EXAM ECON4910 SPRING 2022

Explain your reasoning, and mark the answer clearly, with two lines under. If the question is unclear or you are uncertain what kind of answer we expect, please state your assumptions and proceed from there. Every subquestion counts equally to the final grade.

Important: You must work on the exam independently without obtaining help or consultation from others.

1. Prices vs. quantities

This is based on the article by Weitzman (1974).

(i) Illustrate in a figure, and explain in your own words, the condition for when "prices" (i.e., an emission tax) is better than "quantities" (i.e., emission quotas), if there is uncertainty regarding marginal benefits and costs.

(ii) Suppose the benefit from abatement quantity a is $10a - a^2$, while the cost of abatement is equally likely to be $2a + ca^2$ and a^2, where $c > 0$ is a parameter. What is the optimal quota, and the deadweight loss associated with that quota? Illustrate in the figure.

(iii) What is the optimal emission tax, and the deadweight loss associated with that emission tax? Illustrate in the figure.

(iv) How can a hybrid system, with an emission tax and a price ceiling, reduce the deadweight losses? Illustrate in a figure.

2. Self-enforcing agreements

Take the same benefit function as in (ii), above, but now $a = \sum_{i=1}^{N} a_i$ is the sum of every country i's abatement level, while the cost from abating a_i is ca_i for every country. There are N countries.

(i) What is the first-best abatement level a_i?

(ii) What is the noncooperative "business as usual" level for a_i?

(iii) If the other countries emit according to (i), what must c be, if the most tempting "defection" from first-best cooperation, for a single country i, is to abate nothing at all?

(iv) Based on the lecture notes on repeated games and self-enforcing agreements, do you think the first best is easier to obtain in a subgame-perfect equilibrium (SPE) if c is large, or if c is small?

(v) Suppose $N = 3$, and $c = 8$. Under the condition you derived in (iii), what must δ be for the first-best abatement level to be sustainable as a SPE?

(vi) Repeat (v), but now with $c = 6$.

(vii) Compare (v) and (vi) and explain the intuition for the difference.

3. **Discounting**

(i) What is the difference between the discount factor and the discount rate? If the discount rate is 5 percent per year, what is the corresponding discount factor?

(ii) For this discount rate, plot the present discounted value of 100 dollar realized at future time t, as a function of t.

Assume from now a CRRA utility function with $u_t = \sqrt{c_t}$, and suppose the current decisionmaker maximizes $\sum_{t=0}^{\infty} e^{-\rho t} u_t$.

(iii) Derive Ramsey's formulae for the discount rate of consumption.

(iv) If an investment (for example, in windmills) costs 50 dollar, how soon must the 100 dollar return be realized, for the investment to be valuable, if there is no economic growth? Illustrate in a figure, as the one you make for part (ii).

(v) What is the answer to (iv) if consumption grows with 4 percent every year?

(vi) Compare the answers in (iv) and (v) and explain the intuition for the difference.