

Energy and Environmental Economics 31C01300 and 31E01310

Instructor: Matti Liski

Exam May 23, 2018, 13:00-16:00

Problems 1-4 have equal weighting in grading. Correct, complete, and clearly presented answers will receive full credit. Partial credit will be liberally given for progress toward correct answers. Please write your name on this sheet and RETURN IT together with your answer. Calculators are allowed in this exam. Good luck!

1. You can use a few lines to explain and elaborate each of the following (these are not essay questions!):
 - (a) Pollution trading can achieve cost efficiency. What does this mean precisely?
 - (b) Continuing the previous question, trading with pollution implies costs to producers and consumers. What determines how the final burden of these costs is divided between consumers and producers?
 - (c) Carbon leakage – explain the channels through which it arises.
 - (d) Consumers undervalue the energy cost savings when buying durables. Supported by evidence?
 - (e) Subsidies to renewable power tend to lower the wholesale price of electricity – why?
 - (f) A worker, who is typical in all respects, works for a wage of €30,000 per year in a perfectly safe occupation. Another typical worker does a job requiring exactly the same skills as the first worker, but in a risky occupation with a known death probability of 1 in 1,000 per year, and receives a wage of €36,000 per year. Explain how these numbers could be used to infer a value of a human life for a cost-benefit analysis?
 - (g) The levelized cost of electricity – how is it defined?

2. Coasian solution to an externality problem. My neighbor just acquired 6 noisy dogs (a mother dog and 5 baby dogs). The neighbor is deaf and does not suffer from the noise but I do to an extent that I'm considering moving away. I estimate that moving would cost me 50 000€, including all costs (depreciation of the house value, etc.). It would cost 20 000€ to build a dog house that would solve the noise problem.

- (a) Suppose I have the right to live in a noise-free environment. What is the Coasian solution to the problem? Supposing then the neighbor has the right keep the dogs as she wishes, what is then the solution?
- (b) Explore if the hold-up and free-rider problems often associated with the Coasian solution can arise here.
- (c) What would be the Pigouvian solution to the problem? Compare efficiency of the Coasian and Pigouvian solutions.

3. Prices versus quantities. As in the lectures, let Q denote the level of pollution. Private sector demand for pollution (marginal valuation curve of pollution) is

$$D = 10 - Q \tag{1}$$

The marginal cost of pollution is

$$S = 2Q \tag{2}$$

- (a) What is the optimal Pigouvian tax on pollution? Follow the reasoning from the lectures and explain the idea, for example, by using a graph. Or, you can just provide the number.
- (b) Consider then instead of a tax that tradable emission rights are being used. How many rights to pollute should be released? As above, you can explain the idea, or just provide the number.
- (c) Assume now that the demand can be either high $D^H = 12 - Q$ or low $D^L = 8 - Q$. The ex ante expected demand is the same as

above, that is, $D = 10 - Q$. Compare the two instruments (taxes vs. pollution permits) – which one should be chosen? Consider the social loss under a given instrument, and compare them.

- (d) In the lecture, we discussed a hybrid instrument that combines the price and quantity instruments. Describe the hybrid instrument for our example.

4. Exhaustible resources. Let us assume that the marginal cost is zero (i.e., the cost of extracting the resource from the ground). The demand is $q_t = 10 - p_t$, where p_t is the price at time t and q_t is the quantity at time t . The total resource stock is of size 100. Let us assume that time runs continuously. Interest rate is r .

- (a) In equilibrium, the price must follow

$$p_t = p_0 e^{rt} \tag{3}$$

as long as the resource is used. Can you explain why? Great if you can explain precisely how the condition for prices arises but intuitive reasoning is also accepted.

- (b) Can you find the equilibrium time path for consumption q_t and price p_t ? This involves describing how long the consumption last. Denote the end of the consumption time by T . It is enough to describe the conditions that in principle govern the equilibrium paths for prices and quantities (i.e., an exact solution is not required).
- (c) The concept of "Carbon Budget" can be linked to the above model of scarcity. What is the link?