

**UNIVERSITY OF OSLO**  
**DEPARTMENT OF ECONOMICS**

Exam: **ECON4910 – Environmental Economics**

Date of exam: Wednesday, May 21, 2014

**Grades are given: June 10, 2014**

Time for exam: 2.30 p.m. – 5.30 p.m.

The problem set covers 2 pages

Resources allowed:

- No resources allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences)

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

Note that both problems count equally, but you need to pass both in order to pass the exam.

**Problem 1**

Consider a stock pollution problem where  $x(t)$  is the flow of pollution at time  $t$  and  $A(t)$  is the stock of pollution at time  $t$ . The relationship between these two variables is (where a dot over a variable symbolizes the derivative w.r.t.  $t$  and  $\delta$  is a non-negative parameter):

$$\dot{A} = x(t) - \delta A(t)$$

The environmental damage of  $A(t)$  at time  $t$  is given by the environmental cost function  $D(A(t))$  where  $D' > 0$  and  $D'' \geq 0$ .

- a) Explain why the optimal pollution tax  $q(t)$  is given by

$$q(t) = \int_t^{\infty} e^{-(r+\delta)(\tau-t)} D'(A(\tau)) d\tau$$

when the discount rate is  $r$ .

- b) Assume  $A(0) = 0$ . Derive the properties of the time paths for  $q(t)$ ,  $x(t)$  and  $A(t)$  when  $D'' = 0$ .
- c) Assume now that in addition to the environmental damage from the stock of pollution, there is also environmental damage from the pollution flow, given by the environmental cost function  $E(x(t))$  with properties  $E' > 0$  and  $E'' > 0$ . Denote the optimal pollution tax in this problem  $p(t)$ . What is the optimal pollution tax in this case?

- d) Discuss how the existence of the environmental cost function  $E(x(t))$  from question 1c) affects the long-run stationary value of the pollution stock, as compared to the case where  $D(A(t))$  represents all environmental costs.
- e) What can you say about the time path of the optimal pollution tax  $p(t)$  for the case described in Problem 1c) when  $D'' > 0$  and  $\delta = 0$ ?

## **Problem 2**

Consider the following hypothetical scenario: A newly elected Vice Mayor for Environment and Recreation of some community is approaching you and wants to hear your expert opinion.

In this community, there is a strong social norm for not picking mushrooms before they have grown to full size. When a mushroom picker sees another mushroom picker plucking an undersized specimen, she tends to tell it to everyone else and the others will frown upon the culprit. In order to regain his good social standing, he is then expected to do some community service proportional to how much the picked mushrooms fall short of what is considered an appropriate picking size.

The new Vice Mayor thinks that the existing informal system is ineffective and that there are far too many people picking mushrooms too early. Hence the Vice Mayor wants to install a forest police and introduce a fixed fine of 50 kroner for picking a mushroom that is too small. What is your opinion on this policy proposal?