1 Microeconomics

1. Commodity X is produced in a competitive market where demand is given by:

$$Q_d = 200 - P$$

and supply is given by:

$$Q_s = \frac{P - 50}{2}$$

   (a) What is the equilibrium price and quantity of X?

   (b) Suppose now that a tax T=12 is imposed per unit of X. What is the change in consumer surplus?

   (c) What is the change in producer surplus?

   (d) What is the size of tax revenues?

   (e) How large is the efficiency loss due to imposing the tax?

2. A monopolist has constant marginal cost MC = 20 and is selling a product in two separate and distinct markets. The demand functions facing the monopolist in the two separate markets are:

$$\begin{array}{lcll} \text{Market A} & Q_A & = & 200 - 5P_A \\ \text{Market B} & Q_B & = & 1400 - 50P_B \end{array}$$

   (a) If the monopolist is a profit maximiser, find the prices that will be charged in the different markets and the corresponding quantities.

   (b) What will the monopolist's profit be (assuming fixed costs can be ignored)?

   (c) In each market, find the price elasticities of demand at the price-quantity combinations found in part (a).

   (d) Are the relative prices in the two markets what you would expect given your results in part (b)? Explain your answer.

2 Micro Answers

2.1 Question 1

Commodity X is produced in a competitive market where demand is given by:

$$Q_d = 200 - P$$

and supply is given by:

$$Q_s = \frac{P - 50}{2}$$

1. (a) What is the equilibrium price and quantity of XQ?

The equilibrium price and quantity can be found by setting supply equal to demand: $Q_d = Q_s$. Hence:

$$200 - P = \frac{P - 50}{2}$$

Rearranging for price level P, yields $P^* = 150$. Substituting P^* into supply or demand, yields equilibrium quantity level $Q^* = Q_d = Q_s = 50$.

1. b. Suppose now that a tax T=12 is imposed per unit of X. What is the change in consumer surplus?

The tax introduces a wedge between the consumer price (denoted by P^C) and the producer prices (denoted by P^P), such that:

$$P^C = P^P + 12$$

To find the change in consumer surplus, the new equilibrium (tax-ridden) must be found. The new system of equations is:

$$Q_d = 200 - P^C = 188 - P^P \tag{1}$$

$$Q_s = \frac{P^P - 50}{2} \tag{2}$$

Solving (1) and (2) simultaneously yields the two prices and quantity in the tax-ridden equilibrium:

$$\begin{aligned} P^P &= 142 \\ P^C &= 154 \\ Q_d &= Q_s = 46 \end{aligned}$$

Consumer surplus describes the surplus of consumers' willingness to pay and the price paid. Diagrammatically, it is the area enclosed by the prices level and the demand curve. Illustrating demand and supply with and without the tax allows consumer surplus to be found in the initial equilibrium (CS) and the tax-ridden equilibrium (CS^T).

$$CS = \frac{1}{2}(50)(50) = 1250$$
$$CS^T = \frac{1}{2}(46)(46) = 1058$$
$$\Delta CS = -192$$

The tax lowers consumer surplus by 192.

1. c. What is the change in producer surplus?

Producer surplus is enclosed by the price line and the supply curve. Hence:

$$PS = \frac{1}{2}(150 - 50)(50) = 2500$$
$$PS^T = \frac{1}{2}(142 - 50)(46) = 2116$$
$$\Delta PS = -384$$

The tax lowers producer surplus by 384.

1. d. What is the size of tax revenues? Tax revenue $(TR) = T \cdot Q = (12)(46) = 552$

   e. How large is the efficiency loss due to imposing the tax? Change in social welfare $\Delta SW = \Delta CS + TR = -384$

2.2 Question 2

A Monopolist has constant marginal cost MC = 20 and is selling a product in two separate and distinct markets. The demand functions facing the monopolist in the two separate markets are:

$$\begin{aligned} \text{Market A} \quad Q_A &= 200 - 5P_A \\ \text{Market B} \quad Q_B &= 1400 - 50P_B \end{aligned}$$

1. (a) If the monopolist is a profit maximiser, find the prices that will be charged in the different markets and the corresponding quantities.

Rearrange the demand functions for markets A and B to find inverse demand for each market:

$$\begin{aligned} P_A &= 40 - \frac{1}{5}Q_A \\ P_B &= 28 - \frac{1}{50}Q_B \end{aligned}$$

Hence, marginal revenue for each market is given by:

$$\begin{aligned} MR_A &= 40 - \frac{2}{5}Q_A \\ MR_B &= 28 - \frac{1}{25}Q_B \end{aligned}$$

The monopolist sets marginal revenue equal to marginal cost in each market. Hence:

$$MR_A = MR_B = MC = 20$$

Thus:

$$\begin{aligned} 40 - \frac{2}{5}Q_A &= 20 \\ 28 - \frac{1}{25}Q_B &= 20 \end{aligned}$$

Solving simultaneously yields: $Q_A = 50, Q_B = 200, P_A = 30, P_B = 24$.

1. b. What will the monopolist's profit be (assuming fixed costs can be ignored)?

$$\begin{aligned} \Pi &= \Pi_A + \Pi_B \\ &= (4)(200) + (10)(50) = 1300 \end{aligned}$$

1. c. In each market, find the price elasticities of demand at the price-quantity combinations found in part (a).

Recall that (review the derivation of the formula in class):

$$P_A\left(1 - \frac{1}{|\epsilon_A|}\right) = P_B\left(1 - \frac{1}{|\epsilon_B|}\right) = MR_A = MR_B = MC = 20$$

Hence:

$$\begin{aligned} P_A\left(1 - \frac{1}{|\epsilon_A|}\right) &= 30\left(1 - \frac{1}{|\epsilon_A|}\right) = 20 \qquad (3) \\ P_B\left(1 - \frac{1}{|\epsilon_B|}\right) &= 24\left(1 - \frac{1}{|\epsilon_B|}\right) = 20 \qquad (4) \end{aligned}$$

Solving (3) and (4) yields: $|\epsilon_A| = 3$ and $|\epsilon_B| = 6$

1. d. Are the relative prices in the two markets what you would expect given your results in part (b)? Explain your answer.

The market with the less elastic demand has the higher price. Discuss role of elasticity in price discrimination.