

UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4910 – Environmental Economics**

Date of exam: Monday, May 27, 2013

Grades are given: June 12, 2013

Time for exam: 2:30 p.m. – 5:30 p.m.

The problem set covers 3 pages (incl. cover sheet)

Resources allowed:

- No resources allowed

The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

Problem 1 – Essay (40 points)

Imagine a proposal to build a new high-speed train between Oslo and Bergen. Imagine that the new line would cut through the Hardangervidda national park. What are the pro's and con's of using contingent valuation to estimate the environmental cost of this project? Would you advise the government to commission a contingent valuation study?

Problem 2 – Analysis of a pollution model (60 points)**Base case (10 points)**

Consider two farms at a lake. For each farm, the revenue from selling the harvest, provided that no fertilizer is used, is B . B is a positive constant which is determined exogenously. Each farm benefits from fertilization (as it increases quality) according to the function bx_i , where $b > 0$ is a parameter and x_i denotes the amount of fertilizer used by firm i . Using fertilizer comes at quadratic cost $\frac{c}{2}x_i^2$ ($c > 0$). Profits for each firm are thus given by:

$$\pi(x_i) = B + bx_i - \frac{c}{2}x_i^2 \quad (1)$$

2.1 What is the unregulated use of fertilizer at each farm? (2 pts)

Now suppose that many people like swimming in the lake. However, the lake becomes less attractive for swimming the more fertilizer is used. To be specific, assume that the social value of the environmental damage from run-off from each farm is given by $-\frac{d}{2}x_i^2$, where d is a parameter. Assume that for a given x , marginal damages are higher than marginal cost (i.e. $d > c$). The social objective function is given by:

$$S(x_1, x_2) = \pi(x_1) + \pi(x_2) - \frac{d}{2}x_1^2 - \frac{d}{2}x_2^2 \quad (2)$$

2.2 What is the socially optimal use of fertilizer? (3 pts)

The regulator wants to introduce a tax τ in order to regulate the use of fertilizer since farms do not take the environmental damage into account. This is implemented such that each farm will have to pay a tax per unit of fertilizer they use.

2.3 What is the optimal level of that tax? (5 pts)

Strategic effects (15 points)

Go back to the unregulated case, but suppose that fertilization from firm i has a negative impact on the effectiveness of the fertilizer that firm j uses. To be specific, assume that equation (1) now looks like this (where $\lambda < c$):

$$\pi(x_i, x_j) = B + (b - \lambda x_j)x_i - \frac{c}{2}x_i^2 \quad (3)$$

2.4 What is the unregulated use of fertilizer now? Compare your results with point 2.1 and discuss. (10 pts)

2.5 Characterize the different externalities highlighted in equation (2) and equation (3) and briefly discuss the prospects of finding a bargaining solution. (5 pts)

Uncertainty

(35 points)

Forget about the strategic effect and go back to the social objective function described by equation (2). Now suppose that the marginal effectiveness of the fertilizer is uncertain: With probability $\frac{1}{2}$ fertilizer is not so effective, so that $b = \beta - \delta$, and with probability $\frac{1}{2}$ it's a super fertilizer with $b = \beta + \delta$. You can take it for granted that the firms are law-obedient, but they will observe the true b before making their decision, while the regulator has to make a decision before the true b is revealed.

2.6 Suppose the regulator wants to set a quota q , restricting each farm i 's use of fertilizer such that $x_i \leq q$. If the regulator knew the true b before making its decision, what would have been the optimal quota q (contingent on the true b)? (5 pts)

2.7 In reality, the true b is not known when the regulation has to be set. Describe (mathematically or graphically) the expected deadweight loss from a quota regulation. (10 pts)

2.8 Which quota-level should the regulator choose in this circumstance? Calculate the value of the minimized expected deadweight loss from a quota regulation. (7 pts)

2.9 Should the regulator rather set a tax in the current situation? Why or why not? (In your discussion, you may rely on graphical or analytical arguments.) (13 pts)