THE PENNSYLVANIA STATE UNIVERSITY
Department of Economics

Economics 428   Gallant
Homework 5   Fall 2021
October 28

   This is an individual assignment in the sense that each individual must submit his or
her answers. However, you should feel free to work with another classmate to solve the
problems. Ultimately, it is important that each individual understand how to solve these
problems because questions similar to these will appear on exams. Turn in via Canvas.

1. Consider two adjacent states, S_1 and S_2, that wish to control particulate emissions from
   power plants and cement plants; New Jersey and Pennsylvania, for example. Each state
   wants to remove all particulates larger than 100 nanometres from the airspace below
   1000 feet. Suppose this requires 50 kilotons of abatement in each state. The aggregate
   cost of abatement when the marginal abatement costs of all industries within the state
   are equalized is $3A_1^2$ for state S_1 and it is A_2^2 for state S_2, where A_i is measured in
   kilotons.

   (a) If the states do not cooperate, what is the cost of abatement in state S_1.

   (b) Would a permit market with 50 kilotons of emissions permits distributed to the
       firms by means of an ascending clock auction equate the marginal abatement costs
       of all power and cement firms within state S_1? You may assume that no firms are
       bankrupted.

   (c) If the states do not cooperate, what is the cost of abatement in state S_2.

   (d) If the states do cooperate by means of a 100 kiloton cap and a permit market that
       covers both states with permits allocated by an ascending clock auction, what is
       the total cost of abatement. You may assume that no firms are bankrupted. You
       may also assume that a joint auction will not change the aggregate cost functions
       $3A_1^2$ for state S_1 and A_2^2 for state S_2.

(e) Why does the sum of the costs of abatement from question 1a and 1c not equal the cost of abatement in question 1d.

2. A beekeeper, Jane, and a farmer with an apple orchard, Joe, are neighbors. This is convenient for Joe because the bees pollinate the apple trees: one beehive pollinates one acre of orchard. Unfortunately, there are not enough bees next door to pollinate the whole orchard and pollination costs are $10 per acre. Jane, the beekeeper, has total costs of $TC = H^2 + 10H + 10$ and marginal cost $MC = 10 + 2H$, where H is the number of hives. Each hive yields $20 worth of honey.

   (a) How many hives would Jane maintain if operating independently of Joe?

   (b) How many hives would Jane maintain if Joe offers Jane $10 per hive?

   (c) What is the extra profit (surplus) that Jane receives from this transaction?

   (d) Suppose that Joe wants to try to minimize his cost by making Jane a take it or leave it offer. How many hives over and above the answer to question 2a should Joe offer to buy and how much should Joe offer Jane in total for this incremental number of hives. Stated differently: What is the least amount Joe must offer Jane to get her to keep the same number of hives as the answer to 2b?