Practice exam in ECN 371 - Environmental Economics
Suggested answers

Question 1 (20 points)

(a) What does it mean to say that externalities are reciprocal phenomena. **(5 points)**

Coase focuses his analysis on negative externalities. Such externalities are present whenever some agent's (consumer's, firm's) utility or production function contains variables whose values are influenced by other agents, and these other agents do not compensate the initial agent for th . Coase's point is that for an externality to exist, both parties have to be present. An emission causes no externality or harm if nobody else is exposed to it. Thus, the emitter and the victim are both responsible for the problem. It is reciprocal.

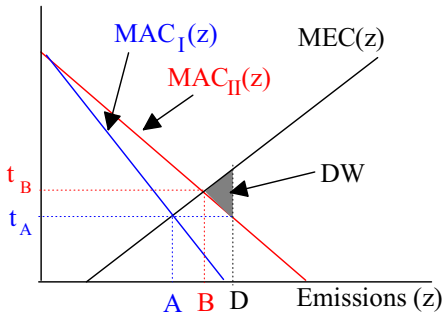
(b) If a firm moves to an area that is exposed to some pollution, emissions and abatement costs may increase.

[figure from question here]

Why might it be relevant for a firm to move from a non polluted to a polluted area? How does the movement of the firm (victim) influence the optimal level of abatement and under which circumstances should society motivate the firm to move?
(15 points)

Why may the firm still move? It will move if the expected profits from moving exceed the expected profits of remaining at the old location. Any adjustments in local emission taxes at the new location from entrant firms may reduce the expected gains from moving (see below).

The figure illustrates a what happens when a new firm enters an area. The $MAC_{II}(z)$ is the result of horizontally summing $MAC_{I}(z)$ and the marginal abatement cost curve of the entrant firm (the difference between the two curves is the impact of the entrant firm into the area). This yields an increase in total marginal abatement costs in the area, and the optimal emission level changes from A to B. If location specific emission taxes were to be used, the optimal emission tax rate increases from t_A to t_B.

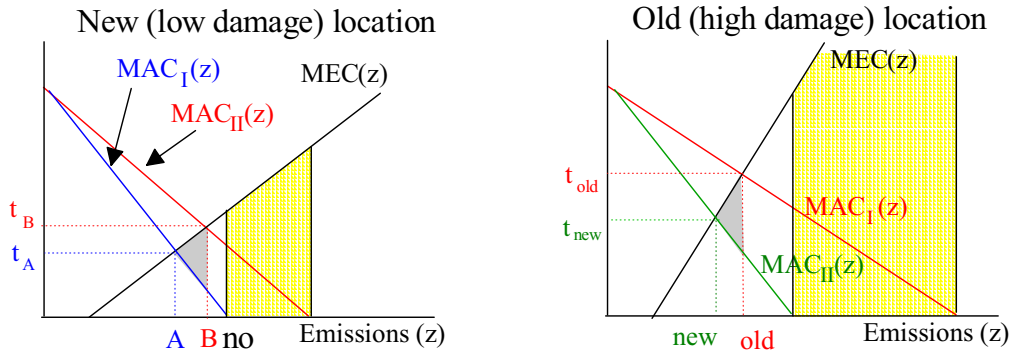


From the above it follows that the emission tax should increase as a result of firm entry into the location. Failure to increase the tax from t_A to t_B leads to an efficiency loss marked by the triangle DW, as total emissions will be at D. Pollution level D is where the tax line t_A (the unadjusted tax) intersects $MAC_{II}(z)$.

Question 2 (20 points)

Using the information in question 1 on the relocation of a firm from a high damage to a low damage area, identify under which circumstances the regulator should motivate firms to move? Consider two cases, when environmental externalities are corrected (the optimal environmental policy is in place) and the uncorrected case (no environmental policies are in place). **(20 points)**

The general answer is that the where the welfare losses at the new (low damage) location are lower than the welfare gains at the old (high damage) location. The economic considerations pertaining to the environmental impacts are illustrated in the figures below.



With taxes being optimally adjusted at the old and new location, the environmental welfare loss at the new location and the welfare gain at the old location are illustrated by the shaded gray triangles.

In the case that there were no environmental regulations in place (i.e., zero abatement), the respective welfare losses at the new and gains at the old location are indicated by the yellow hatched areas. We note that in the case of uncorrected externalities (despite the second-best problems) the environmental gains from relocation generally outweighs the environmental losses. The reason for this is that in the high damage region the MEC are higher than for the low damage region evaluated at the same emission level. The only time this will be different

In addition comes the real costs to society of moving the firm to the new location, and possible welfare losses (time cost + increased transportation) increases in commuting by workers.

Question 3 (20 points)

(a) What are the necessary criteria for a resource allocation mechanism to work as intended, and why are these criteria so important. **(10 points)**

The necessary criteria for resource allocation mechanisms are:

(1) The mechanism should be designed such that the **participation constraint** is met, i.e., it is in the agent's own interest to take part in the exchange of information with the regulator.

(2) The mechanism should be designed so that it is **informationally viable**, i.e., it does not require more information than what is available.

(3) The mechanism is **incentive compatible**, i.e, it is in the agent's own self interest to behave as the regulator wants.

Resource allocation mechanisms aims messages/communication between the regulator and agents (or between agents). These three criteria are important because they are necessary for a resource allocation mechanism to yield predictable outcomes, i.e., induce truthtelling.

(b) Incentive compatibility and Pareto optimality are rarely attainable at the same time. Which of these two conditions are most important when designing regulations, and why? **(10 points)**

Incentive compatibility is more important that Pareto optimality because if a mechanism/-regulation is not incentive compatible, the regulator cannot predict how agents will behave. Hence, the regulator is unable to assess which equilibrium that results, and the comparison of welfare (Pareto optimality) is barely of theoretical interest.

Question 4 (40 points)

(a) Discuss the cost efficiency of the current regulations. In your answer recall that transaction costs with the various policy instruments may change their evaluation. When answering this question focus on the principal aspects, not the details of the various regulations. (20 points)

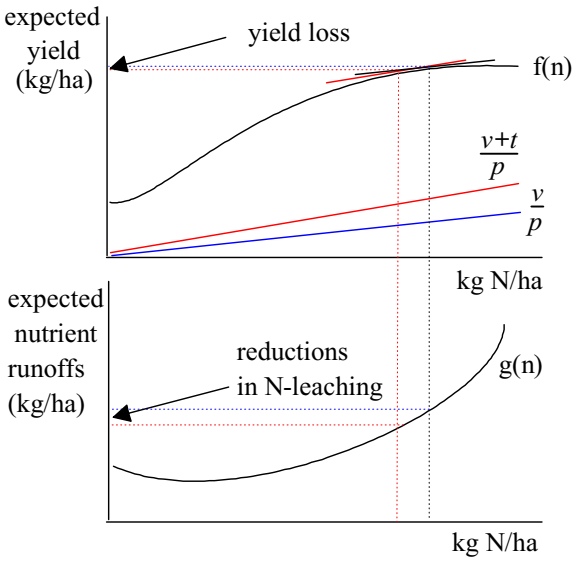
The current regulations are a mix of command and control (like manure spreading and storage), and payments (like reduced tillage subsidies), and end-of-pipe controls (like catch crops and catchment dams). These regulations are not cost efficient (where a necessary condition for cost efficiency is that marginal abatement costs are equal evaluated at the margin). In practice that is also likely to hold as these instruments will have different costs and impacts depending on soil characteristics and crops grown. Consequently, it would only be if costs and environmental impacts from these measures move in the same direction one would have an outcome resembling cost efficiency.

The transaction costs of the above policy measures are fairly low. Given the technical difficulties and assumed high costs of measuring nonpoint emissions, it may still be the case that the overall costs (abatement costs + transaction costs) are the least for such a package.

(b) Outline changes in the Norwegian policies for reducing nutrient runoffs from agriculture that would lead to improved overall efficiency and cost efficiency **(10 points)**

There exists other policy options one also needs to consider. The first is taxes on mineral fertilizers because low such taxes generally result in low abatement costs. In a situation where product prices (to farmers are high, as is the case in Norway), and there are no fertilizer taxes, a minor fertilizer tax entails small real costs relative to the reduced nutrient runoffs.

The figure to the right [$f(n)$ = yield function, v = input price, p = product price, t = tax] depicts such a situation where yield losses are negligible for all practical purposes, while N-leaching (the example in the figure) is reduced by a lot more in relative terms. Note that as the tax is increased, yield losses increase at an increasing rate, while expected nutrient runoffs increase at a decreasing rate. Regarding fertilizer taxes also recall that such an instrument may not be precise, and that it may have some undesirable distributional impacts. The transaction costs are, however, low.



Another alternative is the teams approach, where one makes a collection of farmers jointly responsible for measured (modeled) nutrient runoffs from an area. The advantage of such an approach is that it opens for internal "trades" on abatement efforts, i.e., members of the team who has lower abatement costs or where the impact of abatement is particularly high, abate more than the other team members. This approach is not globally applicable for two reasons: (i) it is a small number-of-agents mechanism, and (ii) it requires that it is possible to trace nutrient runoffs to members of the team. Although theoretically appealing, transaction costs may render such schemes too costly for the time being.

A third approach would be to use models to asses nutrient runoffs in a contract framework. Under such a regulation farmers would report what practices they are undertaking, and nutrient leaching, pesticide leakage etc. are estimated and taxed. The rationale behind such a framework is two-fold: (a) to shift farmers' focus to the direct purpose of nonpoint source regulations (= to reduce emissions), and (b) to provide tools that makes it easier for farmers to assess the environmental (and economic) impacts of their choice of agricultural practices.

(c) What are the implications of this when the objectives of nitrogen and phosphorus runoff policies are improved overall efficiency and increased cost efficiency? When answering, also consider possible impacts of transaction costs and the rights structure. **(10 points)**

Other sectors than agriculture also cause nutrient runoffs. This is particularly the case for nitrogen and phosphorus from the sewage of dispersed rural dwellings and to some extent to older municipal sewage treatment facilities. The costs of reducing these sewage runoffs are commonly higher than is the case in terms of the equivalent reductions from agriculture. This implies that when one sees the sewage and agricultural nutrient runoffs together, and sewage is the high cost sector, more of the abatement should take place in agriculture than if one considers agriculture alone.

Such policies may , however, be hard to implement if farmers perceive that once their sector has done their share, it is unfair that they (as a sector) are required to do more. This rights issueis particularly troublesome in such instances. One way of resolving these difficulties is to have the sewage sector "shop" for abatement services from agriculture (and other possible

lower abatement cost sectors). The rationale for such nonpoint-point trades is that farmers who accepts to deliver abatement services (either by reducing own emissions more, or by undertaking measures that directly reduce sewage problems, for example by providing catchment dams for dispersed rural housing) will benefit from this compared to not delivering these services (i.e., the participation constraint is met).