ECON 4910 Environmental Economics, Spring 2008

Seminar 1

Problem 1

Assume that a profit maximizing factory is using a fixed amount of labor in its production. The production function is given by

$y = F(L)$ where y is the production level, and L is the fixed amount of labor input.

The wage per unit of labor is w, while the price per unit of output is p.

When the factory is run with the fixed level of labor input L, and no cleaning equipment is installed, it emits an amount M^0 of a polluting substance into the air. If production is unprofitable, the factory will close down and emissions will be zero.

Assume that there exists cleaning equipment which can be bought at a cost and installed in the factory. Assume, moreover, that the better equipment one purchases, the more pollution is cleaned; however, better equipment is more costly. Let the cost of cleaning equipment (the cleaning cost, or abatement cost) be given by c(A), where

$A = M^0 - M$ denotes abatement.

Assume that c(A) is twice continously differentiable and that $c'(A)>0$ and $c''(A)>0$.

a) If there is no environmental policy, what will the emissions from the factory be? Characterize and interpret the solution. Will the unit cost of labor *w* matter?

b) If there is a tax *t* per unit of emissions, where $t > 0$, what will be the emissions from the factory? Characterize and interpret the solution. Will there necessarily be a strictly positive level of abatement? Will the unit cost of labor *w* matter?

c) If there is a subsidy *s* per unit of abatement, where $s > 0$, what will be the emissions from the factory? Characterize and interpret the solution. Does your answer differ from your answer to 1b)? If yes, how? Does the cost of labor matter for this?

Problem 2

a) Consider an economy with two consumers and a single resource that exists in a given amount *R*. This resource can be used as a private final good *x* or a public final good *y*. Thus the amount of final goods must satisfy $x_1 + x_2 + y = R$. Here x_i is the amount of the private good consumed by consumer *i*, $i = 1,2$. The consumers have utility functions $U_1(x_1, y)$ and $U_2(x_2, y)$. Derive conditions for Pareto-optimality and show one can write these as:

$$\frac{\frac{\partial U_1}{\partial y}}{\frac{\partial U_1}{\partial x_1}} + \frac{\frac{\partial U_2}{\partial y}}{\frac{\partial U_2}{\partial x_2}} = 1$$

b) Assume that some regulator of this economy wants to maximise a social welfare function given by:

$$W = \alpha U_1(x_1, y) + \beta U_2(x_2, y)$$

Formulate the regulator's optimisation problem and derive the first order conditions. Is it reasonable to expect that you can rewrite these conditions in such a way that you can reproduce Equation (1)? Justify your answer.

Problem 3

A producer's income is given by $f(e)$ where e is pollution. Assume that $f'>0$ for $e<e^0$, and that $f''<0$. The pollution harms a consumer, the money measure of the environemtal damage is $D(e)$. Assume that $D'>0$ and $D''>0$.

Consider the two cases

(a) the producer "owns" the environment
(b) the consumer "owns" the environment

For both cases:

- Derive the status qua outcome, i.e. outcome in the absence of any negotiations between the two parties.
- Show what the outcome of negotiations will be if there are no transaction costs
- Assume next that there are transaction costs T. If these transactions costs exceed the net surplus that can be achieved through negotiations, we assume that the outcome is gives by the status qua. How large must T be to for no negotiations to take place?