placed on the Moon, and these collectors are able to generate electricity and transfer it by microwave to receptors on the Earth. After the initial investment, the marginal costs of producing this electricity will be less than that for fossil fuel-generated electricity. The initial investment will be very large. However, if this investment is economically attractive, it can be conducted on a very large scale, and it will substitute for many other electricity sources.

   Assume you have been assigned to conduct a cost-benefit analysis of the global use of this technology and the consequent transition to solar-derived energy. Explain the matters that you would consider, the market

and nonmarket effects you would examine, and the measures you would use.

3. Changes in the agricultural economy and in farm policy over the past 15 years have caused Texas rice acreage to drop from 600,000 acres to 300,000 acres. New changes in U.S. farm policy have reduced the profitability of rice farming, so additional declines in acreage are likely. Rice fields provide important wetland habitat for a variety of species, especially waterfowl (ducks, geese). The importance of the remaining fields has increased due to the ongoing decline of natural wetlands and the decline of rice acreage. Beneficiaries of these fields include hunters, bird watchers, and biodiversity lovers.

   Suggest and discuss alternative policy measures for this social problem. Is there a market failure here? Include in your discussion the data and information needs necessary for the design and analysis of alternative policy instruments.

Part II: Answer one of the following two questions

4. The total value of a resource or environmental good can be composed of several types of values. Define and describe the various types of values composing total value and, for each, indicate the possible role(s) of market and nonmarket valuation methods for estimating value.

5. Define, explain, and contrast equivalent variation, compensating variation, equivalent surplus, compensating surplus, and consumer surplus for price and quantity changes. Discuss all differences and similarities.