Externalities

1. A company that produces steel operates in a perfectly competitive market. The price of each ton of steel is \$10. The marginal cost of producing steel is given by $MC(Q) = 2 + 0.25Q$, the variable cost is: $VC(Q) = 2Q + \dfrac{0.25Q^2}{2}$ where quantity Q is measured in tons of steel. However, when producing steel, this company pollutes the environment, and a study has determined that there are hundreds of fish dying daily from the pollution this company generates. This study determined that the social marginal cost of producing the steel that this company generates is given by $SMC(Q) = 4 + 0.25Q$. Calculate:

   (a) The quantity that the company will produce when it does not take into account the externality it generates.

   (b) The profits the company will make (assume fixed costs are 0).

   (c) The social and private cost (assume fixed costs are 0).

   (d) The socially optimal quantity.

   (e) The tax that should be charged to this company to induce it to produce the socially optimal quantity.

2. The numerous identical inhabitants of this town love drinking Coca-Cola. Each inhabitant has the following willingness to pay for this drink:

Bottle	Willingness to pay
First bottle	\$5
Second bottle	\$4
Third bottle	\$3
Fourth bottle	\$2
Fifth bottle	\$1
More bottles	\$0

   (a) The cost to produce Coca-Cola is \$1.50 and competitive suppliers sell it at this price (the supply curve is horizontal). How many bottles will each inhabitant of this town consume? What is the consumer surplus for each inhabitant?

   (b) The production of Coca-cola generates pollution. Each bottle has an external cost of \$1. Taking into account this additional cost, what is the final surplus per inhabitant in the distribution from sub-item a)?

   (c) One of the inhabitants of this town, decides on her own to reduce her consumption of Coca-Cola and drink one less bottle. What will happen to this consumer's welfare (her consumer surplus minus the cost of the pollution she suffers)? How will this consumer's decision affect this town's surplus?

   (d) The government imposes a \$1 tax on the consumption of each bottle of Coca-cola. What will now be the consumption per inhabitant? Calculate the consumer surplus, the external cost, the government revenue, and the total surplus per inhabitant.

   (e) Based on your calculations, would you support the mayor's policy? Why?

3. Max has a medical office in an apartment. Next door Lucciano owns a confectionery. Unfortunately, the noise from the confectionery prevents Max from properly attending to his patients.

(a) What is the externality?

(b) According to the Coase theorem, how can Max and Lucciano arrive at an efficient outcome between the two? What can prevent them from achieving an efficient outcome?

Solutions

1. (a) The company equates marginal cost to price:

$$2 + 0.25Q = 10$$

Solving for Q:
$$Q = 32$$

(b)
$$P = I - C = PQ - VC - CF$$
$$3210 - (2Q + 0.25Q^2) = 320 - (232 + 0.25 * (32)^2) = 0$$

(c) $PmC = 2 + 0.25Q = 2 + 0.2532 = 10$ and $SMC = 4 + 0.25Q = 4 + 0.2532 = 12$

(d) We equate the social marginal cost to the price:

$$4 + 0.25Q = 10$$

Solving for Q:
$$Q = 24$$

(e) We want the company to produce the socially optimal quantity, so we need to modify the private marginal cost in such a way that when equated with the price, the optimal production is $Q = 24$. Then:
$$PMC = 2 + 0.25Q + T = 10$$
$$2 + 0.25 * 24 + T = 10$$
$$2 + 6 + T = 10$$
$$T = 2$$

Notice that if $T = 8$ then the private marginal cost equals the social marginal cost:

$$PMC = 2 + 0.25Q + 2 = SMC = 4 + 0.25Q$$

2. (a) If they buy one bottle, the willingness to pay is higher than the price: $5 > 1.5$. If they buy 2, it's also true: $4 > 1.5$, and so on until they consume 4 bottles: $2 > 1.5$, after that the price is higher than the willingness to pay, therefore they consume 4 bottles and the consumer surplus of each of the inhabitants is as follows:

$$CS = 5 - 1.5 + 4 - 1.5 + 3 - 1.5 + 2 - 1.5 = 8$$

(b) If we take into account that each inhabitant consumes 4, then in total there is a pollution cost of 4 for each inhabitant so the surplus now will be:

$$CS = 8 - 4 = 4$$

(c) If she consumes 3 bottles, without taking into account the pollution, her surplus is:

$$CS = 5 - 1.5 + 4 - 1.5 + 3 - 1.5 = 7.5$$

Assuming that the added pollution doesn't change because one less bottle doesn't end up affecting the total pollution:
$$CS = 7.5 - 4 = 3.5$$

(d) If there is a tax of 1, now the price of each bottle rises and therefore the inhabitants only consume 3 bottles, without considering pollution:

$$CS = 5 - 2.5 + 4 - 2.5 + 3 - 2.5 = 4.5$$

Now the pollution is of 3 per each inhabitant since each one consumes 3 bottles, therefore this affects the individual consumer surplus as follows:

$$CS = 4.5 - 3 = 1.5$$

The government's collection is given by the amount of bottles consumed by each inhabitant times the tax, therefore:

$$3NT = 3NT = 3N$$

(e) If what was collected can be returned to each of the inhabitants, 3 can be returned to each one, therefore the individual surplus of each one is:

$$CS = 1.5 + 3 = 4.5$$

Which is greater than 4 which is the result without considering the tax.

3. (a) The externality is the noise and constitutes a negative externality.

   (b) If two conditions are met:

   - Transaction costs are low or non-existent
   - Rights must be well defined

   Now we can consider two situations where the result would be efficient:

   - Let's suppose that the noise generates a cost to the doctor of $10. And we assign the property rights of having a noise-free environment to the doctor. Therefore this doctor could sell such right to the owner of the coffee shop for $10 or more and would be as well as before or better.
   - If the right is assigned to the owner of the coffee shop, he can sell such right to the doctor for 10 or less and the doctor would be as well as before.

   This shows us that it doesn't matter to whom the right is assigned, these individuals can solve the problem without the need for government intervention.