SUMMARY

1. Regulation problems involving asymmetric information typically are associated with the regulator having less information than the polluter.

2. Adverse selection problems involve polluters having hidden characteristics (hidden from the regulator) such as their cost of pollution control. This makes efficient regulation difficult.

3. When a regulator must make a decision about the level of an emission fee or marketable permit system with uncertainty on the marginal cost of pollution control, the relative slopes for marginal savings and marginal damage functions determine which instrument is more desirable. If marginal damage is more steeply sloped than the marginal savings from pollution, marketable permits are preferred; otherwise, emission fees are preferred.

4. A marketable permit system with a subsidy for emitting less than permitted and a penalty for emitting more than permitted can perform better than either an emission fee alone or a marketable permit system alone, when marginal savings are uncertain to the regulator.

5. If a polluter has private costs about marginal savings from pollution, an emission fee will cause the polluter to understate marginal savings. A marketable permit system will cause polluters to overstate marginal savings. A marketable permit system coupled with a subsidy for emitting less than permitted will induce telling the truth about pollution control costs.

PROBLEMS

*1. Suppose we have two polluters that have a hidden characteristic, θ. The θ does not have to be the same for the two firms. Assume that θ can take on one of two values: 1 or 2. These two firms emit pollution, with marginal savings functions equal to $MS(e,\theta) = 1 - \theta e$. Total savings from polluting for each firm are $S(e, \theta) = 1 - \dfrac{(1-\theta e)^2}{2\theta}$. Damage from pollution is $D(e_1 + e_2) = (e_1 + e_2)^2/2$ with a marginal damage of $(e_1 + e_2)$.

   a. Suppose the regulator knew the value of θ for each of the firms, θ_1 and θ_2. For all possible combinations of θ_1 and θ_2, what would be the optimal amount of pollution for each firm: $e_1^*(\theta_1,\theta_2)$, $e_2^*(\theta_1,\theta_2)$?

   b. Now assume the regulator does not know θ but asks each firm its true θ. After receiving those reports from each firm, each firm i will be charged an amount, $T_i(e_i,\theta_i)$, based on the reported θ_i, the report by the other firm, θ_j, and actual emissions, e_i:

$$T_i(e_i,\theta_i) = D[e_i + e_j^*(\theta_1,\theta_2)] - S_j[e_j^*(\theta_1,\theta_2),\theta_j]$$

   where i and j are the two firms. The firms know this before they report their values of θ. Show that it is in the best interest of each firm to tell the truth about θ and also to emit the right amount of emissions, e^*. [*Hint:* Prove in general or enumerate for possible θ_i,θ_j].

*2. Consider a version of the problem discussed in section I.A. of the chapter, except that we will change the form of the regulation: an emission fee will be used instead of the firm being told how much to emit. A reward will still be paid to the firm for telling the truth.

    a. Let the emission fee, based on announced firm cost, be r_L^* and r_H^*, respectively, depending on what the firm says its costs are. If the emission fees are based on an equating of marginal cost of abatement and marginal damage, what do we expect firms to tell us their costs are?

    b. Now develop the conditions for a reward for revealing a firm's costs. Write down the equivalent version of Eqs. 16.3 and 16.4.

    c. Draw a version of Figure 16.1, using linear (straight line) versions of marginal costs and marginal damage. Show (graphically or mathematically) that there is no simple reward (independent of emissions) that can induce truth telling every time.

3. In the hybrid fee-subsidy scheme described in Figure 16.7, suppose there are two additional marginal savings functions, one even higher than MS_H and one lower than MS_L. In this case, graphically show the inefficiencies associated with a fee-subsidy system.

4. Suppose the total cost of controlling the pollution in Bangkok is given by $TC = (3 + r)q^2$ where q is the amount of emissions controlled. Uncontrolled, there would be 2 units of emissions. Thus $q = 2-e$, where e is emissions. The variable r is unknown to the pollution control board. All they know is that it could take the value of either $r = 0$ or $r = 4$, and with equal likelihood. Marginal damage from emissions is given by $MD(e) = 4e$.

    a. Write the total cost of pollution control in terms of e. Graph this total cost as a function of e.

    b. Graph the marginal damages from emissions and the expected value (i.e., average over the two possible rs) of the marginal savings from emissions. Be as accurate as you can.

    c. What level of emission fee or emission permit should be chosen, not knowing what value r will take? Show your answer on the graph.

    d. Suppose after you have set the fee or permit in part (b). it turns out that $r = 4$. Show the deadweight loss from the permit and fee, assuming these instruments cannot be changed. Which instrument appears to be better?

5. Consider the case of a regulator and a single polluter. Suppose the regulator knows the marginal damage from pollution but is unsure about the firm's marginal savings from emitting. The regulator asks the firm to reveal its marginal savings from emitting schedule. Regulators know that if they use an emission fee, the firm has an incentive to lie about its marginal savings. Regulators also know that if they use a permit system, lying may still result. So the regulator announces that after being told the firm's marginal savings, the regulator will flip a coin to determine whether an emission fee or an emission permit will be used to control pollution. In this case, will the firm have an incentive to truthfully reveal its marginal savings from emissions? Why or why not? [*Hint:* Assume a firm is low cost; look at the possible costs or cost savings from telling the regulator it is high cost.]