Mathematics for Business: Lecture Notes - 5

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# Supply and Demand Analysis (Cont.)

Given any particular formula for it is then a matter to produce a picture of the corresponding demand curve. Unlike mathematicians, economists plot (quantity) on the horizontal axis, and  (price) on the vertical axis. Figure 1 shows both supply and demand curves in general:

P

 supply curve



demand

curve

   Q

Figure 1

The supply function is the relation between the quantity, , of a good that producers plan to bring to the market and the price, , of the good. Economic theory indicates that, as the price rises, so does the supply. Mathematically, is then said to be an increasing function of. A price increase encourages existing producers to raise output and entices new firms to enter the market. The supply curve in Figure 1, has equation in the following form:



(Does this equation look familiar? Discuss.)

It is important to note that this is a simplification of what happens in the real world. The supply function does not have to be linear and the quantity supplied, , is influenced by things other than price. These exogenous variables include the prices of factors of production (that is land, capital, labour and enterprise), the profits obtainable on alternative goods, and technology.

Of particular significance is the point of intersection. At this point the market is in **equilibrium** () because the quantity supplied exactly matches the quantity demanded. The corresponding price, , and the quantity, , are called the equilibrium price and quantity.

In practice, it is often the deviation of the market price away from the equilibrium price that is of most interest. Suppose that the market price, exceeds the equilibrium price, . From Figure 1., the quantity supplied, , is greater than the quantity demanded, , so there is excess supply. There are stocks of unsold goods, which tend to depress prices and cause firms to cut back production. The effect is for ‘market forces’ to shift the market back down toward equilibrium. Likewise, if the market price falls below equilibrium price then demand exceeds supply. This shortage pushes prices up and encourages firms to produce more goods, so the market drifts back up towards equilibrium.

**Example 1**: The demand and supply function of a good are given by:



,

where denote the price, quantity demanded and quantity supplied respectively.

1. Determine the equilibrium price and quantity
2. Determine the effect on the market equilibrium if the government decides to impose a fixed tax of £1 on each good.

**Solution 1**:

1. In the equilibrium, the quantity demanded will be equal to quantity supplied.

so the set of equation will take the form of:

 (solve the simultaneous equations for )

=100 (equilibrium quantity)

By substituting  in any given original equation,is found to be 260. (Equilibrium price)

1. If the government imposes a fixed tax of £1, than the money that the firm actually receives from the sale of each good will be less the tax that is .

Replacing by in supply function, we get the new supply equation:

, that is



In the equilibrium, the quantity demanded will be equal to quantity supplied.

so the new set of equations will take the form of:

(solve the simultaneous equations for )

=99

By substituting  in any given original equation,is found to be 258. (Equilibrium price after a fix tax)

**Practice 1**:The demand and supply functions of a good are given by:





where denote the price, quantity demanded and quantity supplied respectively.

1. Determine the equilibrium price and quantity
2. Determine the effect on the market equilibrium if the government decides to impose a fixed tax of £2 on each good.

**Practice 2**: The demand and supply functions of a good are given by:





where denote the price, quantity demanded and quantity supplied respectively

1. Determine the equilibrium price and quantity
2. Determine the effect on the market equilibrium if the government decides to impose a fixed tax of £13 on each good.

# Transposition of Formulae

Mathematical modelling involves the use of formulae to represent the relationship between economic variables. So far, we have seen how useful supply and demand formulae are. And, we have seen supply-demand formulae as expressed by the relationship between price and quantity (demanded and supplied), and is presented in the form of .

However, if we are given many values of, it is clearly tedious and inefficient for us to solve the equation each time to find . The preferred approach to transpose the formula for . In other words, we rearrange the formula

= an expression involving 

into

= an expression involving 

**Example 2**: Transpose the formulae:

a)to express  in terms of  (make the subject of given formula)

b) to express  in terms of 

c) to express  in terms of 

d) to express  in terms of 

**Solution 2**:

a) 

 (subtract 10 from both sides)

 (divide both side by -2)

 (rearrange)

b) 

 (add 5 to the both side)

 (multiply both side by 3)

 (rearrange)

c) 

 (add 5 to the both side)

 (divide both side by 4)

 (take a square root of both sides)

d) 

 (square both side of the equation)

(multiply both sides by 

(multiply out bracket)

(collect ’s on one side of the equation)

(take out a common factor of )

 (divide both side by  to make the subject of given formula)

**Practice 3**: Exercise 1.5, Questions: 1, 2, 6, and Exercise 1.6, Questions 1, 4, 5, 6