Chapter 5: Market Equilibrium

Exercises — Exercises

Q1 Explain market equilibrium.

Market equilibrium is the situation in which the plans of all consumers and all firms in the market match, so the market clears. The total quantity firms wish to sell equals the total quantity consumers wish to buy, that is, market supply equals market demand: $qD(p^*) = qS(p^*)$. The price at which this happens is the equilibrium price (p^*) and the quantity bought and sold at it is the equilibrium quantity (q^*). Graphically, it is the point where the market demand curve cuts the market supply curve. At this point there is neither excess demand nor excess supply, so there is no pressure on the price to change.

Q2 When do we say there is excess demand for a commodity in the market?

There is excess demand when, at a given price, the quantity that consumers wish to buy (market demand) is greater than the quantity that firms wish to sell (market supply). It equals qD - qS and occurs at any price below the equilibrium price. Some consumers cannot get the good, or get too little, and are willing to pay more, so the price tends to rise.

Q3 When do we say there is excess supply for a commodity in the market?

There is excess supply when, at a given price, the quantity that firms wish to sell (market supply) is greater than the quantity that consumers wish to buy (market demand). It equals qS - qD and occurs at any price above the equilibrium price. Some firms cannot sell what they want to, so they cut their price to attract buyers.

Q4 What will happen if the price prevailing in the market is (i) above the equilibrium price? (ii) below the equilibrium price?

(i) Above the equilibrium price: market supply exceeds market demand, so there is excess supply. Firms that cannot sell their desired output lower their price. As price falls, quantity demanded rises and quantity supplied falls, until the two are equal at the equilibrium price.

(ii) Below the equilibrium price: market demand exceeds market supply, so there is excess demand. Consumers who cannot obtain the good offer a higher price, so the price rises. As it rises, quantity demanded falls and quantity supplied increases, until the market clears at the equilibrium price.

Q5 Explain how price is determined in a perfectly competitive market with fixed number of firms.

With a fixed number of firms, the market supply curve (the sum of the firms' supply curves) slopes upward and the market demand curve slopes downward. Price is determined where the two curves intersect, because only there does quantity demanded equal quantity supplied. At any higher price there is excess supply, so sellers undercut one another and price falls. At any lower price there is excess demand, so buyers bid the price up. This adjustment, the working of the 'Invisible Hand', continues until the market reaches the equilibrium price p* and quantity q*. For example, with qD = 200 - p and qS = 120 + p, setting them equal gives p* = Rs 40 and q* = 160 kg.

Q6 Suppose the price at which equilibrium is attained in exercise 5 is above the minimum average cost of the firms constituting the market. Now if we allow for free entry and exit of firms, how will the market price adjust to it?

When price is above the minimum average cost, each existing firm earns supernormal profit. This attracts new firms into the market. As they enter, the market supply curve shifts rightward while demand stays unchanged, so the market price falls. Entry continues until the supernormal profit is wiped out, that is, until price falls to the minimum average cost. At that price every firm earns only normal profit, so no further firms want to enter and none wants to leave. The market price therefore settles at p = min AC.

Q7 At what level of price do the firms in a perfectly competitive market supply when free entry and exit is allowed in the market? How is equilibrium quantity determined in such a market?

With free entry and exit, firms supply at the price equal to the minimum average cost (p0 = min AC). Above it, supernormal profit draws in new firms and pushes price down. Below it, firms make less than normal profit and some exit, pushing price up. Only at min AC does each firm earn normal profit, so this price prevails. The equilibrium quantity is then fixed by market demand at that price: it is read off the point where the demand curve DD meets the horizontal price line p = min AC. Firms adjust in number to supply exactly this quantity.

Q8 How is the equilibrium number of firms determined in a market where entry and exit is permitted?

First, the equilibrium price is p0 = min AC and the equilibrium market quantity q0 is read from the demand curve at that price. At p0 each identical firm supplies the same output, say q0f. The equilibrium number of firms is the number needed to supply the market quantity at that price: n0 = q0 / q0f. For example, if q0 = 180 and each firm supplies 30 units, n0 = 180 / 30 = 6 firms.

Q9 How are equilibrium price and quantity affected when income of the consumers (a) increase? (b) decrease?

Take a normal good, whose demand rises with income. Income does not affect the supply curve, which shifts only with technology or cost changes.

(a) Income increases: the demand curve shifts rightward. At the old price there is excess demand, so the price rises. Both the equilibrium price and the equilibrium quantity increase.

(b) Income decreases: the demand curve shifts leftward. At the old price there is excess supply, so the price falls. Both the equilibrium price and the equilibrium quantity decrease.

For an inferior good the directions are reversed, since its demand falls when income rises.

Q10 Using supply and demand curves, show how an increase in the price of shoes affects the price of a pair of socks and the number of pairs of socks bought and sold.

Shoes and socks are complements: they are used together. When the price of shoes rises, fewer shoes are bought, and so less demand arises for socks at every price. The demand curve for socks DD0 shifts leftward to DD1, while the supply curve of socks stays at SS0. At the old price p0 there is now excess supply of socks, so firms cut their price. The new equilibrium is at the intersection of DD1 and SS0. In the diagram (price on the vertical axis, quantity of socks on the horizontal axis), the new equilibrium point lies lower and to the left of the old one. The equilibrium price of socks falls and the number of pairs bought and sold also falls.

Q11 How will a change in price of coffee affect the equilibrium price of tea? Explain the effect on equilibrium quantity also through a diagram.

Tea and coffee are substitutes. Suppose the price of coffee rises. Consumers switch towards tea, so demand for tea increases at every price: the demand curve shifts rightward from DD0 to DD2, with the supply curve SS0 unchanged. At the old price there is excess demand for tea, so the price rises. In the diagram, the new equilibrium G lies above and to the right of the old equilibrium E. Hence the equilibrium price and quantity of tea both increase. If the price of coffee falls, the reverse happens: tea demand shifts leftward, and both the equilibrium price and quantity of tea fall.

Q12 How do the equilibrium price and quantity of a commodity change when price of input used in its production changes?

A change in input price alters firms' marginal cost, so it shifts the supply curve but not the demand curve.

If the input price rises, marginal cost rises and at each price firms supply less, so the supply curve shifts leftward. At the old price there is excess demand. The new equilibrium has a higher price and a lower quantity.

If the input price falls, marginal cost falls, the supply curve shifts rightward, and the new equilibrium has a lower price and a higher quantity.

So price and quantity move in opposite directions whenever the supply curve shifts.

Q13 If the price of a substitute (Y) of good X increases, what impact does it have on the equilibrium price and quantity of good X?

When the price of the substitute Y rises, Y becomes costlier relative to X, so consumers buy more of X at each price. The demand curve of X shifts rightward, while its supply curve is unchanged. At the old price there is excess demand for X, so its price rises until a new equilibrium is reached. The equilibrium price of X increases and the equilibrium quantity of X bought and sold also increases.

Q14 Compare the effect of shift in demand curve on the equilibrium when the number of firms in the market is fixed with the situation when entry-exit is permitted.

Fixed number of firms: a rightward (leftward) shift of demand raises (lowers) both equilibrium price and quantity, because the upward-sloping supply curve stays put.

Free entry and exit: the equilibrium price always equals min AC. A rightward shift of demand briefly raises price and creates supernormal profit, so new firms enter until price returns to min AC. Price therefore stays unchanged, while quantity and the number of firms rise. A leftward shift leads to exit of firms, so quantity and the number of firms fall, with price unchanged.

So price changes in the first case but not in the second, and the effect on quantity is larger when entry and exit is permitted.

Q15 Explain through a diagram the effect of a rightward shift of both the demand and supply curves on equilibrium price and quantity.

Draw price on the vertical axis and quantity on the horizontal axis, with the initial equilibrium E where DD0 cuts SS0 at price p0 and quantity q0. Now shift demand rightward to DD1 and supply rightward to SS1. The new equilibrium is where DD1 and SS1 intersect.

The rightward shifts mean that at every price, both more is demanded and more is supplied, so the equilibrium quantity increases definitely. The effect on price depends on the relative sizes of the shifts. If demand shifts more than supply, price rises. If supply shifts more than demand, price falls. If the shifts are equal in magnitude, price remains unchanged at p0, with only quantity rising (this is the case shown in the textbook diagram).

Q16 How are the equilibrium price and quantity affected when (a) both demand and supply curves shift in the same direction? (b) demand and supply curves shift in opposite directions?

(a) Same direction: the effect on quantity is unambiguous. If both shift rightward, equilibrium quantity increases. If both shift leftward, it decreases. The effect on price is uncertain: it may rise, fall or stay unchanged, depending on the relative magnitudes of the shifts.

(b) Opposite directions: the effect on price is unambiguous. If demand shifts rightward and supply leftward, price increases. If demand shifts leftward and supply rightward, price decreases. The effect on quantity is uncertain, since it may rise, fall or remain unchanged depending on the magnitudes of the shifts.

Q17 In what respect do the supply and demand curves in the labour market differ from those in the goods market?

The difference lies in who supplies and who demands. In the goods market, firms supply the good and consumers demand it. In the labour market, it is the opposite: households supply labour and firms demand it. Here labour means hours of work, not the number of labourers. The labour market price is the wage rate. The firm's demand for labour slopes downward because of diminishing marginal product. An individual's labour supply can bend backward at high wages, because the income effect on leisure outweighs the opportunity-cost effect, although the market supply curve of labour still slopes upward.

Q18 How is the optimal amount of labour determined in a perfectly competitive market?

A profit-maximising firm in a perfectly competitive labour market takes the wage rate (w) as given and hires labour up to the point where the extra cost of the last unit equals the extra benefit from it. The extra cost is the wage rate. The extra benefit is the marginal revenue product of labour, MRPL = MR x MPL. For a perfectly competitive firm MR equals price, so MRPL equals the value of marginal product, VMPL. The optimal amount of labour is therefore where w = VMPL. If VMPL exceeds w, hiring one more unit raises profit. If VMPL is below w, reducing labour raises profit.

Q19 How is the wage rate determined in a perfectly competitive labour market?

The wage rate is determined at the intersection of the market demand curve and the market supply curve of labour. Market demand for labour is the sum of firms' demands; it slopes downward because, with diminishing marginal product, firms hire less labour at higher wages. Market supply of labour is the sum of households' supplies and slopes upward, because higher wages attract more people to work even if some individuals work fewer hours. At the equilibrium wage w*, the labour that households wish to supply equals the labour that firms wish to hire, which is l* hours.

Q20 Can you think of any commodity on which price ceiling is imposed in India? What may be the consequence of price-ceiling?

Yes. Examples are wheat, rice, sugar and kerosene, which are sold at controlled prices through ration (fair price) shops. A price ceiling is set below the market-determined price, so quantity demanded exceeds quantity supplied and there is a shortage. To share the limited supply, the government may ration the good through coupons. Consequences: consumers must stand in long queues at ration shops, and since many remain unsatisfied with their quota, some are willing to pay more, which can give rise to a black market.

Q21 A shift in demand curve has a larger effect on price and smaller effect on quantity when the number of firms is fixed compared to the situation when free entry and exit is permitted. Explain.

With a fixed number of firms, the supply curve is upward sloping. When demand shifts rightward, existing firms can raise output only by moving up their rising marginal cost curves, so a higher price is needed to induce more output. Price rises noticeably, and quantity rises only modestly.

With free entry and exit, the long-run supply is a horizontal line at p = min AC. A rise in demand tempts in new firms attracted by supernormal profit, and the entry stops only when price returns to min AC. Price does not change at all, and the whole adjustment falls on quantity (and the number of firms). Hence the shift in demand has a larger effect on price and a smaller effect on quantity when the number of firms is fixed.

Q22 Suppose the demand and supply curve of commodity X in a perfectly competitive market are given by: qD = 700 - p; qS = 500 + 3p for p >= 15 and qS = 0 for 0 <= p < 15. Assume that the market consists of identical firms. Identify the reason behind the market supply of commodity X being zero at any price less than Rs 15. What will be the equilibrium price for this commodity? At equilibrium, what quantity of X will be produced?

SOLUTION

Reason for zero supply below Rs 15: Rs 15 is the minimum average cost (the break-even level) of the identical firms. At a price below it, each firm would earn less than normal profit, so no firm would produce and market supply is zero.

Set qD = qS (valid since the equilibrium price will be at least 15): 700 - p = 500 + 3p
700 - 500 = 3p + p, so 200 = 4p
p* = 200 / 4 = 50, which is more than 15, so the supply formula used is valid.
q* = 700 - 50 = 650
Check with supply: qS = 500 + 3(50) = 500 + 150 = 650, which equals qD.
Equilibrium price = Rs 50 and equilibrium quantity = 650 units of X.

Q23 Considering the same demand curve as in exercise 22, now let us allow for free entry and exit of the firms producing commodity X. Also assume the market consists of identical firms producing commodity X. Let the supply curve of a single firm be: qSf = 8 + 3p for p >= 20 and qSf = 0 for 0 <= p < 20. (a) What is the significance of p = 20? (b) At what price will the market for X be in equilibrium? State the reason for your answer. (c) Calculate the equilibrium quantity and number of firms.

SOLUTION

(a) p = 20 is the minimum average cost of each firm, the break-even price at which a firm earns just normal profit. Below Rs 20 a firm would make a loss, so it supplies nothing.
(b) With free entry and exit, the market equilibrium price equals the minimum average cost: p0 = Rs 20. Reason: above Rs 20 firms earn supernormal profit, so new firms enter and push the price down. Below Rs 20 firms make losses, so some exit and the price rises. Only at Rs 20 do firms earn normal profit and neither enter nor leave.
(c) Equilibrium quantity from the demand curve (qD = 700 - p): q0 = 700 - 20 = 680
Output of each firm at p = 20: q0f = 8 + 3(20) = 8 + 60 = 68
Equilibrium number of firms: n0 = q0 / q0f = 680 / 68 = 10
Equilibrium price = Rs 20, equilibrium quantity = 680 units and number of firms = 10.

Q24 Suppose the demand and supply curves of salt are given by: qD = 1,000 - p; qS = 700 + 2p. (a) Find the equilibrium price and quantity. (b) Now suppose that the price of an input used to produce salt has increased so that the new supply curve is qS = 400 + 2p. How does the equilibrium price and quantity change? Does the change conform to your expectation? (c) Suppose the government has imposed a tax of Rs 3 per unit of sale of salt. How does it affect the equilibrium price and quantity?

SOLUTION

(a) Set qD = qS: 1,000 - p = 700 + 2p
300 = 3p, so p* = 100
q* = 1,000 - 100 = 900. Check: qS = 700 + 2(100) = 900.
(b) New supply qS = 400 + 2p. Set qD = qS: 1,000 - p = 400 + 2p
600 = 3p, so p* = 200
q* = 1,000 - 200 = 800. Check: qS = 400 + 2(200) = 800.
The price rises from Rs 100 to Rs 200 and the quantity falls from 900 to 800. This matches expectation: a higher input price raises cost, shifting the supply curve leftward, which raises

price and lowers quantity.

(c) Take the original supply curve of part (a). With a tax of Rs 3 per unit, sellers keep only p - 3 of the price p paid by buyers, so supply becomes qS = 700 + 2(p - 3) = 694 + 2p

Set qD = qS: 1,000 - p = 694 + 2p

306 = 3p, so p* = 102

q* = 1,000 - 102 = 898. Check: qS = 694 + 2(102) = 898.

The price paid by buyers rises from Rs 100 to Rs 102 (sellers receive 102 - 3 = Rs 99) and the quantity falls from 900 to 898 units.

Results: (a) p* = Rs 100, q* = 900; (b) p* = Rs 200, q* = 800; (c) p* = Rs 102, q* = 898.

Q25 Suppose the market determined rent for apartments is too high for common people to afford. If the government comes forward to help those seeking apartments on rent by imposing control on rent, what impact will it have on the market for apartments?

Rent control is a price ceiling set below the market-determined rent. At the controlled rent, the quantity of apartments demanded exceeds the quantity supplied, so there is excess demand, a shortage of apartments. Although meant to help tenants, it leaves many people unable to find a rented flat. Those who get a flat gain, but others queue or look for unofficial routes, and some may pay extra secretly, as in a black market. The government may need to allocate the limited apartments by some form of rationing.