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Tutorial 1 - Pigouvian Taxes and Permits (from Kolstad Ch. 7&9)

Exercise 1

Assume an economy of two firms and two consumers. The two firms pollute. Firm one has a marginal savings function of $MS_1(e) = 5 - e$ where e is the quantity of emissions from the firm. Firm two has a marginal savings function of $MS_2(e) = 8 - 2e$. Each of the two consumers has marginal damage $MD(e) = e$, where e is this case is the total amount of emissions the consumer is exposed to.

a. Graph the firm-level and aggregate marginal savings functions.

b. Graph the aggregate marginal damage function.

c. What is the optimal level of pollution, the appropriate Pigovian fee, and emissions from each firm?

Exercise 2

Consider the market for electricity. Suppose demand (in megawatt hours) is given by $Q = 50 - P$ and that the marginal private cost of generating electricity is $10 per megawatt hour ($P$ is in the same units). Suppose further that smoke is generated in the production of electricity in direct proportion to the amount of electricity generated. The health damage from the smoke is $15 per megawatt hour generated.

a. Suppose the electricity is produced by an unregulated monopolist. What price will be charged, and how much electricity will be produced?

b. In part (a), what is the consumer surplus from the electricity generation? What is the net surplus, taking into account the pollution damage?

Exercise 3

Two identical firms save money from polluting. A firm's marginal savings from emitting an amount e are given by $10-2e$. The two firms differ in their impact on ambient pollution concentrations. Two units of emissions from firm 1 result in one unit of ambient pollution. Firm 2 has twice the impact on the ambient environment from the same amount of emissions.

a. What are the transfer coefficients for each of the two firms?

b. If firm 1 is given two emission permits and firm 2 is given four emission permits and they are allowed to trade, how many permits will each firm end up with and what will be the price?

c. If instead each firm is given two ambient pollution permits and trading takes place, tow much will each firm end up emitting and what will be the permit price?

Exercise 4

Consider the case of carbon dioxide being emitted into the atmosphere. Assume that a ton of $C0_2$ emitted decays at a very slow rate; assume only 1% of the stock in the atmosphere decays in any given year. Also assume that the marginal damage of a ton of CO2 in the atmosphere is $1 per year regardless of the amount of CO2 in the atmosphere. Using a discount rate of 3% per year, calculate the marginal damage caused by emitting 1 ton of CO2 into the atmosphere. What C02 emission fee would you recommend to control this greenhouse gas problem?