Chapter 10

Perfect Competition

Introduction:

To an economist, a competitive firm is a firm that does not determine its market price. This type of firm is free to sell as many units of its good as it wishes without affecting the market price. Consequently, the challenge in this circumstance is not deciding what price to charge consumers, but rather what **quantity** to produce at the prevailing market price. We will explore these decisions in the short and long-runs with the assumption that the firm pursues the goal of profit maximization.

The Competitive Firm

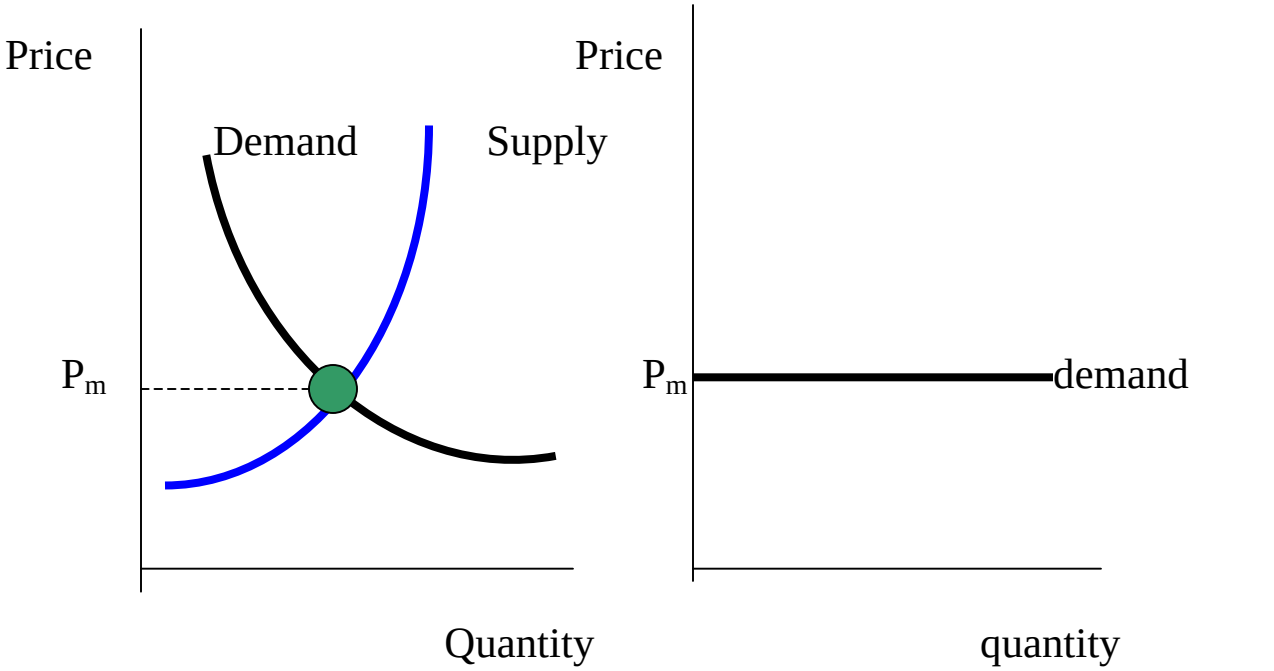
Assumptions:

1)Many firms.

2) Each produces a homogeneous product.

3) Firm is a price taker (market price is independent of the number of units sold by each firm).

4) Firm's demand function is a horizontal line at the market price.



Market Demand and Supply

Demand Function for the firm.

Perfect Competition

- Conditions for Perfectly competitive markets
  - Product firms are perfect substitutes (*homogeneous product)*
  - Firms are price takers Reasonable with many firms, all with very small market share
  - Perfect and symmetric information
  - Long run: Perfect factor mobility
  - Capital and labor flow freely all firms face same factor prices
  - Free entry and exit of firms (*no barriers to entry)*
- This Chapter
  - How do firms in perfectly competitive market choose?
  - What forces drive the market price and quantity?
  - Long run vs short-run
  - Welfare properties of perfectly competitive markets

Organization

Setup

- Competitive markets in the short run
  - The quantity chosen by the firm
  - Aggregating individual supply curves to market supply curve
  - The market equilibrium
- Digression: Welfare revisited
- Competitive markets in the long run
- Welfare in competitive markets

Definition of Profits

- Economic profit:
  - is defined as the difference between total revenue and total cost, where total cost includes fixed cost (implicit cost/opportunity cost) and variable cost (explicit cost)
- Accounting profit:
  - is defined as the difference between total revenue and all explicit costs incurred.
- Here we consider economic profit.

Competitive markets: the short run

11.3 Competitive markets in the short run

Short run (in this context)

- # firms is fixed (no entry or exit)

(a) The short-run quantity decision

- Firms take price as given
- Firms face short-run cost curves (as capital is fixed)

Problem of the competitive firm:

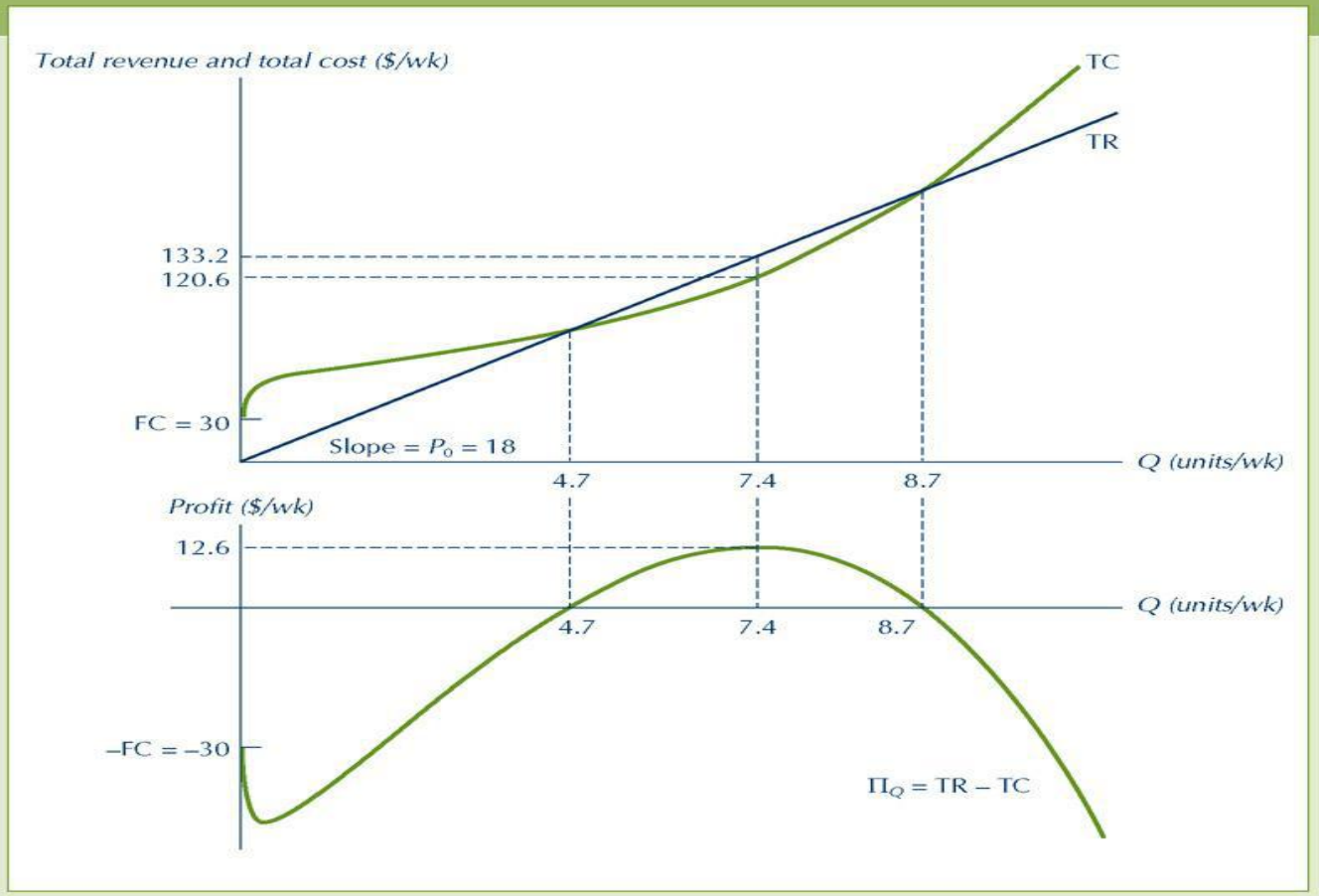
$$\max_{q} pq - C(Q)$$

- In words, choose q so as to maximize profits given the price of output (and input prices)
  - Necessary condition: marginal benefit (MB) = marginal cost (MC).
  - $p - C'(q) = 0$, that is p=MC(q) (with price taking behavior)
  - Here, necessary condition p=MC(q), to get optimum q

Competitive market in the short run

FIGURE 11-2

Revenue, Cost, and Economic Profit
The total revenue curve is the ray labelled TR in the top panel. The difference between it and total cost (TC in the top panel) is economic profit (Π_Q in the bottom panel). At $Q = 0$, $\Pi_Q = -FC = -\$30/wk$. Economic profit reaches a maximum ($12.60/wk) for $Q = 7.4$ units/wk.

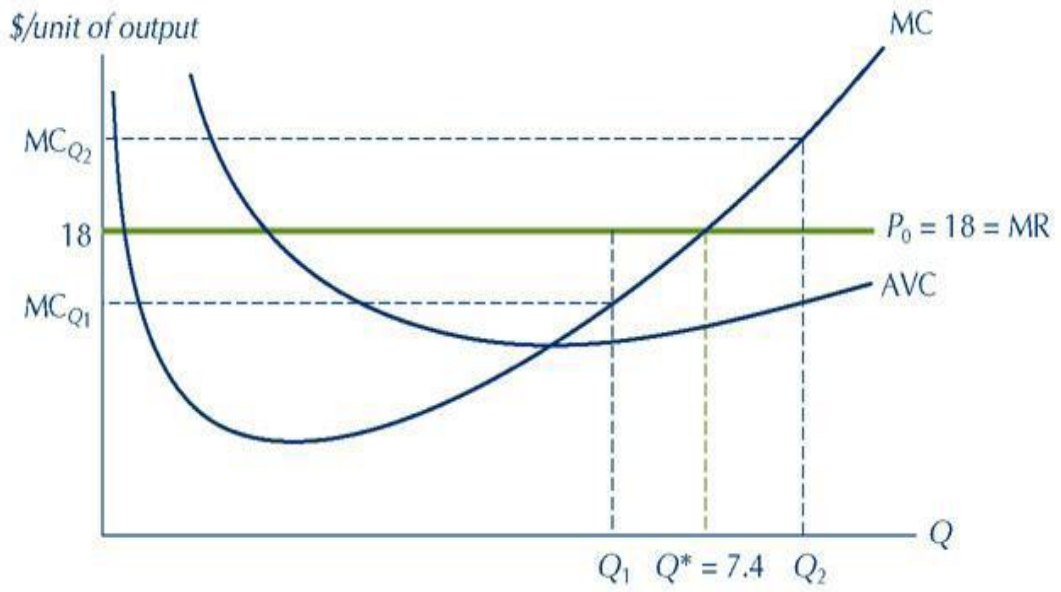


Competitive market in the short run

FIGURE 11-3

The Profit-Maximizing Output Level in the Short Run

A necessary condition for profit maximization is that price equal marginal cost on the rising portion of the marginal cost curve. Here, this happens at the output level $Q^* = 7.4$ units/wk.



The Short-Run Supply Function of A Competitive Firm

In the short-run, the supply function of a competitive firm shows the quantity supplied at each price when one factor of production is fixed.

Assumption: The firm attempts to maximize profit by constantly adopting cost saving technologies in order to:

- survive
- avoid a takeover

Short-Run Profit is denoted as:

Profit = Revenues – Costs

$$\Pi(q) = (P \times q) - [V(q) + F]$$

$$\Pi(q) = (P \times q) - V(q) - F$$

When the firm decides to shut down production, [q=0], the firm loses (-F). That is, profit is equal to minus fixed cost.

In the short run, the firm will only engage in production if total revenue is equal or greater than total variable cost.

$$\boxed{Pq \geq V(q)}$$

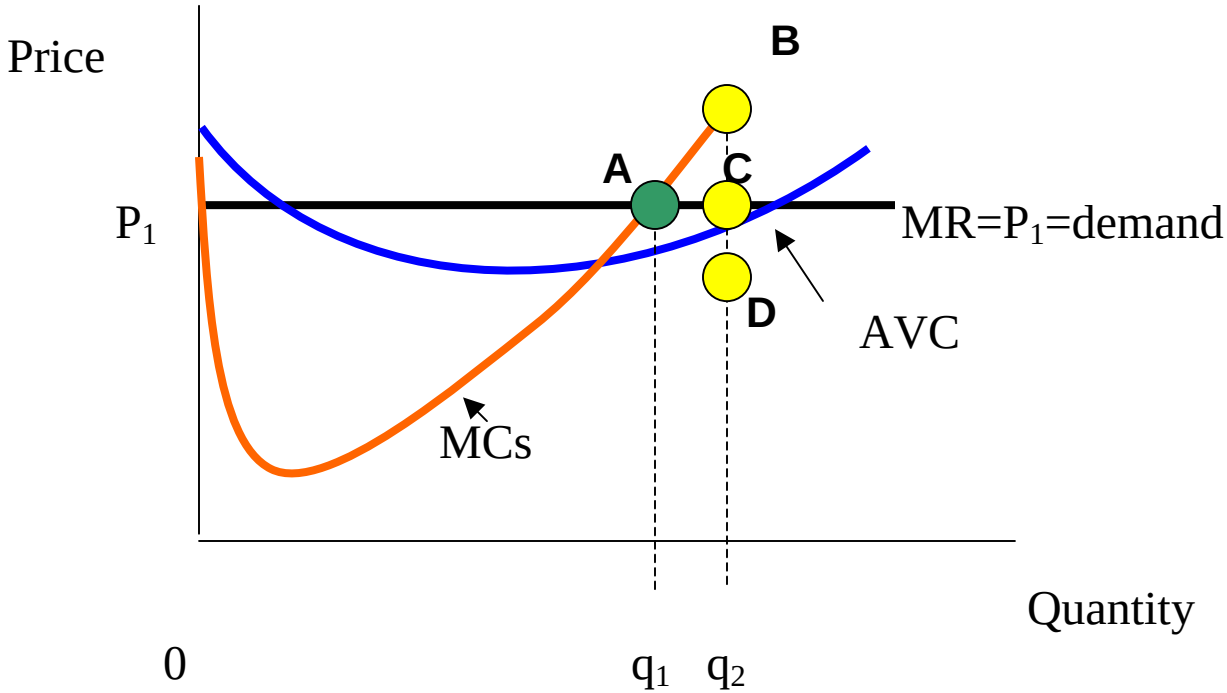
In the short run, the fixed cost is a sunk cost, and therefore the quantity produced does not depend on the size of fixed cost.

Deriving The Output That Maximizes Total Short-Run Profits

In the short run, we will assume that capital is fixed. To maximize short run profits, the firm selects a level of output where marginal revenue, MR, equals short-run marginal cost.

$$MR = P = MC_s(q)$$

"A competitive firm produces a quantity where price equals short-run marginal cost, and marginal cost is rising."



The firm's horizontal demand function is located at the market price P_1.

The firm maximizes short-run profits by producing q_1 units where $MR=P_1=MCs$.

Total profit will fall if the firm produces a larger or smaller output than q_1.

The Short-Run Supply Function of A Competitive Firm

By applying the MR=P=MCs rule, we have derived one point on the firm's short-run supply function. I.e. At price P_1, the firm should supply q_1 units.

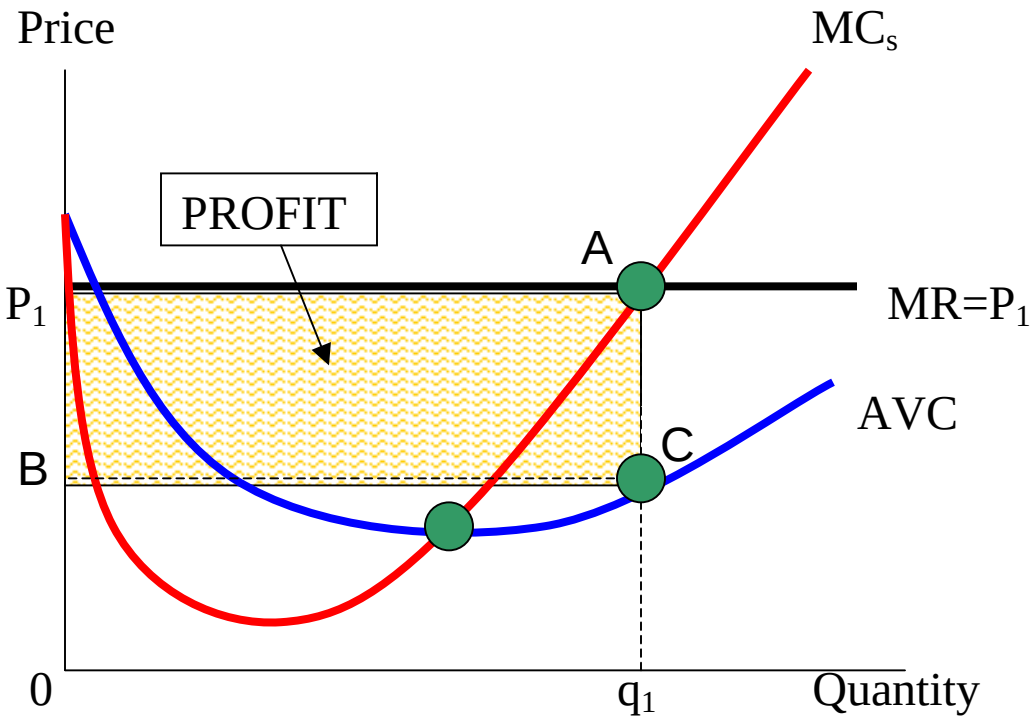
The quantity the firm supplies at any price can also be found by using this rule for profit maximization.

Consequently, the firm's short-run marginal cost function is the firm's short-run supply function where total revenue equals or is greater than total variable cost.

The firm's short-run marginal cost function is the firm's short-run supply function as long as total revenue $\geq$ total variable cost.

Note:

You need to know the position of the SAC curve in order to determine whether the firm's is making a profit or a loss in the short-run. But the firm can determine its short-run profit maximizing output without knowing whether it is earning a profit or a loss. If a firm sets output where price equals short-run marginal cost, it is operating as well as it can at the given price level.



When the price is equal or greater than minimum average variable cost, the firm will maximize its profit by producing where MC=MR.

When the market price is P_1, the firm supplies q_1 units.

Total revenue equals the area $0P_1 Aq_1$.
Total variable cost equals $0BCq_1$.
Since TR>TVC, the firm will make a profit in the short run.

Competitive market in the short run

(b) Short-run supply curve of the individual firm

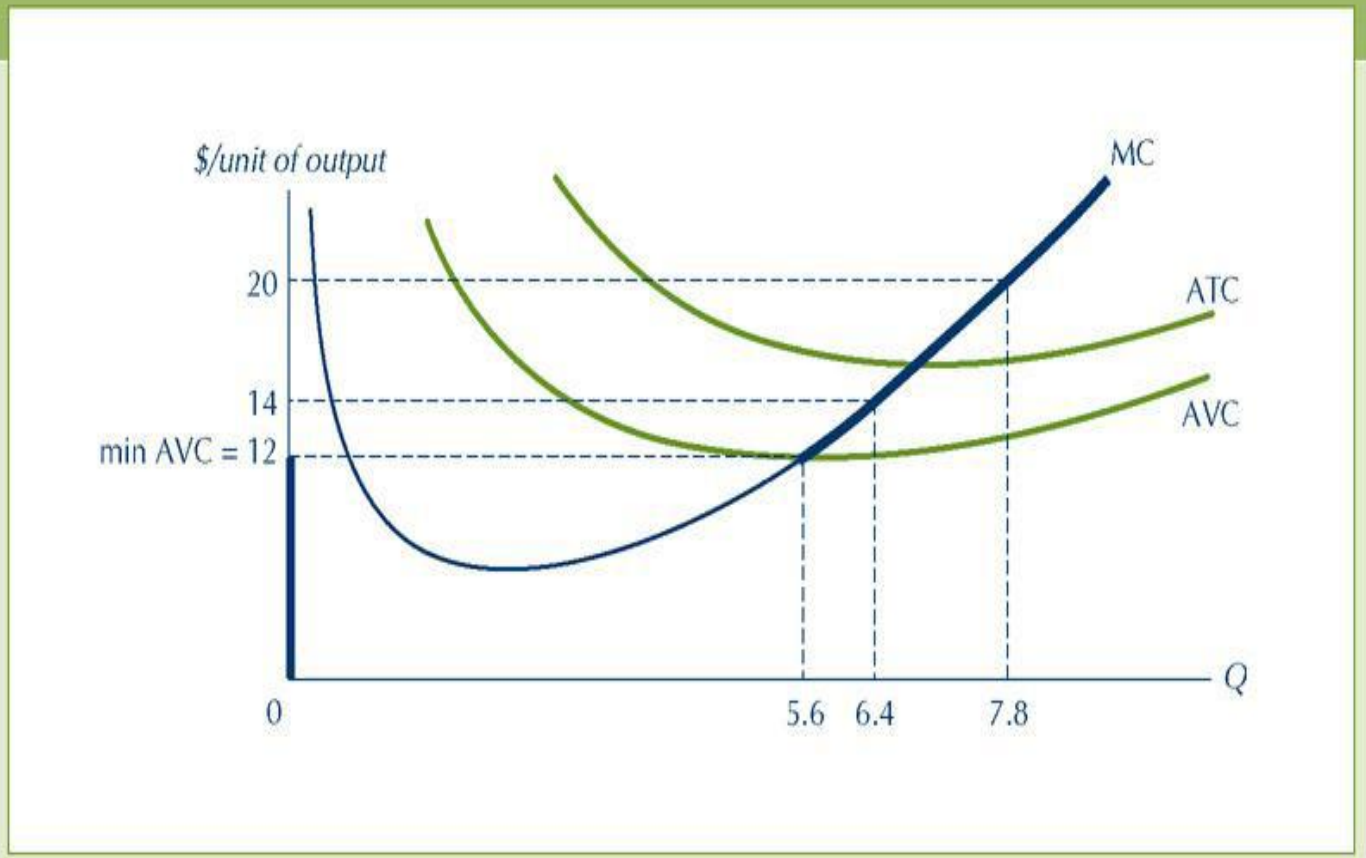
- Supply curve: curve relating price and quantity supplied
- Supply curve coincides with MC curve, but…
- Only if price exceeds average variable costs p>AVC(q).
- This way at least the variable costs are covered, other wise the firm will shut down.
- Condition to stay in business: p>=AVC

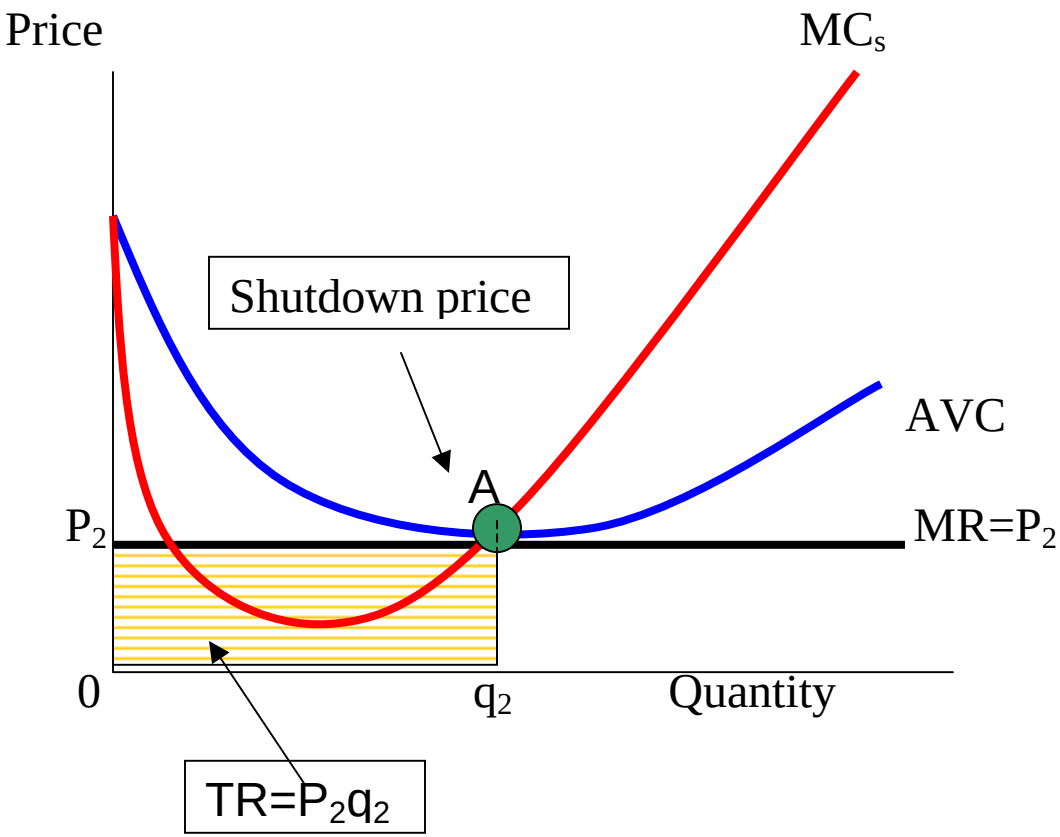
Competitive market in the short run

FIGURE 11-4

The Short-Run Supply Curve of a Perfectly Competitive Firm

When price lies below the minimum value of average variable cost (here \$12/unit of output), the firm will make losses at every level of output, and will keep its losses to a minimum by producing zero. For prices above min AVC, the firm will supply that level of output for which P = MC on the rising portion of its MC curve.





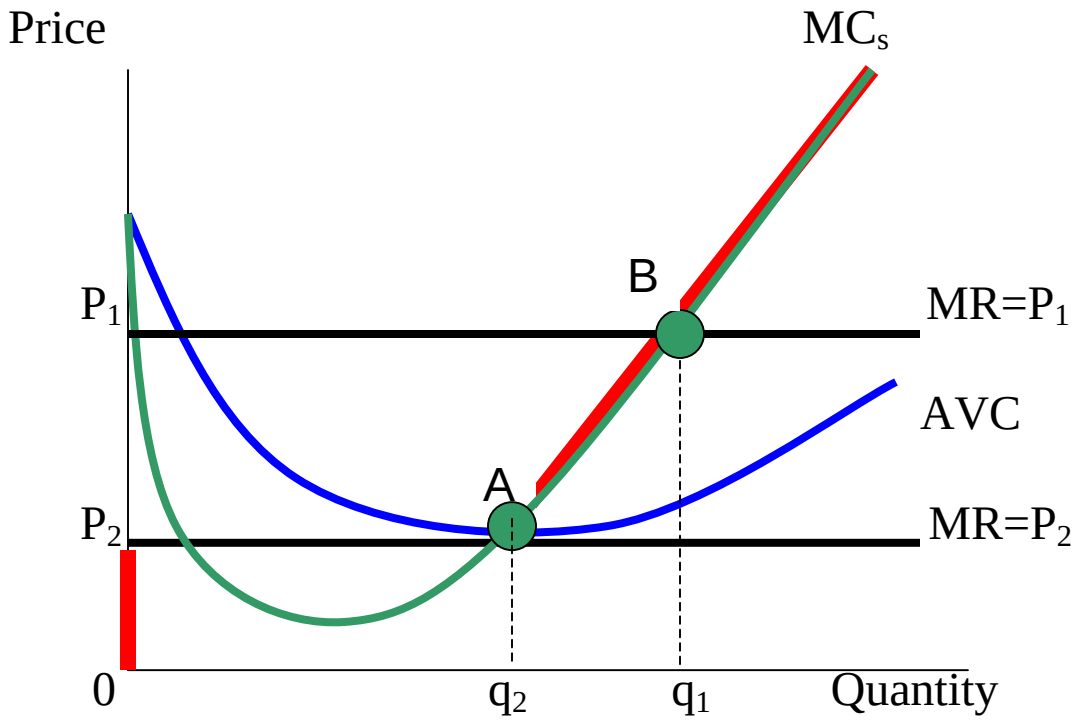
Suppose the market price is P_2. The firm supplies q_2 units.

In this instance, the market price P_2 equals the short-run marginal cost and minimum average variable cost.

Total revenue= total variable cost.

If the market price is less than P_2, total revenue is less than total variable cost. The firm will supply nothing and incur the loss equal to fixed cost, rather than incur a larger loss.

P_2 is referred to as the **shutdown price**.



The firm's short-run <u>supply</u> function consists of two parts:

- The red vertical line from 0 to P_2.
- The red line/ short-run marginal cost curve for price above P_2.

Competitive market in the short run

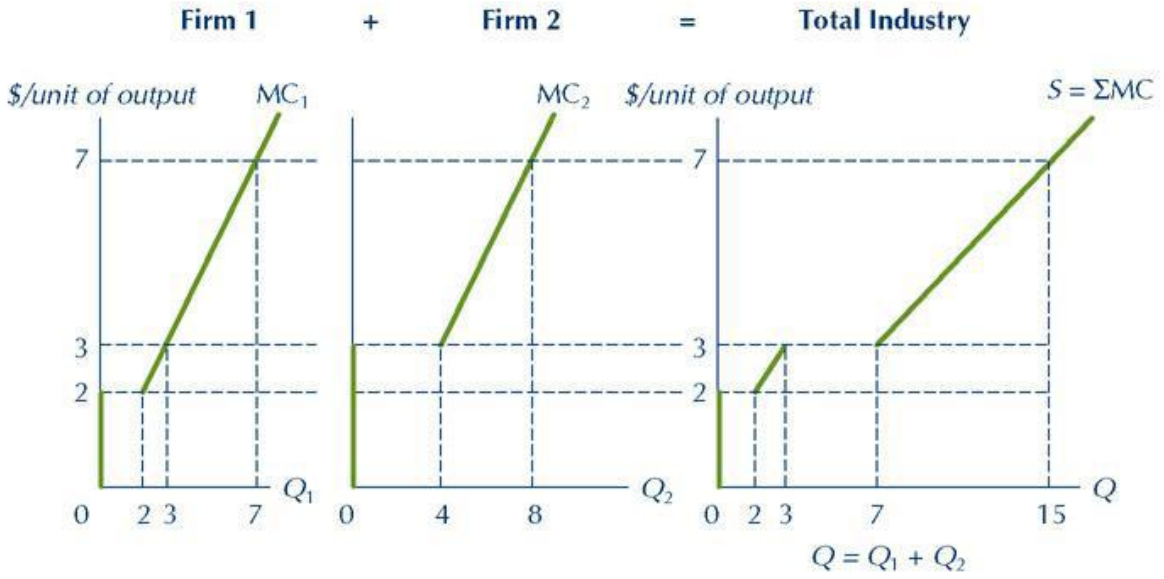
(c) Short-run market supply

- Aggregate Supply Curve: aggregating ("Add up") supplied quantities across all firms in industry. Qagg= q1+q2+…+qn

Competitive market in the short run

FIGURE 11-5

The Short-Run Competitive Industry Supply Curve
To get the industry supply curve (right panel), we simply add the individual firm supply curves (left and centre panels) horizontally.



Competitive market in the short run

(d) Market equilibrium in the short run

- Short-run market equilibrium (definition)
  - Firms maximize profits
  - Consumers maximize utility given budget restriction
  - No excess demand or supply (demand = supply)

Short-Run Industry Equilibrium

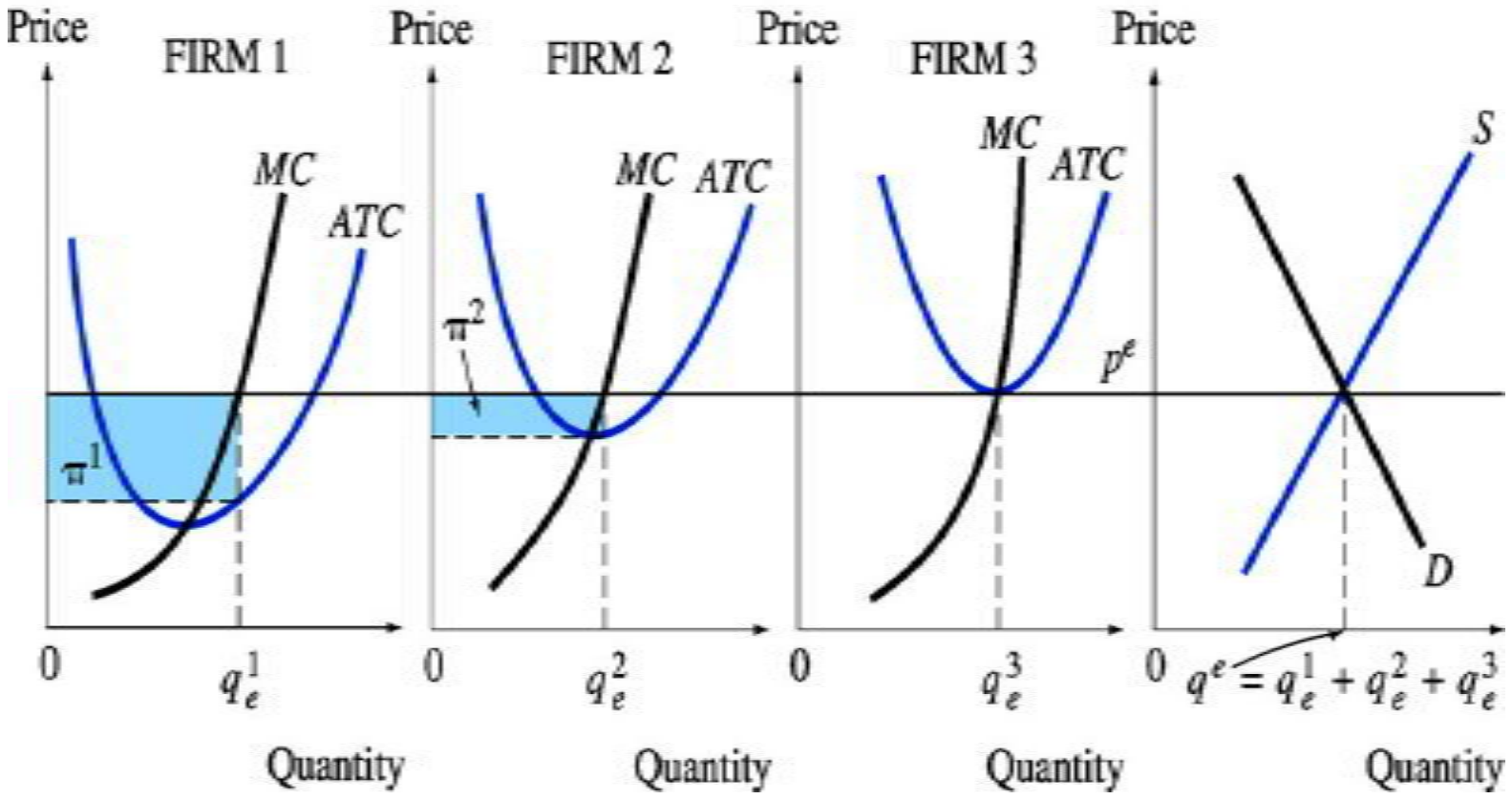
Conditions:

No firm within the industry can change the "fixed" factor of production.

No new firms can enter the industry.

Hence, a competitive industry is in short-run equilibrium if the firms in the industry have no incentive to change the quantity they produce.

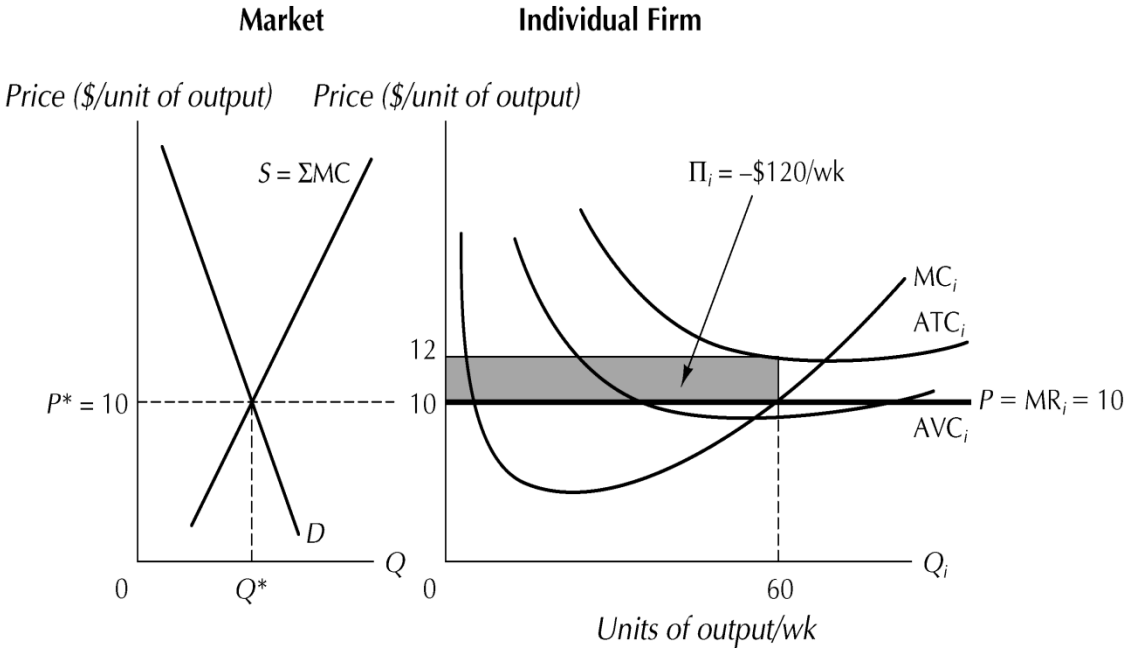
What's going on here?



Competitive markets in short run

(d) Market equilibrium in the short run

- In the SR, firms can make a loss
- The idea is that producing results in a loss of that is smaller than not producing at all (can be due to fixed cost).



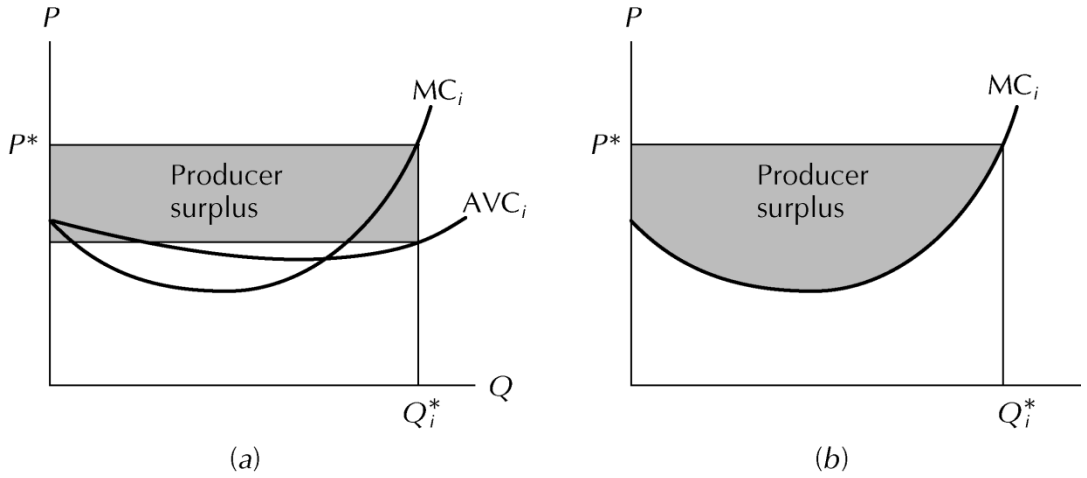
Welfare

Welfare Implication.

- Consumer surplus (CS) = the measure of consumer welfare
  - CS expresses by how much consumers value access to market i.e. Area under demand curve and above price level
- Producer surplus (PS) = the measure of producer welfare
  - PS expresses by how much producers value access to market i.e. profits (or loss) + fixed costs for individual firm i.e. area between MC curve and price level for all firms in industry

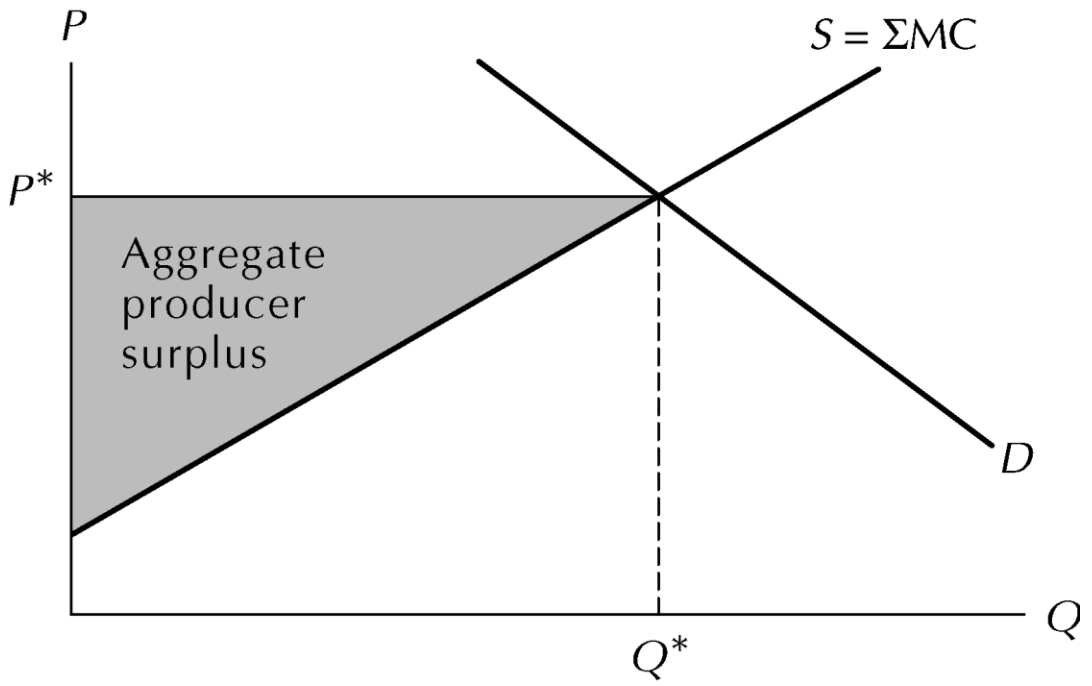
Welfare:
Producer surplus of the individual firm

FIGURE 11-9
Two Equivalent Measures of Producer Surplus



Welfare

FIGURE 11-10
Aggregate Producer Surplus When Individual Marginal Cost Curves Are Upward Sloping Throughout



Welfare

- *Total surplus = the measure of social welfare (welfare of society, also known as **social surplus**)*
- Expresses by how much all agents in society (all consumers, producers, and government) value access to market
- Measure total surplus by area between MC curve and demand curve

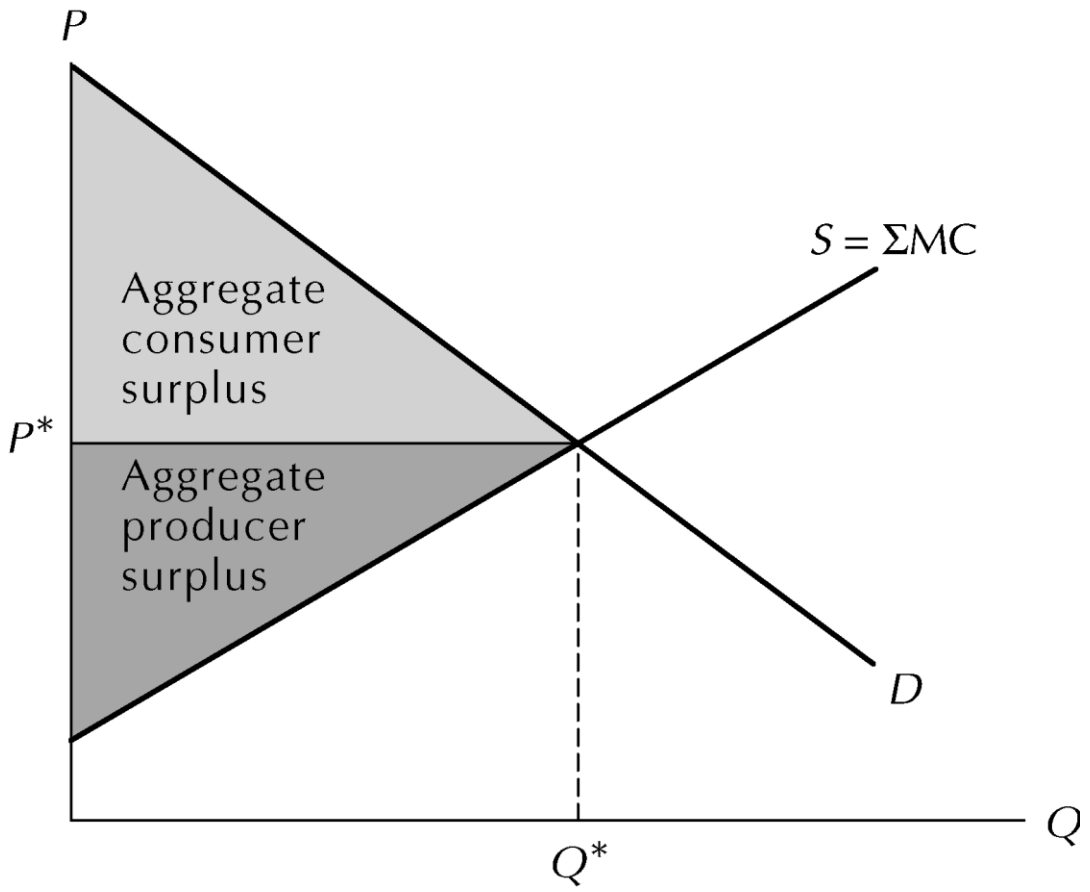
Competitive markets, the short run (cont.)

(e) Important property competitive markets: allocative efficiency

- No scope for further beneficial trades between consumers and firms
- Total welfare or social surplus is maximized
- One way to see this: p=MC(q). That is: “willingness to pay (p) is exactly equal to extra cost to produce (C’(q))”
- Another way to see this: No better Q than Q*

Competitive markets, the short run (cont.)

FIGURE 11-11
The Total Benefit from Exchange in a Market



Competitive markets, the long run

11.8-11.11 Competitive markets in the long run

- *Long-run market equilibrium (definition)*
  - Firms choose output optimally
  - Consumers maximize utility given budget restriction
  - Firms choose inputs optimally
  - There are no incentives to enter or exit from the market, that is:
  - no extra-normal profits or losses
  - No excess demand or supply (demand = supply)

When we refer to an industry being in a **state of equilibrium**, we are referring to an industry where the market price and quantity produced is stable given the market demand and supply functions. No firm outside the industry desires to enter the industry and no firm within the industry leaves.

Long-Run Industry Equilibrium

Conditions:

All factors of production are variable.
Firms can enter or exit from the industry

Hence, a competitive industry is in long run equilibrium if:

►Each firm has no incentive to change its method of production or the amount of output.

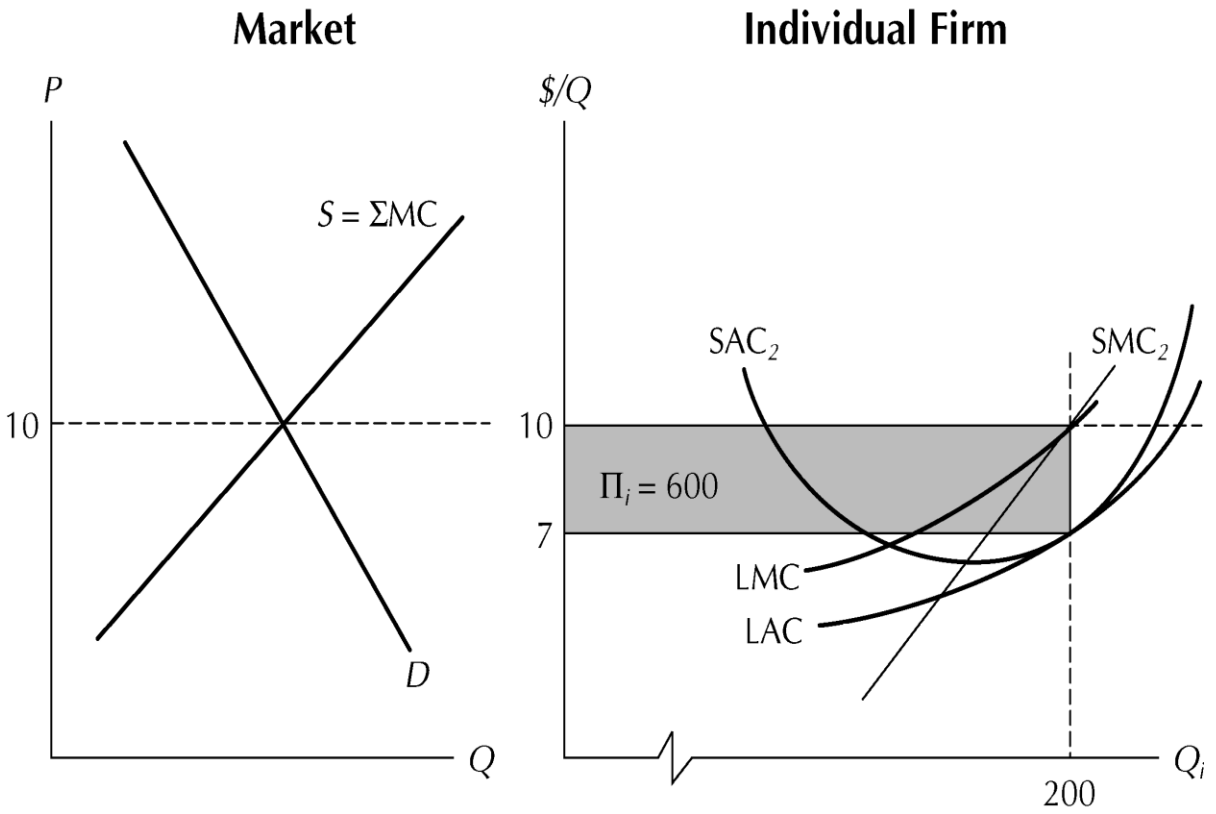
►Profits are zero, so the firm has no incentive to enter or exit the industry.

Competitive markets, the long run

From SR to LR competitive market equilibrium

Before entry or exit

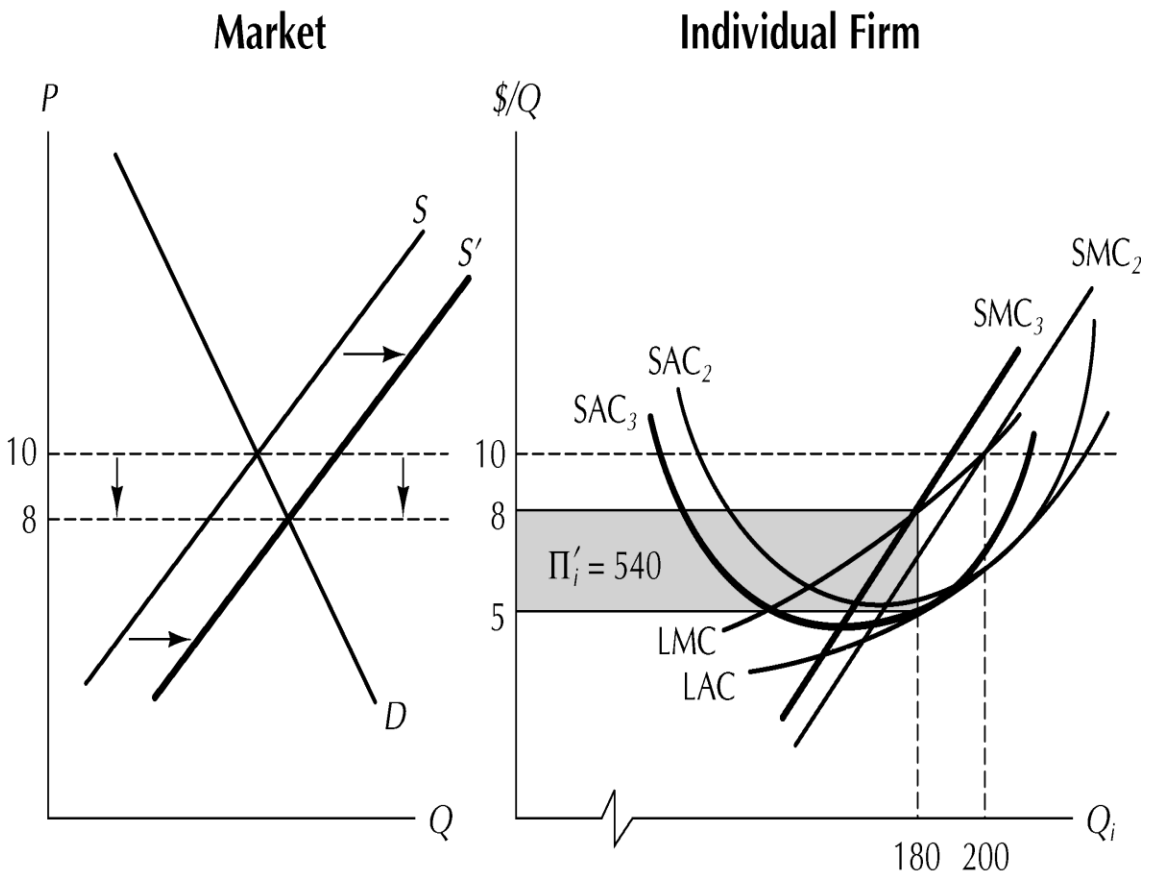
FIGURE 11-13
A Price Level That Generates Economic Profit
At the price level *P = $10/unit, the firm has* adjusted its plant size so that SMC2 = LMC =10.
At the profit-maximizing level of output, *Q = 200, the* firm earns an economic profit equal to $600 each time period



Competitive markets, the long run

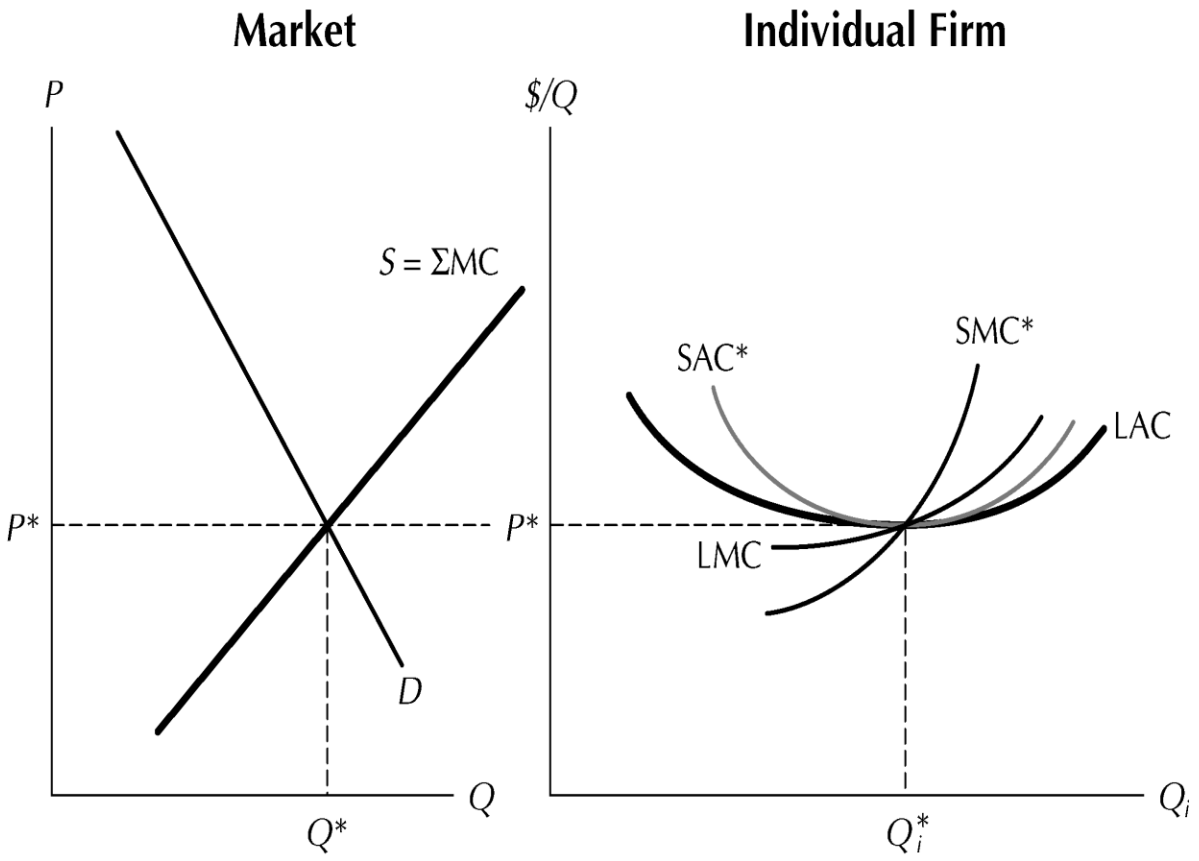
Profits induce market entry:

FIGURE 11-14
A Step Along the Path Toward Long-Run Equilibrium
Entry of new firms causes supply to shift rightward, lowering price from 10 to 8. The lower price causes existing firms to adjust their capital stocks downward, giving rise to the new short-run cost curves SAC3 and SMC3. Incentives for new firms to enter remains there.



Competitive markets, the long run Finally:

FIGURE 11-15
The Long-Run Equilibrium Under Perfect Competition
If price starts above *P*,* entry keeps occurring and capital stocks of existing firms keep adjusting until the rightward movement of the industry supply curve causes price to fall to *P*. At the profit maximizing* level of output we have *P* = SMC* = LMC*=SAC*= LAC. Economic profits of all firms are equal to zero.



A Change in Long-Run Equilibrium

What would motivate a firm to be in an industry where profits are zero?

To create a more realistic model, let's assume that demand changes and map out the process of moving from one state of long run equilibrium to another.

Situation: ***Demand for the product increases***

1) How do <u>existing</u> firms in the industry respond to a shift in demand?

Assume before market demand increases there are: N_0 firms.

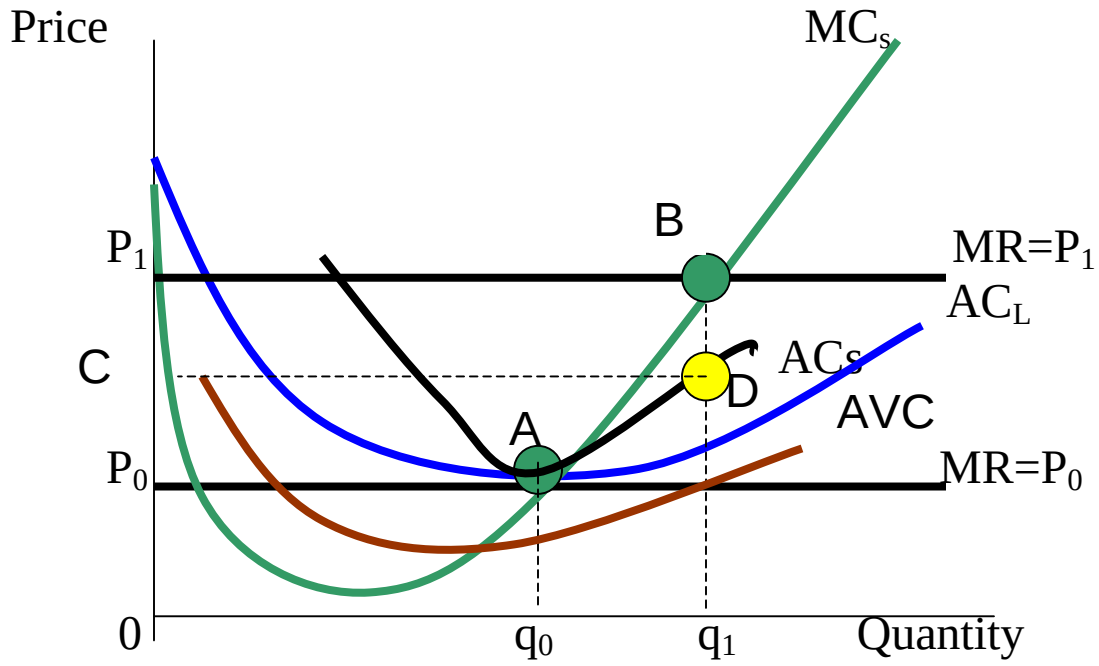
Each firm operates a plant with SAC and MC as shown in the previous diagram.

Each plant produces q_0 units at the minimum long run average cost of AC_L.

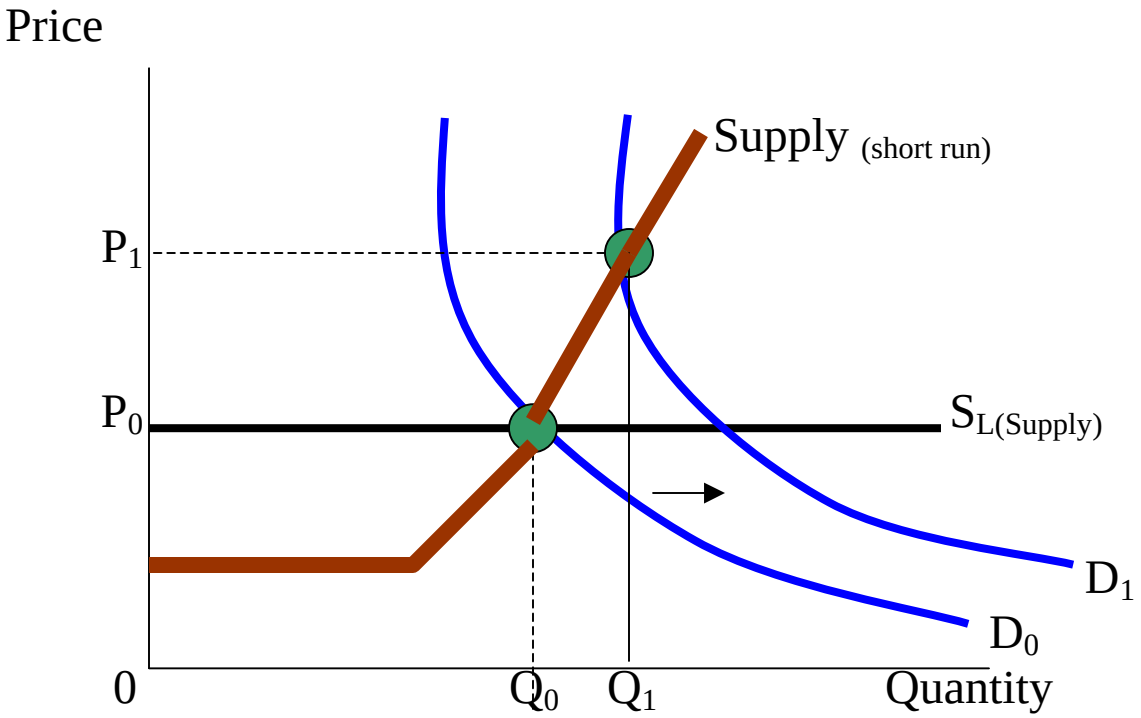
Each firm maximizes short-run profits by producing q_0 units when price is P_0, and q_1 units when price is P_1.

The firm's short run MC curve is the firm's short run supply function for prices above minimum average variable cost.

Short Run supply Curve of the Firm:



Industry Supply Curve:



The short-run industry supply function is the horizontal sum of the short-run supply functions of the N_0 firms. (Red line.)

The short-run industry supply function shows the quantity that existing firms in the industry supply at each price.

The total quantity supplied in the short run when price is P_0 is equal to $Q_0=q_0N_0$.

The long run industry supply function intersects the short run industry supply function at $Q=Q_0$.

Note:

The short run industry supply function has a horizontal segment. This is because firms will not supply any output below the minimum average variable cost and will leave the industry leaving the remaining firms to produce at minimum average variable cost.

Note:

The short run supply function is less elastic (steeper) than the long-run supply function. This implies that any change in demand will cause the price to change more in the short run than the long run.

Analysis:

The above figure shows the original demand function D_0. When demand increases, the new market demand function is D_1. The new short run equilibrium is point B and prices rise to P_1. Point B is the new short run equilibrium because the market clears with just the existing firms.

Question: ***How does this increase in demand affect each competitive firm?***

At the higher price P_1, each firm maximizes its profits by producing q_1 units.

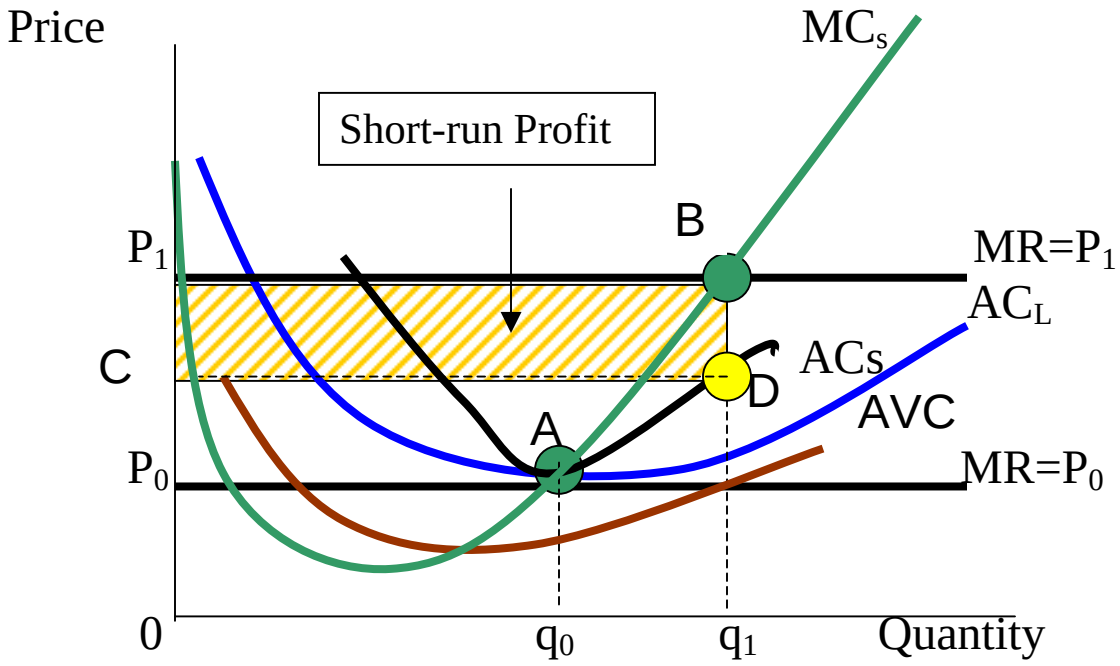
The firm's short run average cost increases from $0P_0$ to 0C when the firm increases output from q_0 to q_1.

Each firm earns a profit of CP_1BD.

An unexpected increase in market demand increases price, firm output, and industry output. Each firm earns a profit in the short run. Each firm's revenue now exceeds the minimum payment necessary to retain factors of production in this industry.

<u>Situation:</u> ***Demand for the product increases***: each firm makes a profit.

<u>Short Run Supply Curve of the Firm</u>



2) ***How does the industry respond to a shift in demand when firms can freely enter the market?***

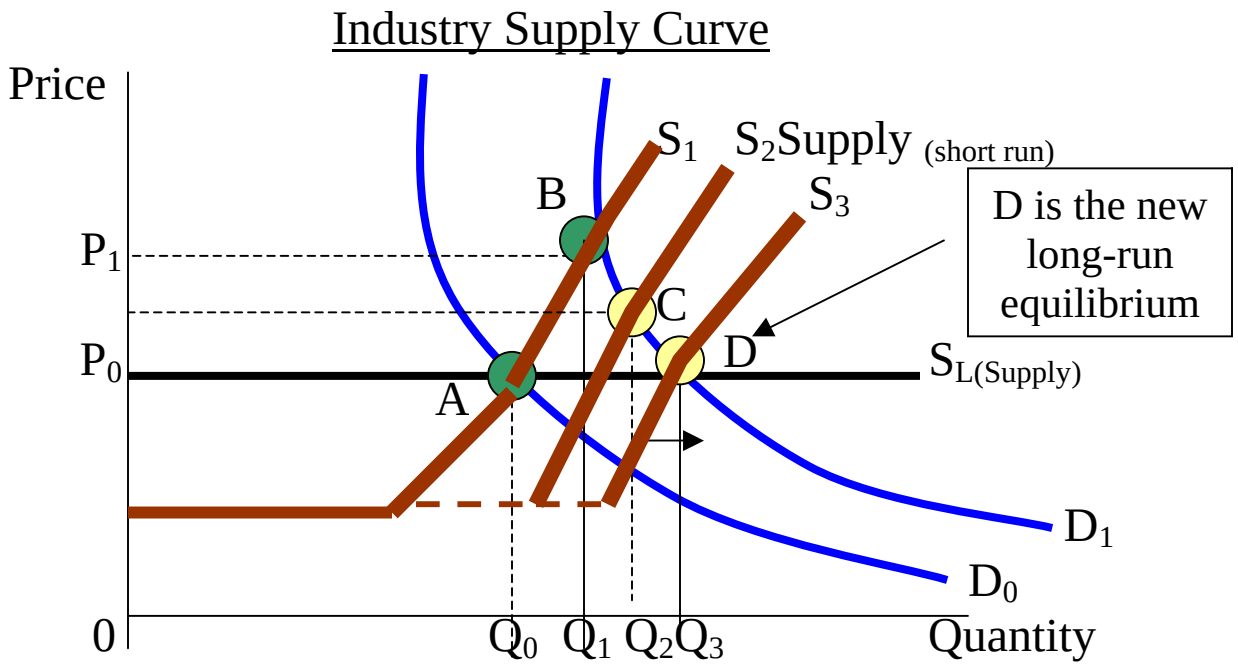
Assume before market demand increases there are:N_0 firms.

The increase in market demand, which caused an increase in market price, has made the industry profitable and attractive.

New firms enter the market in order to sell at this attractive price.

The amount of time a firm continues to make a profit depends on how long it takes new firms to enter the industry.

Once new firms enter the industry, price declines. This is because short-run industry supply shifts to the right as more and more firms enter the market. The rightward shift in the short-run function causes price to fall to P_2 and then to P_0.



<u>Question:</u> ***How does this increase in the number of firms in the industry affect the total amount produced***?

As more firms enter the market, market price falls to P_2 and the quantity produced by each firm falls to q_2.

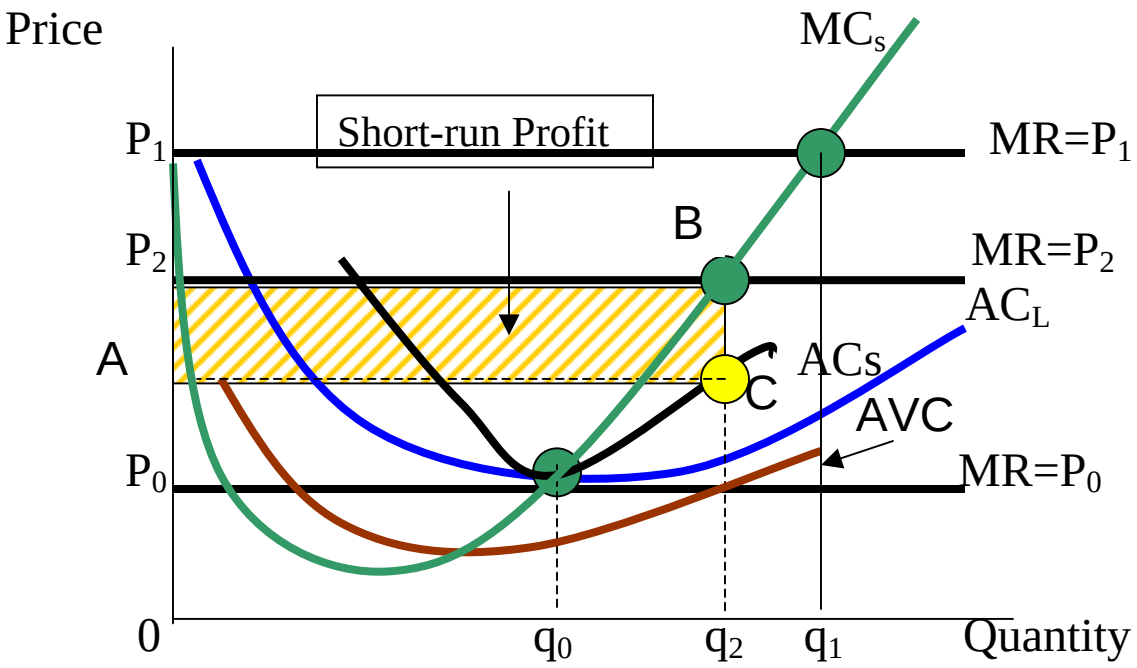
So, although the total industry quantity supplied increases because of the additional output supplied by the new firms, the amount of output produced by existing firms falls.

The entry of firms causes short run supply to shift to the right and pressures the market price and firm profits down to the original level.

Eventually, there are more firms in the industry, each one producing the initial level of output.

An increase in market demand causes equilibrium industry output to increase but does not change the long-run equilibrium price in a constant cost industry.

Short Run Supply Curve of the Firm



Note: An increase in demand is responsible for the profit earned by existing firms in the industry. The profit earned from higher prices, is ultimately responsible for lowering prices back to the original level, and increasing the supply of the product now in greater demand.

Profit motivates firms to enter the industry and causes price to fall back to the original long run level where price = marginal cost = LAC.

Price Determination In An Increasing-Cost Industry

Consider an industry that produces a good that contains a specialized factor.

Assumptions:

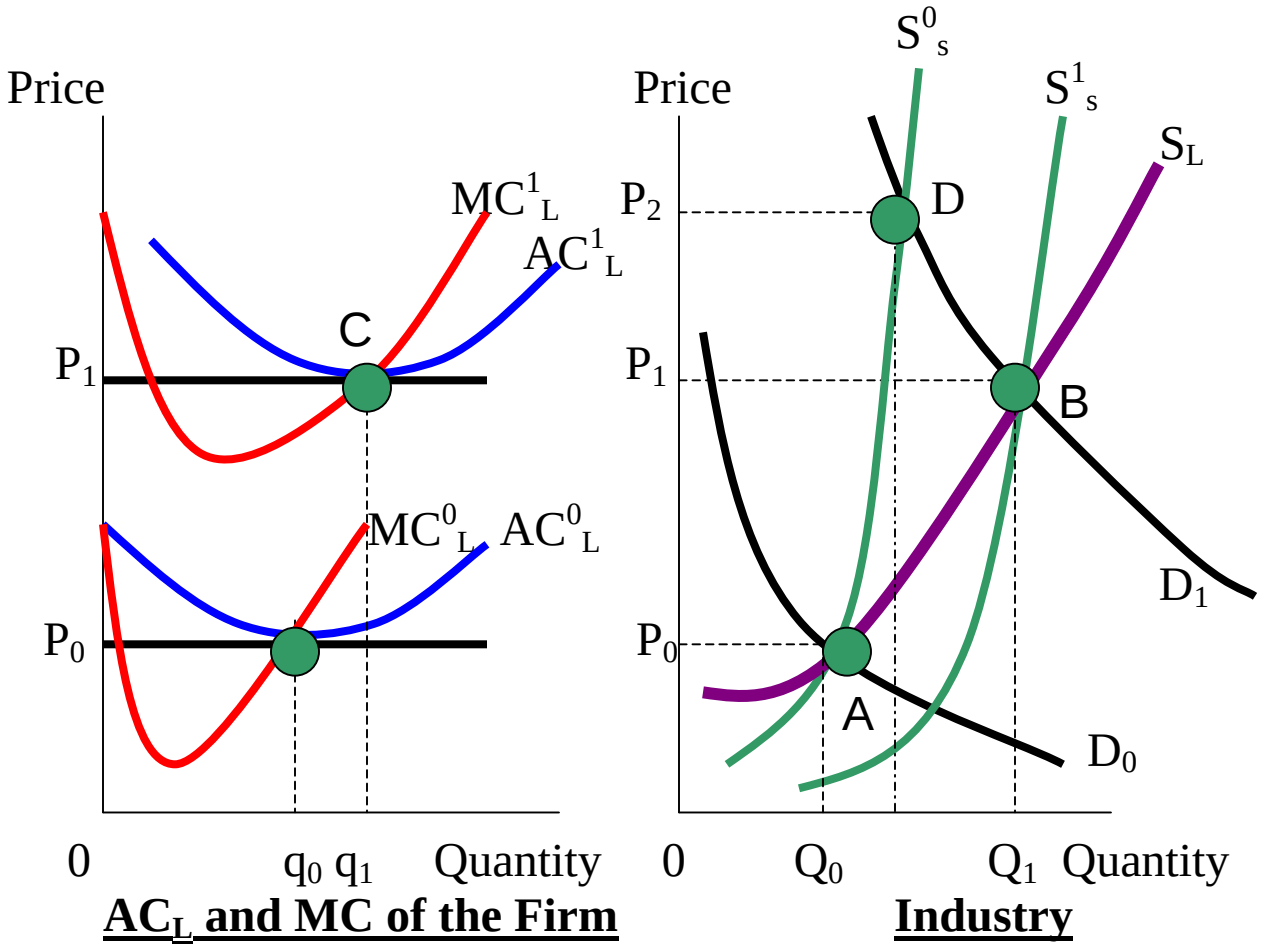
1) **Firms do not have the same long-run average cost function.**
There is a factor of production that is not in perfectly elastic supply. To increase output the product price must be increased in order to pay for the increasing cost of the factor.

2) **The position of the firms LAC function will shift as industry output changes.** The quantity supplied will increase in the long run only if the industry receives a higher price. The long run industry supply function has a positive slope.

Situation: Rising Factor Price When Industry Output Expands

Definition: **External pecuniary diseconomy of scale:** an increase in industry output causes a factor price to increase.

In an increasing cost industry the price of a factor of production increases as industry output increases. The industry's long run supply function slopes upward.
This is referred to as an external **pecuniary diseconomy of scale.**



The first diagram illustrates two pairs of long-run AC and MC functions of a competitive firm.

When the industry output is Q_0, the firm's long-run AC function is AC^0_L.

When the industry output increases to Q_1, the firm's long-run AC function is AC^1_L.

Analysis: Demand increases

Initially, the industry produces Q_0 when market price is P_0. Each firm in the industry produces q_0 units.

After demand increases, the firm's LAC function shifts upward. This is because an increase in industry output increases the price of a factor of production and causes every firm's LAC and MC functions to shift upward.

For each firm, the quantity where LAC reaches a minimum is at q_1 due to the increasing factor cost.

(Note: This new quantity of output could have stayed the same or decreased. In this example it increases.)

When the price of a factor increases as the industry expands output, there are **external pecuniary diseconomies** of scale

In the second diagram we can illustrate what happens in the industry as demand increases:

Initially, market demand is D_0, market price is P_0 and quantity supplied is Q_0. Each firm produces q_0 units and there are N_0 firms in the industry.

After market demand increases to D_1, the price increase to the new short run equilibrium price P_2 and the existing firms earn a profit.

This motivates new firms to enter the industry, and the short-run supply function shifts to the right and becomes S_s^1.

The price falls from P_2 to P_1.

The new short run supply function intersects the long run supply function at point B at the market equilibrium price P_1.

Industry output increases to Q_1.

Firms increase their output to q_1.

When there are external pecuniary diseconomies, an increase in market demand increases the long run equilibrium price and industry output.

Firms in the industry earn ***zero*** profits.

> Note: External pecuniary diseconomies are more likely in an industry that requires the use of a **specialized** factor of production.

Example: Land
Skilled labour

Competitive Market

The Price Elasticity of Supply.

- < 1 implies Inelastic. A large change in price causes a small change in quantity supplied.
- > 1 implies Elastic. A small change in price causes a small change in quantity supplied.
- = 1 implies Unit elastic. A 1% change in price causes 1% change in quantity supplied.

- Read section 11.12.

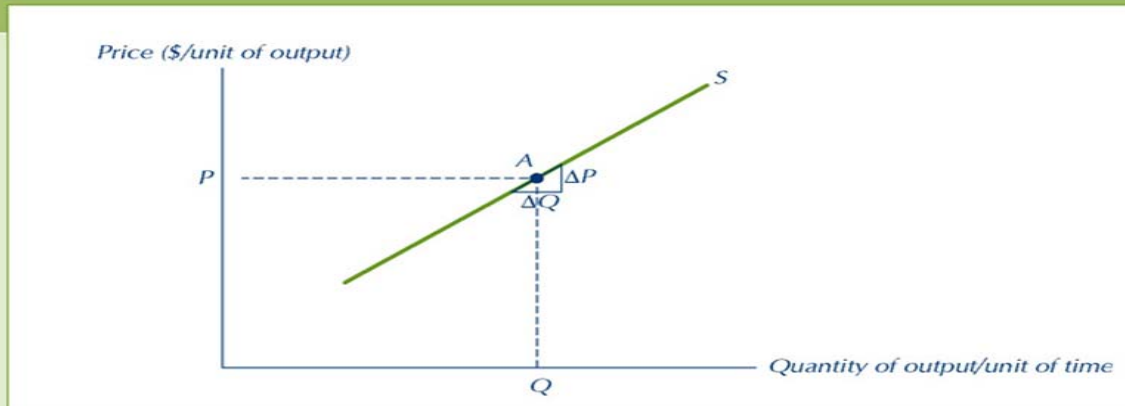
The Elasticity of Supply

→A measure of the responsiveness of quantity supply to variations in price.

$$\varepsilon^s = \left(\frac{P}{Q}\right)\left(\frac{\partial Q}{\partial P}\right) = \left(\frac{P}{Q}\right)\left(\frac{1}{slope}\right)$$

FIGURE 11-19

The Elasticity of Supply In the neighbourhood of point *A*, the elasticity of supply is given by $\epsilon^S = (\Delta Q/\Delta P)(P/Q)$. If the short-run supply curve is upward sloping, the short-run elasticity of supply will always be positive. In the long run, elasticity of supply can be positive, zero, or negative.



Example:

Suppose industry supply curve is P=-30+2Q, for $Q \geq 15$.
What is the price elasticity of supply when Q = 20?

If Q = 20, then price is

P = -30+2Q= -30 + 2(20) =10

Rearrange demand in terms of Q:

$$P = -30 + 2Q$$

$$2Q = 30 + P$$

$$Q = 15 + 0.5P \quad \Rightarrow \frac{\partial Q}{\partial P} = 0.5$$

$$\varepsilon^S = \left(\frac{P}{Q}\right)\left(\frac{\partial Q}{\partial P}\right) = \left(\frac{10}{20}\right)(0.5) = 0.25$$