Intermediate Microeconomic Theory
ECN 100B, Fall 2019
Professor Brendan Price

Section Problems #6
(Week of Monday, November 18)

# Perc

Traditional dry-cleaning methods use a chemical called "perc" that's believed to increase the risk of cancer. In this problem, we'll see how the negative externality caused by perc pollution affects the socially optimal amount of dry cleaning.

Suppose that Sacramento has a perfectly competitive dry cleaning industry, with a market-level demand curve given by

$$p(Q) = 50 - 5Q$$

Suppose that each dry cleaner has (private) costs of production given by

$$PC(q) = 20q$$

(Remember that the private marginal cost curve equals the supply curve.)

Finally, suppose that dry cleaning imposes external costs given by

$$EC(Q) = \frac{1}{2}Q^2$$

Notice that the external marginal cost, $EMC(Q) = \frac{d}{dQ}\left(\frac{1}{2}Q^2\right) = Q$, is an increasing function of total output ($Q$), reflecting the idea that small levels of perc pollution are not very harmful but increased exposure becomes more and more dangerous at higher levels of exposure.

a. Plot the demand curve, private marginal cost curve, external marginal cost curve, and social marginal cost curve.

b. Compute the (unregulated) competitive equilibrium quantity $Q_c$ and price $p_c$. What is the *consumer* surplus in this equilibrium? What is the *total* surplus?

c. Now compute the socially optimal quantity $Q_s$. Compute total surplus using the formula $TS = SB - SC$ (total surplus equals social benefits minus social costs).

d. Compute DWL in the competitive equilibrium. How does it compare to the difference in total surplus between the competitive equilibrium and the social optimum?

e. Suppose that the government imposes a corrective tax equal to $5 per unit produced. Find the new competitive equilibrium quantity $Q_c^{\text{tax}}$. Then find the total surplus.

# Mending Wall

*. . . I let my neighbour know beyond the hill;*
*And on a day we meet to walk the line*
*And set the wall between us once again.*
*We keep the wall between us as we go.*
*To each the boulders that have fallen to each.*
*And some are loaves and some so nearly balls*
*We have to use a spell to make them balance:*
*"Stay where you are until our backs are turned!"*
*We wear our fingers rough with handling them.*
*Oh, just another kind of out-door game,*
*One on a side . . .*
*—Robert Frost, "Mending Wall"*

Two neighbors, Alessandra and Elinor, share a fence between their property. The fence is in poor condition and each neighbor is deciding how many units of fencing to replace.

Let $Q = q_A + q_E$ denote the total number of renovated units of fencing, where $q_A$ and $q_E$ are the quantities contributed by each neighbor. Alessandra's private marginal benefit from fencing (i.e., her demand curve) is given by

$$p_A(Q) = \begin{cases} 90 - Q & \text{for } Q \leq 90 \\ 0 & \text{for } Q > 90 \end{cases}$$

Elinor's private marginal benefit is given by

$$p_E(Q) = \begin{cases} 110 - Q & \text{for } Q \leq 110 \\ 0 & \text{for } Q > 110 \end{cases}$$

a. Plot the individual and social demand (i.e., marginal benefit) curves.

b. Suppose that each unit of fencing costs \$100. What is the socially optimal number of units of fencing ($Q_s$)? If Alessandra and Elinor play a static game, how much fencing will each neighbor purchase (i.e., what are the Nash equilibrium quantities $q_A^*$ and $q_E^*$)?

c. Now suppose that each unit of fencing costs \$150. What is the socially optimal number of units of fencing ($Q_s$)? How much fencing will each neighbor choose to purchase?

 