ECN 275/375 Environmental and natural resource economics
Exercise set 8

Exercise 8.1 – Taxes or tradable permits when marginal abatement costs are uncertain

The marginal damages of emissions is given by the formula $MD(M)=2M$, where M denotes emissions. The marginal abatement cost function is $MAC(M)=A-M$, where A is a constant with uncertain value between 8 and 12.

(a) Which of the policy instruments *emission taxes* or *tradable emission permits* would you choose? Justify your answer.

(b) Given your answer in (a), what is then most important of cost and damage considerations, and how does that influence your choice of instruments? Justify your answer.

(c) Suppose the true value of A is 16, while the wrongful assessment of A is 12. Find the welfare losses of this wrongful assessment. Hint: Draw the solution first, then solve mathematically.

(d) Suppose that current emissions without any regulations are 40. What is then the size of the uncertain parameter A?

Exercise 8.2 – Nonmeasurable emissions

In some cases emissions are not measurable. If pollution is closely linked to the produced quantity, a way to circumvent this problem is to put a tax on production (or the consumption) of the good. There are several ways of dealing with this issue. This exercise show that with a connection between production and pollution, this approach works quite well (some tedious steps ahead, but you will learn new stuff or have something repeated).

Consider the following farm firm with the following total cost function $c(y)=a\,y+b\,y^2$, where y is the produced quantity, and the constants a and b are positive.

(a) Write down the firm's profit function.

(b) Show that the firm's profit maximizing output $y^*=\frac{p-a}{2b}$, and calculate the firm's profits.

(c) Let a = 1, b = 0.25, and p = 4. Draw the firm's marginal revenue (MR) function and marginal cost (MC) functions in the same graph. From your graph, what appears to be the profit maximizing production level, y*.

(d) The firms emissions, m, is connected to output by the following function: $m(y)=\frac{y^2}{2}$.

Assume that emissions are taxed with the tax rate t per unit of emissions. Write down the firms revised profit function.

(e) Show that the optimal production level with the tax is: $y^T=\frac{p-a}{2b+t}$

(f) Use the parameter values from part c, and let the tax rate, t = 0.5. Find the firms profit maximizing output level and profits.

(g) Show the solution of the above question graphically. From the graph, how can you see that profits must decline as a result of the tax t and the reduced production ($y^T < y$*)?

(h) Suppose that instead of a tax, the regulatory agency issues a constraint on how much the firm can produce, $y_{max} = 7$. What happens to the firms profits?

(i) Suppose the constraint is tightened to $y_{max} = 3$, the same output level as under the tax. Why would the firm's owner prefer this solution to the tax in the short run, but possibly not in the long run?