RESOURCES ECONOMICS PRELIMINARY EXAMINATION
June 6, 1991

You have until 12:00 (four hours) to complete this examination. Exams will be collected promptly. Pace yourself in responding to questions so that you do not spend an undue amount of time on any one question at the expense of other questions. Write the last three digits of your student ID number at the top of each page of your answers, and do not write your name anywhere on the answers.

Part I: Answer all of the following three questions

1. The theory of optimal intertemporal allocation of a nonrenewable resource yields the fundamental "Hotelling Rule" that the net marginal rent should rise continuously over time at the rate of interest.

   a. Concisely explain the logic behind this rule.

   b. Define a "backstop technology" and indicate its significance for the allocation of a nonrenewable resource.

   c. What does the rule, and economic theory in general, have to say about the socially optimal distribution of scarcity rents within and among periods?

2. The world's many environmental and natural resource issues are firmly linked to global population policy. Explore this issue using the following model components. Every individual's lifetime utility function and budget constraint can be given by

$$U_i = f_i(x_i, k_i, K) \quad \text{and} \quad x_i + pk_i \leq M_i$$

where x_i is the individual's consumption of a composite good,
k_i is the number of children the individual has,
K is the total children of all individuals,
p is the personal cost of having a child, and
M_i is income (in units of the composite good).

x_i and k_i are the individual's only decision variables. Logically, we have

$$K = \sum k_i.$$

The marginal utility of x_i and k_i are nonnegative, but the marginal utility of K is nonpositive because the impact of higher K is to accelerate environmental degradation and resource depletion. Your investigation should employ economic efficiency as the goal of population policy and should suggest and discuss some preferred policy(ies). You should augment the model with whatever discussion or additional details you feel are pertinent.

3. Policy recommendations for addressing environmental problems having long term, delayed effects (e.g. global warming, groundwater pollution, storing nuclear wastes) are demonstrably sensitive to the selection of a social rate of discount. Some policy advocates argue that economists are ill equipped to offer useful policy advice for such matters. Their reasoning hinges upon the strong role of discounting in economic analysis. Using the global warming problem as an example, should economists participate in this type of policy debate? Discuss pros and cons for this question in developing your response. Draw a personal conclusion.

   Note: In global warming the production of greenhouse gases (e.g. methane, CO_2) are causing an irreversible 0.1°C increase in average world temperature every decade. The negative consequences of global warming are inundation of tidal areas, increased desertification, and a poorer distribution of the world's agricultural productivity.

Part II: Answer one of the following two questions

4. The concept of externality has been around for quite some time in economic literature and its consequences for the use of society's resources have been widely discussed. Consider the Gulf coast shrimp fishery, essentially an open access resource. The following is a quote about that shrimp fishery from the Gulf of Mexico Fishery Management Council's 1981 management plan:

   > Very few [shrimp] live a year and the majority harvested are less than six months old. There is no demonstrable stock-recruitment relation and recruitment overfishing, given present technology, is essentially impossible, That is, it is not economically or technically feasible to take so many shrimp that there are too few survivors to provide an adequate supply for the following year. Because of these characteristics, fishing mortality and yield in one year do not affect yield in the following year. The maximum yield in number for a given year is essentially all the shrimp available to harvest, using current technology.

   Using your knowledge of economic theory pertaining to natural resources, discuss this quotation in terms of a) the type of resource problem which exists in this case, b) whether policy institutions should be devised to address this resource problem, and c) what types of policy actions might be appropriate.

   Note: Adult shrimp spawn in the Gulf and their eggs hatch into free-swimming larvae which make way to the shallow estuaries to feed on algae and microfauna. As the shrimp grow larger, they move to deeper water and eventually migrate to the Gulf.

5. On May 23, 1991 the U.S. Congress granted the "fast track" authority for the Bush administration to pursue the completion of free trade negotiations with Mexico. Such an agreement would create a North American Free Trade Area (NAFTA) and is expected to significantly increase trade between Mexico, the United States, and Canada. It is also expected that rapid economic development will occur along the U.S. - Mexico border. Most of this growth is likely to occur within Mexico in the area bordering Texas, an area known to be environmentally sensitive and limited in natural resources, especially water.

   At present there are no institutions governing water allocation between the two countries. Groundwater from several aquifers transcends the international border and are used by people in both countries. Please discuss this problem using resource economics theory. Identify the relevant theoretical construct(s) that bear on this potential resource management problem. Discuss the institutions needed to manage these water resources and design a management model that might be used to allocate the resource for the benefit of society (both countries) being careful to consider future economic growth potentials.