AAE / ECON / Env. St. 343
Environmental Economics

Homework #7
Suggested Answers

The following 4 questions relate to the required reading.

1. According to the article, how is China expected to affect future oil demand? What will happen to the marginal user cost of oil? What about the current price of oil?

China's demand is expected to increase in the future. This will raise the marginal user cost of oil because future extraction is more valuable. Since marginal user cost goes up, so does the current price of oil.

2. In the 1970s, Middle East countries enacted an oil embargo. In 1978, the revolution in Iran had an impact on that country's oil exports. Explain the effects of these two events on world oil prices and oil consumption in the late 1970s and early 1980s.

According to the article, these two events led to a reduction in the supply of oil, which then raised oil prices, which proceeded to lower oil consumption.

3. Why did the price of oil drop in the mid 1980s and how is this price change related to events discussed in question #2?

According to the article, higher oil prices in the late 1970s spurred development of new oil fields in Alaska, Mexico, and the North Sea. Thus, the economic reserves increased. Simultaneously, U.S. oil consumption dropped by 15% between 1978 and 1981 as demand for automobiles shifted to "thrifty Japanese and European cars" and the speed limit was dropped to 55 mph. This increase in supply, coupled with a downward shift in demand led to the fall of oil prices in the mid 80s.

4. Explain why people disagree about the amount of oil left in the world? What factors drive perceptions of the expected size of future economic reserves?

According to the article, the U.S. Geologic Survey expects there to be at least 50% more oil left than many pessimists believe. Their reason is that they expect advances in technology to reduce the costs of extracting previously unavailable reserves, thereby increasing the size of the economic reserve. More pessimistic observers do not believe that technology will increase the economic reserves by as much as USGS believes.

Consider how a market will allocate a fixed non-renewable resource over time. Suppose demand for the resource is given by p=50-q, where p is price and q is quantity. Further, suppose that marginal extraction costs are constant at $35/unit, the discount rate is 10%, and the total resource stock is 4 units, infinitely divisible.

5. Using the market allocation of this resource, calculate the consumer and producer surplus for all periods in which the resource is extracted. Show your work.

The backstop price is equal to $50. Therefore, using Hotelling's rule [$(P_{T-1}-MEC)=(P_T-MEC)/(1+r)$], $P_{T-1}=\$48.60$; $Q_{T-1}=1.4$; $P_{T-2}=\$47.40$; $Q_{t-2}=2.6$.

Period 1: *CS = (1/2)($50-$47.40)(2.6 units) = $3.38*
PS = ($47.40-$35)(2.6 units) = $32.24
Period 2: *CS = (1/2)($50-$48.60)(1.4 units) = $0.98*
PS = ($48.60-$35)(1.4 units) = $19.04

6. How could investment ensure that this market allocation satisfies the sustainability criterion of fairness across time periods? What are the primary assumptions for investment to yield sustainability?

CS + PS in period 1 is equal to $35.62, while CS + PS in period 2 equals $20.02. If period 1 generation keeps $28 and invests the remaining $7.62 at 10% for period 2 generation, then period 2 gets $20.02 from extraction, $8.38 in investments from period 1, for a total value of $28.40. The key for sustainability is for period 1 to invest a sufficient amount, and for that investment to be a substitute for consuming the non-renewable resource in period 2.

Suppose there is a pollutant which affects two countries. The benefits of reducing this pollutant are equal to 25 if both countries reduce, 10 if one country reduces, and 0 if neither country reduces. The costs of reducing the pollutant are equal to 20. These numbers apply to both countries.

7. Set up this problem in a game theoretic format and show that this is a Prisoner's Dilemma.

	Country B	
Country A	*Reduce*	*Not Reduce*
Reduce	*5, 5*	*-10, 10*
Not Reduce	*10, -10*	*0, 0*

The Nash Equilibrium is for both countries to not reduce. No matter what the other country's strategy, each country is always better off not reducing. This is a Prisoner's Dilemma because both countries could be better off if they both reduced.

8. Suppose you are called on to solve the Prisoner's Dilemma. Propose a tax on these two countries that would lead to both countries reducing their output of the pollutant.

Tax each country 11 if they don't reduce, and 0 if they do reduce.

	Country B	
Country A	*Reduce*	*Not Reduce*
Reduce	*5, 5*	*-10, -1*
Not Reduce	*-1, -10*	*-11, -11*

The Nash Equilibrium is for both countries to reduce. No matter what the other country's strategy, each country is always better off reducing.