

ECN 371 - Environmental Economics 09:00-12:00 - May 13, 2009

A1: No books except English dictionary, no other aiding tools.
This exam consists of 4 questions, for a total score of 100 points.
All questions are to be answered. You may answer in English or Norwegian.

Question 1 (20 points)

- State the condition for cost effective abatement, and compare the cost effectiveness of tradable and non-tradable emission permits. **(10 points)**
- Assume that the conditions for applying emission based instruments are satisfied. Show graphically why a tax on emissions gives a least cost distribution of emissions reductions among firms. **(5 points)**
- Use the assumptions from (b). Let q_i denote firm i 's emissions reductions, and let $C_i(q_i)$ be firm i 's cost function for of emissions reductions. $C_i(q_i)$ is twice differentiable, and with the standard properties of cost functions. Set up a model that shows why a tax on emissions gives a distribution of abatement (emissions) among firms which is cost minimizing. **(5 points)**

Question 2 (20 points)

- The predicted behavioral impacts of economic instruments are some times overestimated. Explain why this may be the case under different assumptions about agent behavior. **(10 points)**
- Explain what is meant by the *Pareto irrelevancy* (PI), and briefly discuss implications of PI for the choice of policy instrument. What is the main condition for assessing if an environmental regulation is to be implemented or not? **(10 points)**

Question 3 (20 points)

The basic expression of the Folk theorem is: $1 > \beta_i \geq \frac{\varphi_{i,t} - \pi_{i,t}^c}{\pi_{i,t+1}^c - \pi_{i,t+1}^n} \quad \forall i \in I, \forall t \in T$

- Starting from the basic condition for cooperative outcomes emerging in non-cooperative games, show how to arrive at the above expression for the Folk theorem. **(10 points)**
- Explain **all the terms** in the above equation, and use the expression to graphically illustrate how changes in the payoffs influence the likelihood of cooperative outcomes. **(10 points)**

Question 4 (40 points)

Assume that the Kyoto protocol is extended to 2020, and that the United States of America, India, and the Peoples' Republic of China have joined the Kyoto agreement. The poorest developing countries are still exempt from the emission targets in the agreement.

Suppose that new estimates from the UN Intergovernmental Panel on Climate Change (IPCC) suggest that global climate gas emissions need to be reduced by 30 percent (from the 1990 base year) by 2020.

Now, suppose that the government of Norway, a country that frequently is termed a *small open economy*, proposes that Norway will do its share by reducing its emissions by 30 percent by 2020 regardless of which reductions in climate gas emissions other countries implement. To reach the self-imposed 30 percent domestic emission reductions target, the Norwegian government suggests the following domestic policies:

- (i) The introduction of a uniform rate carbon emission tax in all sectors of the economy where emissions can be measured at reasonable costs. A uniform rate emissions tax rate will be the same regardless from which sector in the economy the climate gas emissions originate. The "climate tax" is set so that the domestic emissions reductions target will be met.
- (ii) For sectors where emissions cannot be measured with reasonable costs, a set of technology innovation programs will be implemented using government funds to finance the necessary investment in the new technologies.
- (iii) Part of the tax revenues from the "climate tax" will be used to cut labor taxes, thereby reducing some of the costs of the abatement measures the tax induces.

Industry representatives strongly oppose point (i), and would rather see a tradable permit regime put in place where initial permits are grandfathered as a percentage of each firm's 2012 emission level.

- (a) Discuss the Norwegian government's proposal to have a fixed target for Norway's domestic climate gas emissions reductions. **(10 points)**
- (b) Discuss the policy elements (i - iii) of the government's proposal. **(10 points)**
- (c) Discuss the advantages and disadvantages of the industry proposal. **(10 points)**
- (d) Suppose that you are called in as an advisor to the government. What changes would you recommend in the proposed climate policy? Briefly justify your suggested changes. **(10 points)**

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