Homework Assignment #3: Energy Economics 399

Due: Friday, February 13

1. Suppose the demand for a depletable good like oil is P = 8 - .4q in each period. Using this demand function it can be shown that the consumer's total WTP for the good is: WTP = $8q - .2\ q^2$ in each period. Assume the marginal cost of extracting oil is constant over time and production and MC = 2.

   a. Suppose that the producer of the oil is also the final user. If there is an unlimited amount of oil, how much is produced and consumed in each period?
   b. Now suppose that there is a 2-period world and that the total endowment of oil is 10 units. The rate of time preference (discount rate) = 5%. How much oil is consumed in each period?
   c. Instead of the producer being the final user now assume that a monopolist owns the oil well. If there is an unlimited supply of oil, how much oil is produced in each period and at what price is it sold?
   d. Now again assume that a monopolist produces the oil over two periods but that the total amount of oil is 10 units. How much oil will be sold in each period, what will be the price, what will be the monopolist's profits, and how much consumer surplus will the consumer realize?
   e. Again assuming that there are 10 total units of oil, if there is free, unlimited access to the oil in each period, how much oil is produced in each period, at what price is it sold, what will be the firms' profits, and how much consumer surplus will the consumer realize? Compare the social welfare of monopoly to competition.
   f. What is meant by the term "rent seeking" and how does it apply here?
   g. Finally, suppose that there are alternative energy source to oil available at a marginal cost = 6. How might this change the long-run equilibrium production and consumption of oil?
   h. In two separate graphs, graph the situations in part a. and part c. In your graph, clearly identify price, quantity, and any areas of producer and consumer surplus.

2. According to data by the U.S. Department of Natural Resources, the United States has current reserves of petroleum of 34 billion barrels. Current consumption of domestic petroleum is 2.9 billion barrels per year.

   a. Calculate the Static Reserve Index for petroleum in the United States.
   b. Tell me at least three different reasons why this <u>does not</u> mean that we should worry about running out of gasoline and going back to horses and buggies by the time we are middle-aged.
   c. Calculate the Exponential Reserve Index for petroleum in the United States assuming a 5% annual growth in petroleum consumption.

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3. Suppose that the government identifies the problem with depletable resources and decides to levy a severance tax of 3 per unit on each unit of oil extracted.

   As in question 1, suppose the demand for a depletable good like oil is P = 8 - .4q in each period. Using this demand function it can be shown that the consumer's total WTP for the good is: WTP = $8q - .2 q^2$ in each period. Assume the marginal cost of extracting oil is constant over time and production and MC = 2. There is also a severance tax = 3 on each unit.

   a. Now suppose that there is a 2-period world and that the total endowment of oil is 10 units. The rate of time preference (discount rate) = 5%. How much oil is consumed in each period under the social planner's problem?
   b. Now suppose that there is a 2-period world and that the total endowment of oil is 10 units. The rate of time preference (discount rate) = 5%. How much oil is consumed in each period under monopoly?
   c. Now suppose that there is a 2-period world and that the total endowment of oil is 10 units. The rate of time preference (discount rate) = 5%. How much oil is consumed in each period under perfect competition?
   d. Compare your results in a., b., and c. to b., d., and e. of question 1. Has the severance tax improved societal welfare?
   e. What would be the level of severance tax that would maximize societal welfare under perfect competition in a 2-period world with a total endowment of oil = 10.