Chapter 9: Perfect competition in the single market

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TIMING OF A SUPPLY RESPONSE

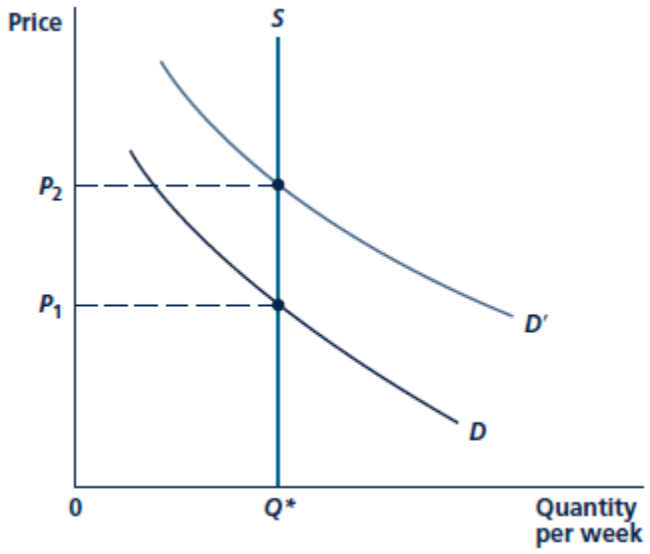
Supply response: The change in quantity of output supplied in response to a change in demand conditions.

It has been traditional in economics to discuss pricing in three different time periods: (1) the very short run, (2) the short run, and (3) the long run. Although it is not possible to give these terms an exact time length, the essential distinction among them concerns the nature of the supply response that is assumed to be possible. In the very short run, there can be no supply response–quantity supplied is absolutely fixed. In the short run, existing firms may change the quantity they are supplying but no new firms can enter the market. In the long run, firms can further change the quantity supplied and completely new firms may enter a market; this produces a very flexible supply response. This chapter discusses each of these different types of responses.

PRICING IN THE VERY SHORT RUN

In the very short run or market period, there is no supply response. The goods are already ‘‘in’’ the marketplace and must be sold for whatever the market will bear. In this situation, price acts only to ration demand. The price will adjust to clear the market of the quantity that must be sold. Although the market price may act as a signal to producers in future periods, it does not perform such a function currently since current period output cannot be changed.

Figure illustrates this situation. Market demand is represented by the curve D. Supply is fixed at Q*, and the price that clears the market is P_1. At P_1, people are willing to take all that is offered in the market. Sellers want to dispose of Q* without regard to price. The price P_1 balances the desires of demanders with the desires of suppliers. For this reason, it is called an equilibrium price. In Figure, a price in excess of P_1 would not be an equilibrium price because people would demand less than Q* (remember that firms are always willing to supply Q* no matter what the price). Similarly, a price below P_1 would not be an equilibrium price because people would then demand more than Q*. P_1 is the only equilibrium price possible when demand conditions are those represented by the curve D.



Example

A perfectly competitive market has 1,000 firms. In the very short run, each of the firms has a fixed supply of 100 units. The market demand is given by: Q = 160,000 – 10,000 P.

a. Calculate the equilibrium price in the very short run.

   Market supply: 1000 x 100 = 100,000

   At equilibrium price: $Q_d = Qs \rightarrow 160{,}000 - 10{,}000\,P = 100{,}000 \rightarrow 10{,}000P = 60{,}000 \rightarrow P = \$6$

b. Calculate the demand schedule facing any one firm in the industry.

   Q = 160,000 – 10,000 P → Q = 1000 (160 – 10P)

   demand facing any one firm = market demand / 1000 → q = 160 – 10P.

SHORT-RUN SUPPLY

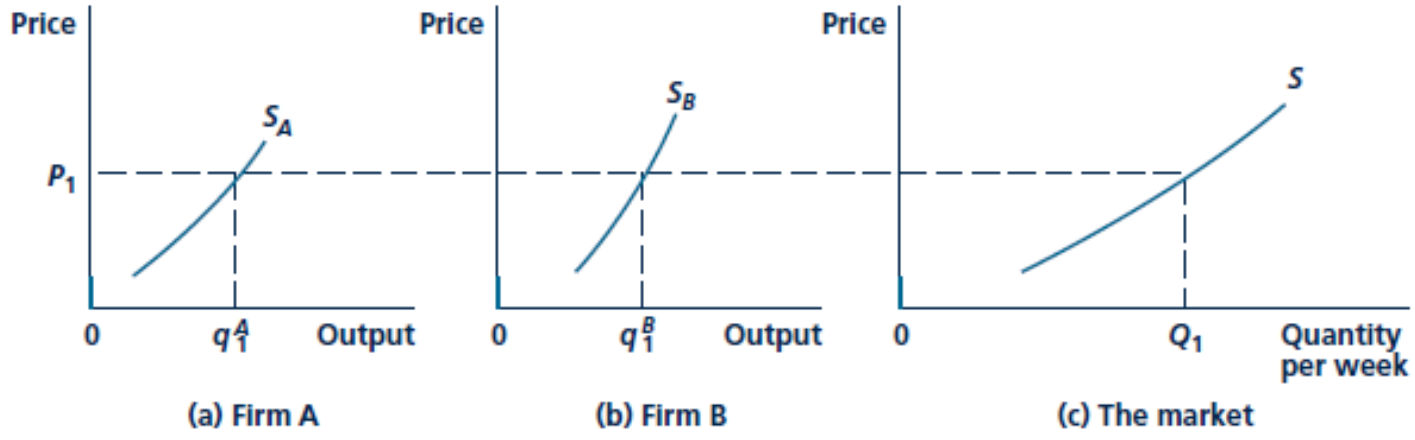
In analysis of the short run, the number of firms in an industry is fixed. There is just not enough time for new firms to enter a market or for existing firms to exit completely. However, the firms currently operating in the market are able to adjust the quantity they are producing in response to changing prices. Because there are a large number of firms each producing the same good, each firm will act as a price taker.

The firm's short-run supply curve is simply the positively sloped section of its short-run marginal cost curve above the shutdown price.

Construction of a Short-Run Supply Curve

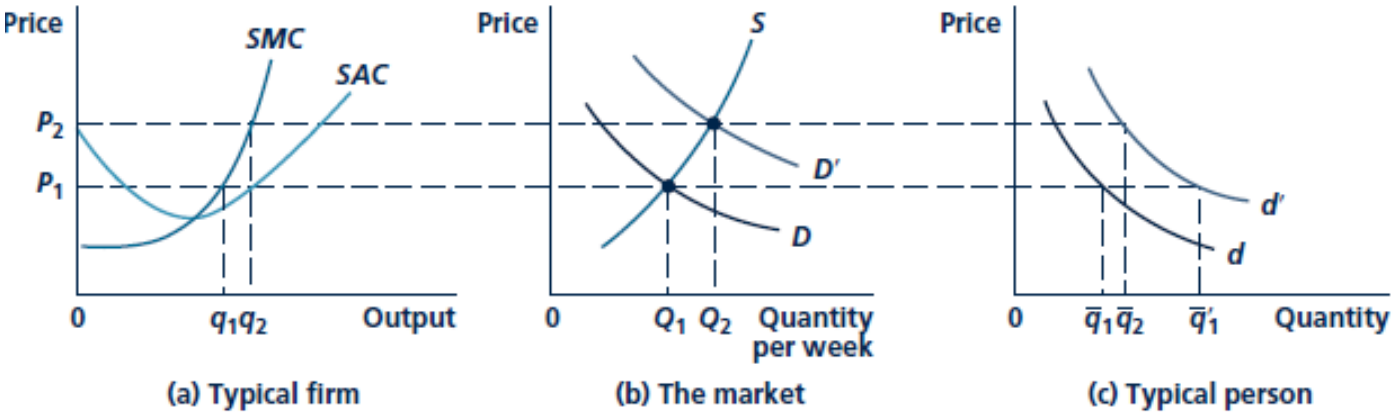
The quantity of a good that is supplied to the market during a period is the sum of the quantities supplied by each of the existing firms. Because each firm faces the same market price in deciding how much to produce, the total supplied to the market also depends on this price. This relationship between market price and quantity supplied is called a short-run market supply curve.

Short-run market supply curve: The relationship between market price and quantity supplied of a good in the short run.



SHORT-RUN PRICE DETERMINATION

We can now combine demand and supply curves to demonstrate how equilibrium prices are established in the short run. Figure below shows this process. In Figure (b), the market demand curve D and the short-run supply curve S intersect at a price of P_1 and a quantity of Q_1. This price-quantity combination represents an equilibrium between the demands of individuals and the supply decisions of firms—the forces of supply and demand are precisely balanced. What firms supply at a price of P_1 is exactly what people want to buy at that price. This equilibrium tends to persist from one period to the next unless one of the factors underlying the supply and demand curves changes.



Effect of an Increase in Market Demand

To study a short-run supply response, let's assume that many people decide they want to buy more of the good in Figure above. The typical person's demand curve shifts outward to D', and the entire market demand curve shifts. Figure (b) shows the new market demand curve, D'. The new equilibrium point is P_2, Q_2: At this point, supply-demand balance is reestablished. Price has now increased from P_1 to P_2 in response to the shift in demand. The quantity traded in the market has also increased from Q_1 to Q_2.

The rise in price has also acted as a signal to the typical firm to increase production. In Figure (a), the typical firm's profit-maximizing output level has increased from q_1 to q_2 in response to the price rise. That is the firm's short-run supply response: An increase in market price acts as an inducement to increase production. Firms are willing to increase production (and to incur higher marginal costs) because price has risen. If market price had not been permitted to rise, firms would not have increased their outputs. At P_1, there would have been an excess demand for the good in question. If market price is allowed to rise, a supply demand equilibrium can be reestablished so that what firms produce is again equal to what people demand at the prevailing market price. At the new price P_2, the typical firm has also increased its profits.

Example

Suppose there are 20 identical firms in the perfectly competitive note card industry. Each firm has a short run total cost curve of the form: $STC = \frac{1}{3} q^3 + 10q^2 + 100q + 48$, and the sort run marginal cost curve is given by: $SMC = q^2 + 20q + 100$.

a. Calculate the firm's short run supply curve with q as a function of market price (P).

   Short run supply curve is the MC curve.

   ⇨ P = MC ⇨ $P = q^2 + 20q + 100$

$P = (q + 10)^2$ ⇨ (بأخذ الجذر للطرفين) $\sqrt{p} = q + 10$ ⇨ $q = \sqrt{P} - 10$

b. Calculate the industry supply curve for the 20 firms in this industry.

Industry supply curve = the sum of the individual supply curve.

$Q = 20(\sqrt{P} - 10)$ ⇨ $Q = 20\sqrt{P} - 200$ (industry supply).

c. Suppose market demand is given by Q = 64 – 4P. What will be the short run equilibrium price?

$Q_d = Q_s$ ⇨ $20\sqrt{P} - 200 = 64 - 4P$ ⇨ $4P + 20\sqrt{P} - 264 = 0$ ⇨ $P + 5\sqrt{P} - 66 = 0$

⇨ $(\sqrt{P} + 11)(\sqrt{P} - 6) = 0$ ⇨ $\sqrt{P} - 6 = 0$ ⇨ $\sqrt{P} = 6$ ⇨ P = $36.

Short-Run Supply Elasticity

The percentage change in quantity supplied in the short run in response to a 1 percent change in price.

$$Short\ run\ supply\ elasticity = \frac{Percentage\ change\ in\ quantity\ supplied\ in\ the\ short\ run}{Percentage\ \ change\ in\ price}$$

$$E_S = \frac{\%\Delta Q_S}{\%\Delta P} = \frac{\partial Q_S}{\partial P} * \frac{P}{Q}$$

For example, if the short-run supply elasticity is 2, each 1 percent increase in price results in a 2 percent increase in quantity supplied. Over this range, the short-run supply curve is rather elastic. If, on the other hand, a 1 percent increase in price leads only to a 0.5 percent increase in quantity supplied, the short-run elasticity of supply is 0.5, and we say that supply is inelastic. As we will see, whether short-run supply is elastic or inelastic can have a significant effect on how markets respond to economic events.

- If a 1percent increase in price causes firms to increase quantity supplied by more than 1 percent, $supply\ is\ elastic\ (E_S > 1)$.
- If a 1 percent increase in price causes firms to increase quantity supplied by less than 1 percent, supply is inelastic($E_S < 1$) .
- If a 1 percent increase in price causes firms to increase quantity supplied by 1 percent, supply is unit elastic($E_S = 1$) .

Example: Suppose that the supply curve for good A is given by : $Q_S = 12 + 0.5P$. Calculate the price elasticity of supply at P=$6

$E_S = \frac{\partial Q_S}{\partial P} * \frac{P}{Q} = 0.5 * \frac{6}{15} = \frac{3}{15} = \frac{1}{5} = 0.2 < 1$ supply is inelastic

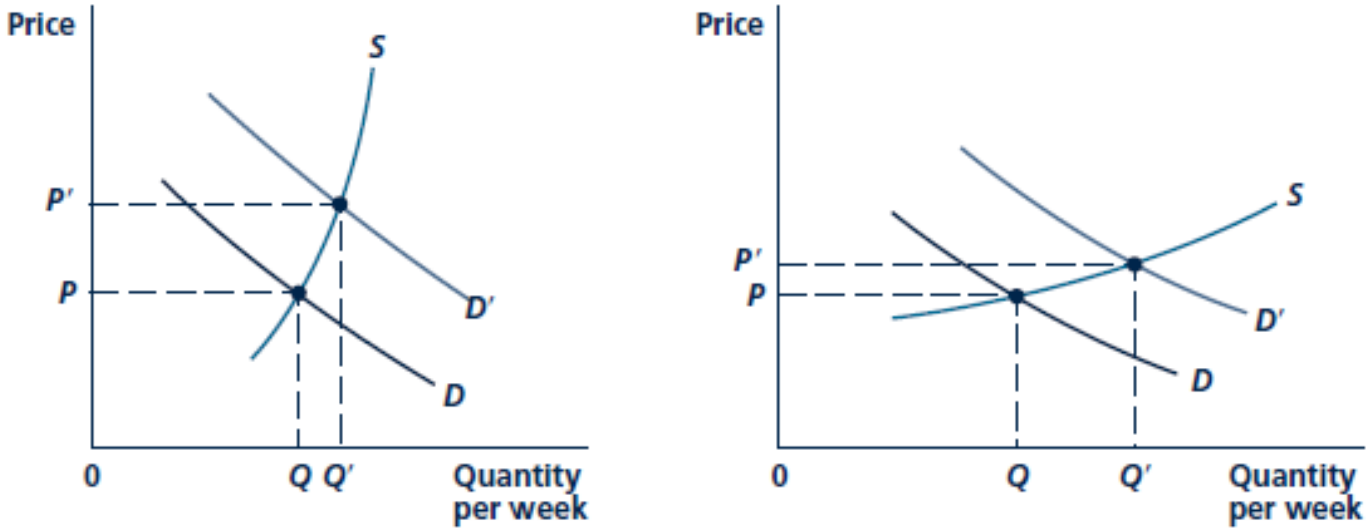
Shifts in Supply Curves and the Importance of the Shape of the Demand Curve

In panel a, the shift inward in the supply curve causes price to increase only slightly, whereas quantity contracts sharply. This results from the elastic shape of the demand curve. In panel b, the demand curve is inelastic; price increases substantially with only a slight decrease in quantity.

(a) Elastic demand (b) Inelastic demand

Shifts in Demand Curves and the Importance of the Shape of the Supply Curve

In panel a, supply is inelastic; a shift in demand causes price to increase greatly with only a small increase in quantity. In panel b, on the other hand, supply is elastic; price rises only slightly in response to a demand shift.



(a) Inelastic supply (b) Elastic supply

THE LONG RUN

In perfectly competitive markets, supply responses are more flexible in the long run than in the short run for two reasons. First, firms' long-run cost curves reflect the greater input flexibility that firms have in the long run. Diminishing returns and the associated sharp increases in marginal costs are not such a significant issue in the long run. Second, the long run allows firms to enter and exit a market in response to profit opportunities.

Equilibrium Conditions

A perfectly competitive market is in long-run equilibrium when no firm has an incentive to change its behavior. Such an equilibrium has two components: Firms must be content with their output choices (that is, they must be maximizing profits), and they must be content to stay in (or out of) the market.

Profit Maximization

As before, we assume that firms seek maximum profits. Because each firm is a price taker, profit maximization requires that the firm produce where price is equal to (long-run) marginal cost. This first equilibrium condition, P = MC, determines both the firm's output choice and its choice of a specific input combination that minimizes these costs in the long run.

Entry and Exit

A second feature of long-run equilibrium concerns the possibility of the entry of entirely new firms into a market or the exit of existing firms from that market. The perfectly competitive model assumes that such entry and exit entail no special costs. Consequently, new firms are lured into any market in which (economic) profits are positive because they can earn more there than they can in other markets.

Similarly, *firms leave a market when profits are negative*. In this case, firms can earn more elsewhere than in a market where they are not covering all opportunity costs. *If profits are positive, the entry of new firms causes the short-run market supply curve to shift outward* because more firms are now producing than were in the market previously. Such a shift causes market price (and market profits) to fall. The process continues until no firm contemplating entering the market would be able to earn an economic profit. At that point, entry by new firms ceases and the number of firms has reached an equilibrium. When the firms in a market suffer short-run losses, some firms choose to leave, causing the supply curve to shift to the left. Market price then rises, eliminating losses for those firms remaining in the marketplace.

Long-Run Equilibrium

we initially assume that all the firms producing a particular good have the same cost curves, that is, we assume that no single firm controls any special resources or technologies. Because all firms are identical, *the equilibrium long-run position requires every firm to earn exactly zero economic profits*. In graphic terms, long-run equilibrium price must settle at the low point of each firm's long-run average total cost curve. Only at this point do the two equilibrium conditions hold: P = MC (which is required for profit maximization) and P = AC (which is the required zero-profit condition).

These two equilibrium conditions have rather different origins. Profit maximization is a goal of firms. The P = MC rule reflects our assumptions about firms' behavior and is identical to the output-decision rule used in the short run. The zero profit condition is not a goal for firms. Firms would obviously prefer to have large profits. The long-run operations of competitive markets, however, force all firms to accept a level of zero economic profits (P = AC) because of the willingness of firms to enter and exit. Although

the firms in a perfectly competitive industry may earn either positive or negative profits in the short run, in the long run only zero profits prevail.

A long run competitive equilibrium occurs when three conditions hold:

- All firms in the industry are maximizing profit (P = MC)
- No firms have an incentive either to enter or exit the industry because all firms are earning zero economic profit (P = ATC)

In the long-run equilibrium: <u>MC = ATC</u>

<u>Example</u>

Gasoline is sold thought local gasoline stations under perfectly competitive conditions. All gasoline station owners face the same long run average cost curve given by: $AC = 0.01q - 1 + \frac{100}{q}$ and the same long run marginal cost curve given by: MC = 0.02q – 1, where q is the number of gasoline sold per day.

a. Assuming the market is in the long run equilibrium, how much gasoline will each individual owner sell per day? What are the long run average cost and marginal cost at this output level?

In the long-run equilibrium: $MC = AC \Rightarrow 0.01q - 1 + \frac{100}{q} = 0.02q - 1$

$\Rightarrow \frac{100}{q} = 0.01q \Rightarrow 0.01q^2 = 100 \Rightarrow q^2 = 10{,}000 \Rightarrow q = 100$ gallon per day

$AC = 0.01q - 1 + \frac{100}{q}$ when $q = 100 \Rightarrow AC = 0.01(100) - 1 + 100/100 = 1 - 1 + 1 = 1$

MC = 0.02q – 1 when $q = 100 \Rightarrow MC = 0.02(100) - 1 = 2 - 1 = 1$.

b. The market demand for gasoline is given by: Q = 2,500,000 – 500,000P. Given your answer to part a, what will be the price of gasoline in long run equilibrium? How much gasoline will be demanded and how many gas station will there be?

P = MC = AC = 1

Q = 2,500,000 – 500,000P when $P = 1 \Rightarrow Q = 2{,}500{,}000 - 500{,}000\,(1) = 2{,}000{,}000$ gallon per day

# of gas station = total demand / amount of gasoline will each individual owner sell per day

# of gas station = 2,000,000 / 100 = 20,000 gas station

Example

Kim's company makes dachshund refrigerator magnets. The total cost function is T $C = 9 + 3q + q^2$, where q=packets of magnets. $MC = 3 + 2q$. The market price is $11.

a. How many packets will she supply in the short run?

   Short run supply curve = MC curve ⇨ S : P = 3 + 2q

   P = 3 + 2q ⇨ 11 = 3 + 2q ⇨ 2q = 8 ⇨ q = 4 packets

b. How much profit will she earn?

   Profit = TR - TC = Pq - TC = 11q - 9 - 3q − q² = 8q −q² - 9

   Profit = 8(4) - (4)² − 9 = 32 - 16 - 9 = 32 - 25 = $7

c. What is Kim's shut-down point?

   Shut down price = when AVC = MC

   VC = 3q + q² ⇨ AVC = 3 + q MC = 3 + 2q

   3 + q = 3 + 2q ⇨ q = 0

   AVC = 3 + 0 = 3 → shut down price = $3.

d. Is the price likely to stay at $11 in the long run? What will be the price in the long run equilibrium if this is a constant-cost market?

   In long runs equilibrium: MC = ATC ⇨ 3 + 2q = $\frac{9}{q}$ + 3 + q ⇨ q = $\frac{9}{q}$ ⇨ q² = 9 ⇨ q = 3

   From supply curve: P = 3 + 2q ⇨ P = 3 + 2(3) ⇨ P = $9

   In the long run the price decrease to $9.

LONG-RUN SUPPLY: THE CONSTANT COST CASE

Constant cost case: A market in which entry or exit has no effect on the cost curves of firms.

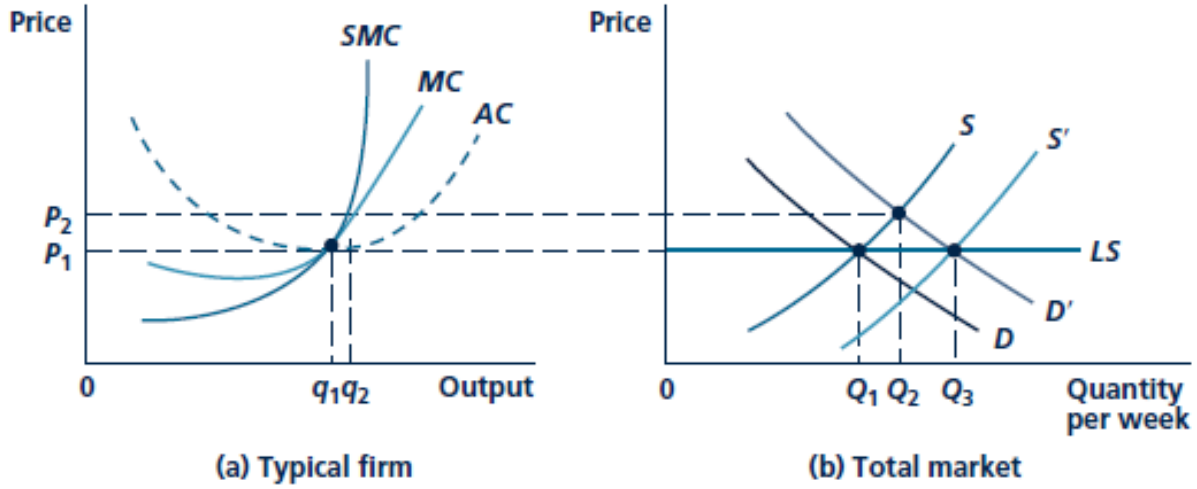
The typical firm will produce output level q1 which results in Q_1 in the market. The typical firm is maximizing profits since price is equal to long-run marginal cost. The typical firm is earning zero economic profits since price equals long-run average total costs. There is no incentive for exit or entry.

If demand increases to D', the short-run price will increase to P_2. A typical firm will maximize profits by producing q_2 which will result in short-run economic profits (P_2 > AC). Positive economic profits cause new firms to enter the market until economic profits again equal zero.

Since costs do no increase with entry, the typical firm's costs curves do not change. The supply curve shifts to S' where the equilibrium price returns to P_1 and the typical firm produces q_1 again. The new long-run equilibrium output will be Q_3 with more firms in the market.

Regardless of the shift in demand, market forces will cause the equilibrium price to return to P_1 in the long-run. The long-run supply curve is horizontal at the low point of the firms long-run average total cost curves.

FIGURE 9.7 Long-Run Equilibrium for a Perfectly Competitive Market: Constant Cost Case

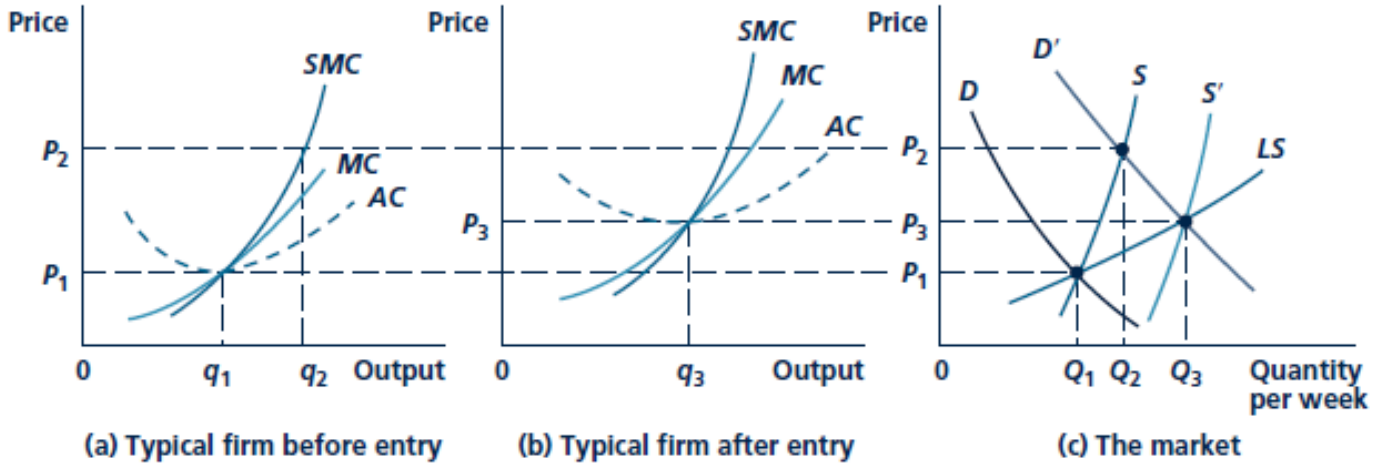


Long-Run Supply Curve: The Increasing Cost Case:

The *increasing cost case* is a market in which the entry of firms increases firms' costs. (New firms may increase demand for scarce inputs driving up their prices).

The increase in demand to D', with short-run supply curve S, causes equilibrium price to increase to P_2 with the typical firm producing q_2 resulting in positive profits. The positive profits entice firms to enter which drives up costs. The typical firm's new cost curves are shown in Figure (b). The new long-run equilibrium price is P_3 with market output Q_3. The long-run supply curve, LS, is positively sloped because of the increasing costs.

FIGURE 9.8 Increasing Costs Result in a Positively Sloped Long-Run Supply Curve



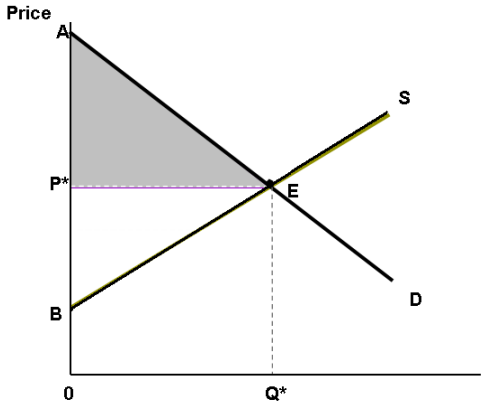
CONSUMER AND PRODUCER SURPLUS

Consumer surplus is the extra value individuals receive from consuming a good over what they pay for it.

In the Figure, the equilibrium price and quantity are P* and Q*.

The demand curve, D, shows what people are willing to pay for the good. The total value of the good to buyers is given by the area below the demand curve from Q = 0 to Q = Q* (AEQ*0).

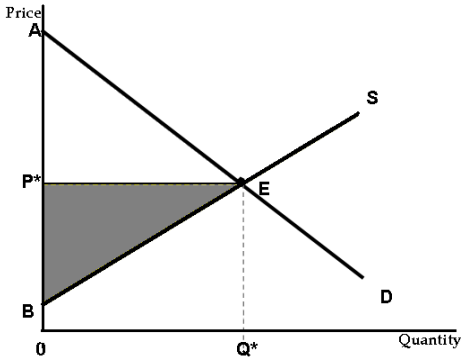
Consumers expenditures for Q* are given by the area P*EQ*0. Consumers receive a "surplus" (total value less what they pay) equal to the area AEP*, which is shaded gray in Figure.



Consumer surplus = consumer willing to pay − market price

Producer surplus is the extra value producers get for a good in excess of the opportunity costs they incur for producing it. *It can also be defined as s the difference between the actual price a producer receives and the minimum acceptable price.*

At the equilibrium shown in Figure, producers receive total revenue equal to the area P*EQ*0. If producers sold one unit at a time at the lowest possible price, producers would have been willing to produce Q* for the payment of BEQ*0. Thus, producer surplus the area P*EB shaded in green in Figure.



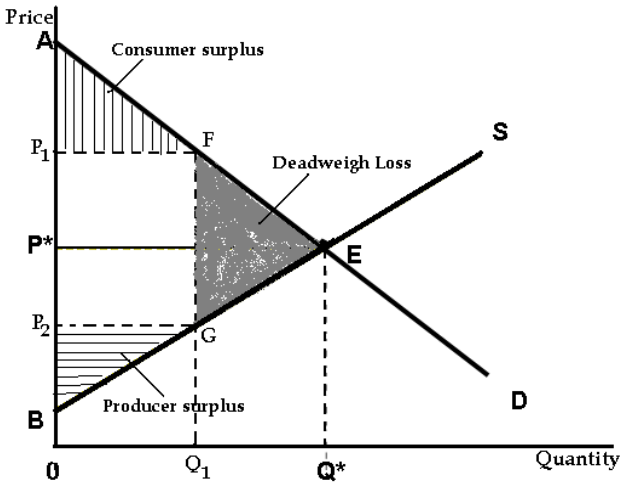
Producer surplus = Actual (market) price − minimum acceptable price

Equilibrium and Consumer/Producer Surplus

At the equilibrium quantity (Q), the sum of consumer surplus and producer surplus is maximized*. For an output level less than Q*, say Q1, there is a deadweight loss of consumer and producer surplus given by the area FEG.

If output is less than equilibrium output:

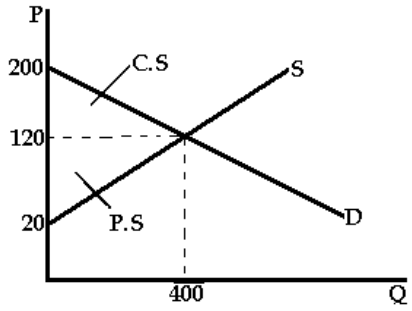
Consumer surplus become the area: AFP1
Producer surplus become the area: BGP2.
⇨ Deadweight loss = the area FEG.



Example

Suppose that the demand for broccoli is given by: $Q = 1000 - 5P$. Where Q is quantity per year measured in hundreds of bushels and P is price in dollars per hundred bushels. The long run supply curve for broccoli is given by: $Q = 4P - 80$.

a. What is the equilibrium price and quantity for broccoli?



At equilibrium: $Q_d = Q_s \Rightarrow 1000 - 5P = 4P - 80 \Rightarrow 9P = 1080$

$\Rightarrow P = 1080/9 = \$120$

$Q = 1000 - 5P = 1000 - 5(120) = 1000 - 600 = 400$ hundreds of bushels.

b. What is consumer and producer surplus at this equilibrium?

From demand curve: P = 200 - 0.2Q

From supply curve: P = 0.25Q + 20

Consumer surplus = ½ {(400) x (200 - 120)} = $16,000

Producer Surplus = ½ {(400) x (120 - 20)} = $20,000.

c. How much in total consumer and producer surplus would be lost if Q = 300 instead of Q = 400? What are the deadweight losses?

New consumer surplus = ½{(300) (200 - 140)} = $9,000

New producer surplus = ½{(300) (95 - 20)} = $11,250

Losses in consumer surplus = 16,000 - 9,000 = $7,000

Losses in producer surplus = 20,000 - 11,250 = $8,750

Deadweight losses = ½ {(400 - 300) x (140 - 95)} = $2,25