# Firms in Competitive Markets

## Part I

## EE211

# Perfect Competition

- What is a perfectly competitive market
- How does a competitive firm determine the quantity that maximize profits?
- When might a competitive firm shut down in the short run?
- When might a competitive firm exit the market in the long run?
- What does the market supply curve look like in the short run?
- What does the market supply curve look like in the long run?

# Market Structure and Firm Behavior

- Firms have **market power** when they can influence the price of their product or the terms under which their product is sold
- The competitiveness of the market is the extent to which individual firms **lack** such **market power**
- A market is said to have a competitive structure when its **firms have little or no market power**

# The Significance of Market Structure

- When a firm decides how much output to produce in order to maximize its profit, it needs to know the demand for its product and also the costs of production

- Market structure enters the picture because the details of market structure determine how we get from the industry demand curve to the demand curve facing any individual firm in that industry

# The Theory of Perfect Competition

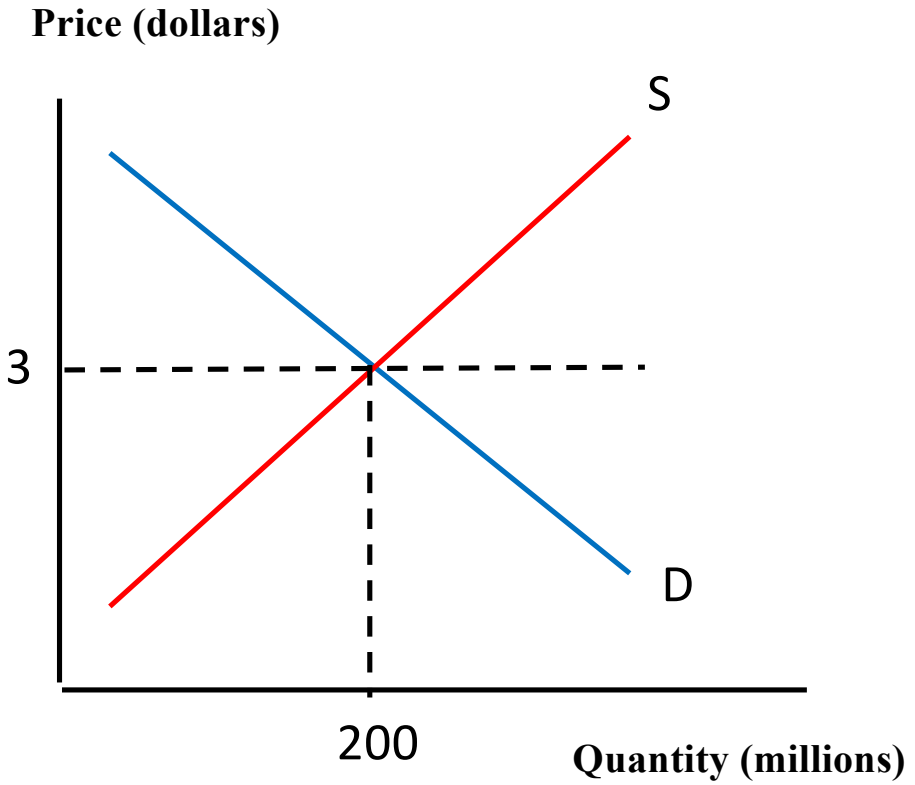
# The Assumption of Perfect Competition

1. **Homogeneous product** – All the firms in the industry sell an identical product
2. **Firms are price takers** – This means that individual firm treats the market price of the product as given. The level of a firm's output at which its long-run average cost reaches a minimum is small relative to the industry's total output
3. **Firms and Consumers have Perfect Information** – Consumers know the nature of the product being sold and the prices charged by each firm
4. **Free Entry and Exit**

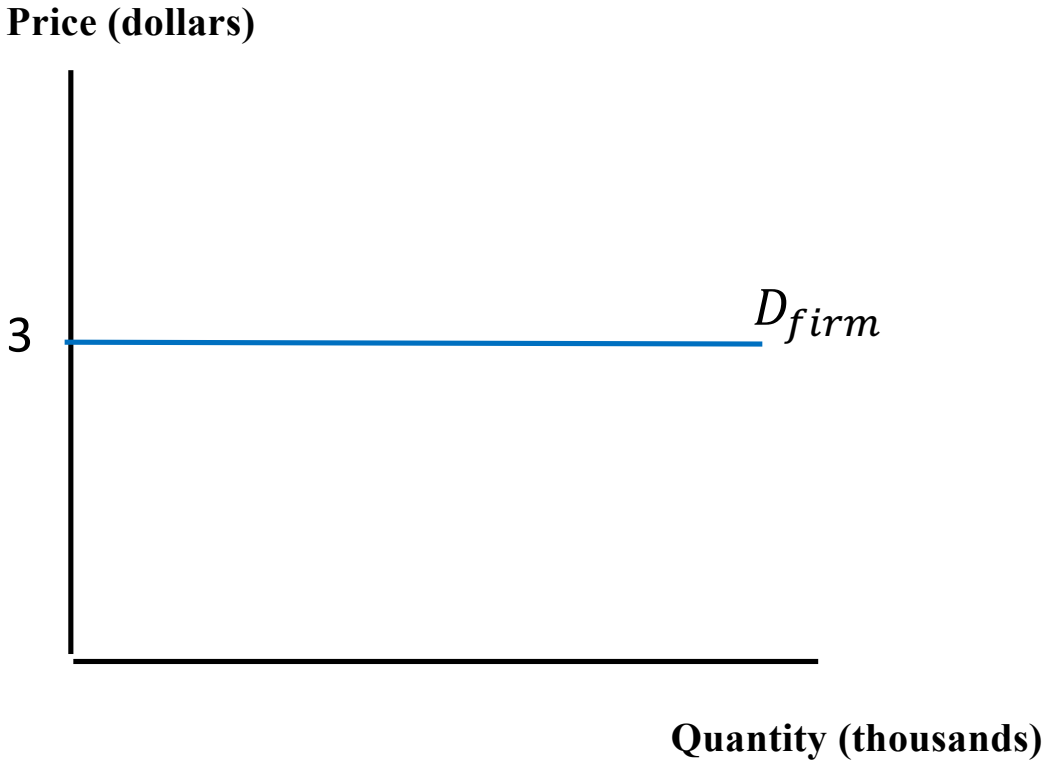
# The Demand Curve for a Perfectly Competitive Firm

- Even though the demand curve for the entire industry may be negatively sloped, **each firm in a perfectly competitive market faces a horizontal demand curve** because variations in the firm's output have no effect no price
- The horizontal demand curve **does not indicate** that the firm could actually sell an infinite amoung at the going price
- It **indicates** that the variations in production that it will normally be possible for the firm to make will leave price unchanged because their effect on total industry output will be negligible

# The demand curve for a competitive industry and for one firm in the industry




Competitive industry's demand curve




Competitive firm's demand curve

# The Revenue of a Competitive Firm

- Total Revenue (TR) $TR = P \times Q$

- Average Revenue (AR) $AR = \frac{TR}{Q} = P$

- Marginal Revenue (MR) $MR = \frac{\Delta TR}{\Delta Q}$

The change in TR from selling one more unit

# Using Marginal Analysis

Marginal revenue is the change in total revenue generated by an additional unit of output

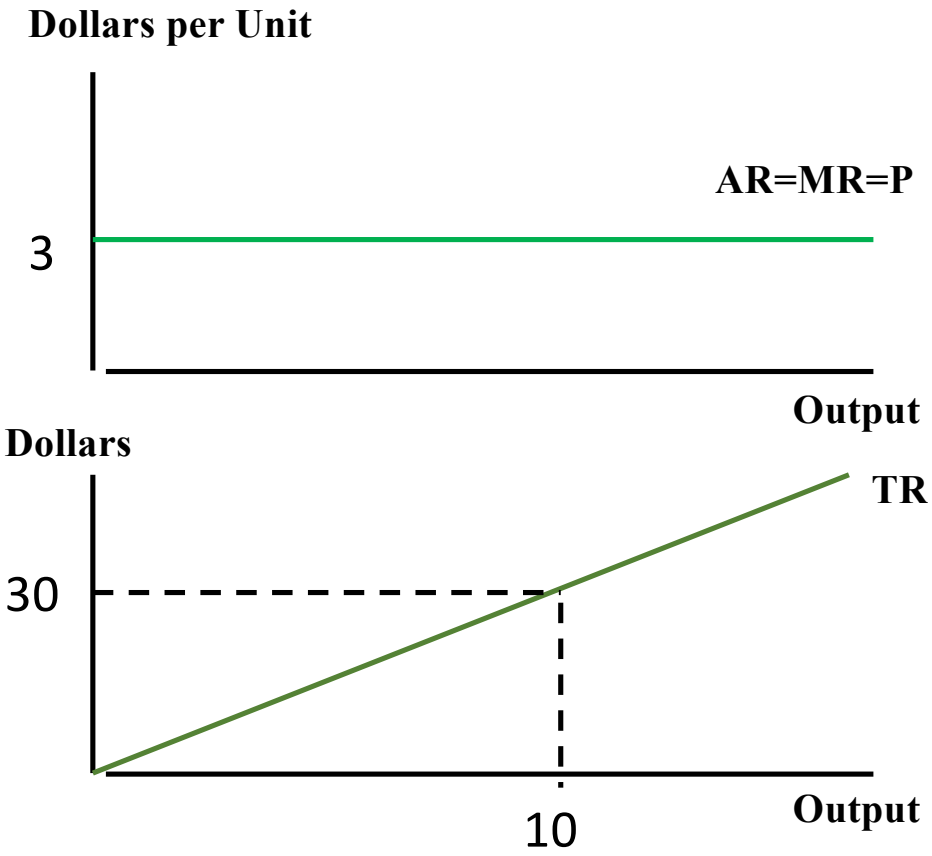
$$\mathrm{MR} = \frac{\Delta \mathrm{TR}}{\Delta \mathrm{Q}}$$

Example

If an increase in output of three units is accompanied by an increase in revenue of \$1500, the marginal revenue is $\frac{1500}{3}$ = \$500

# Example
# Revenues for a Price-Taking Firm

| Price P | Output Q | TR= P×Q | AR= TR/Q | MR= $\frac{\Delta TR}{\Delta Q}$ |
|---|---|---|---|---|
| $3 | 10 | $30 | $3 | |
| | | | | $3 |
| 3 | 11 | 33 | 3 | |
| | | | | 3 |
| 3 | 12 | 36 | 3 | |
| | | | | 3 |
| 3 | 13 | 39 | 3 | |



# The Revenue of a Competitive Firm

- The Vaca Farm produces a quantity of milk, $Q$, and sells each unit at the market price, $P$
- The farm's total revenue is $P \times Q$
- Because the Vaca Farm is small compared with the world market for milk, it takes the price given by the market. This mean that the price does not depend on how much milk the Vaca Farm produces and sells.
- How much revenue does the farm receive for the typical gallon of milk?
- How much additional revenue does the farm receive if it increases the production of milk by 1 gallon?

| Quantity (Q) | Price (P) | Total Revenue ($TR = P \times Q$) | Average Revenue ($AR = TR/Q$) | Marginal Revenue ($MR = \Delta TR/\Delta Q$) |
|---|---|---|---|---|
| 1 gallon | $ 6 | $ 6 | $6 | |
| | | | | $6 |
| 2 | 6 | | | |
| | | | | |
| 3 | 6 | | | |
| | | | | |
| 4 | 6 | | | |
| | | | | |
| 5 | 6 | | | |
| | | | | |
| 6 | 6 | | | |
| | | | | |
| 7 | 6 | | | |
| | | | | |
| 8 | 6 | | | |

| Quantity (Q) | Price (P) | Total Revenue ($TR = P \times Q$) | Average Revenue ($AR = TR/Q$) | Marginal Revenue ($MR = \Delta TR/\Delta Q$) |
|---|---|---|---|---|
| 1 gallon | $ 6 | $ 6 | $6 | |
| | | | | $6 |
| 2 | 6 | 12 | 6 | |
| | | | | 6 |
| 3 | 6 | 18 | 6 | |
| | | | | 6 |
| 4 | 6 | 24 | 6 | |
| | | | | 6 |
| 5 | 6 | 30 | 6 | |
| | | | | 6 |
| 6 | 6 | 36 | 6 | |
| | | | | 6 |
| 7 | 6 | 42 | 6 | |
| | | | | 6 |
| 8 | 6 | 48 | 6 | |

# MR=P for a Competitive Firm

- A competitive firm can keep increasing its output without affecting the market price
- So, each one-unit increase in Q causes revenue to rise by P, MR=P

MR=P is only true for firms in competitive markets

# Profit Maximization and the Competitive Firm's Supply Curve

- Total cost includes fixed costs and variable costs.
- The Vaca family wants to produce the quantity of milk that makes its profit as large as possible.
- The farm maximizes profit by producing either 4 or 5 gallons of milk for a profit of $7.
- The Vaca can find the profit-maximizing quantity by comparing the marginal revenue and marginal cost of each unit produced.

| Quantity (Q) | Total Revenue (TR) | Total Cost (TC) | Profit (TR-TC) | Marginal Revenue ($MR = \Delta TR/\Delta Q$) | Marginal Cost ($MC = \Delta TC/\Delta Q$) | Change in Profit (MR-MC) |
|---|---|---|---|---|---|---|
| 0 gallons | $0 | $3 | -$3 | | | |
| | | | | $6 | $2 | $4 |
| 1 | 6 | 5 | | | | |
| | | | | | | |
| 2 | 12 | 8 | | | | |
| | | | | | | |
| 3 | 18 | 12 | | | | |
| | | | | | | |
| 4 | 24 | 17 | | | | |
| | | | | | | |
| 5 | 30 | 23 | | | | |
| | | | | | | |
| 6 | 36 | 30 | | | | |
| | | | | | | |
| 7 | 42 | 38 | | | | |
| | | | | | | |
| 8 | 48 | 47 | | | | |

| Quantity (Q) | Total Revenue (TR) | Total Cost (TC) | Profit (TR-TC) | Marginal Revenue ($MR = \Delta TR/\Delta Q$) | Marginal Cost ($MC = \Delta TC/\Delta Q$) | Change in Profit (MR-MC) |
|---|---|---|---|---|---|---|
| 0 gallons | $0 | $3 | -$3 | | | |
| | | | | $6 | $2 | $4 |
| 1 | 6 | 5 | 1 | | | |
| | | | | 6 | 3 | 3 |
| 2 | 12 | 8 | 4 | | | |
| | | | | 6 | 4 | 2 |
| 3 | 18 | 12 | 6 | | | |
| | | | | 6 | 5 | 1 |
| 4 | 24 | 17 | 7 | | | |
| | | | | 6 | 6 | 0 |
| 5 | 30 | 23 | 7 | | | |
| | | | | 6 | 7 | -1 |
| 6 | 36 | 30 | 6 | | | |
| | | | | 6 | 8 | -2 |
| 7 | 42 | 38 | 4 | | | |
| | | | | 6 | 9 | -3 |
| 8 | 48 | 47 | 1 | | | |

- As long as MR exceeds MC, increasing quantity produced raises profit
- Once the farm's output reaches 5 gallons of milk, however, the situation changes.
- The sixth gallon would have a MR of $6 and a MC of $7, so producing it would reduce profit by $1. As a result, the Vacas do not produce more than 5 gallons.
- If the MR is less than MC – the Vacas should decrease production

# The Marginal Cost Curve and the Firm's Supply Decision

These cost curves exhibits the three features:

- The MC curve slopes upward
- The ATC curve is U shaped
- The MC curve crosses the ATC curve at the minimum of ATC

The price line is horizontal because a competitive firm is a price taker: the price of the firm's output is the same regardless of how much it produces.

**For a competitive firm, the price equals both the firm's average revenue (AR) and its marginal revenue (MR)**

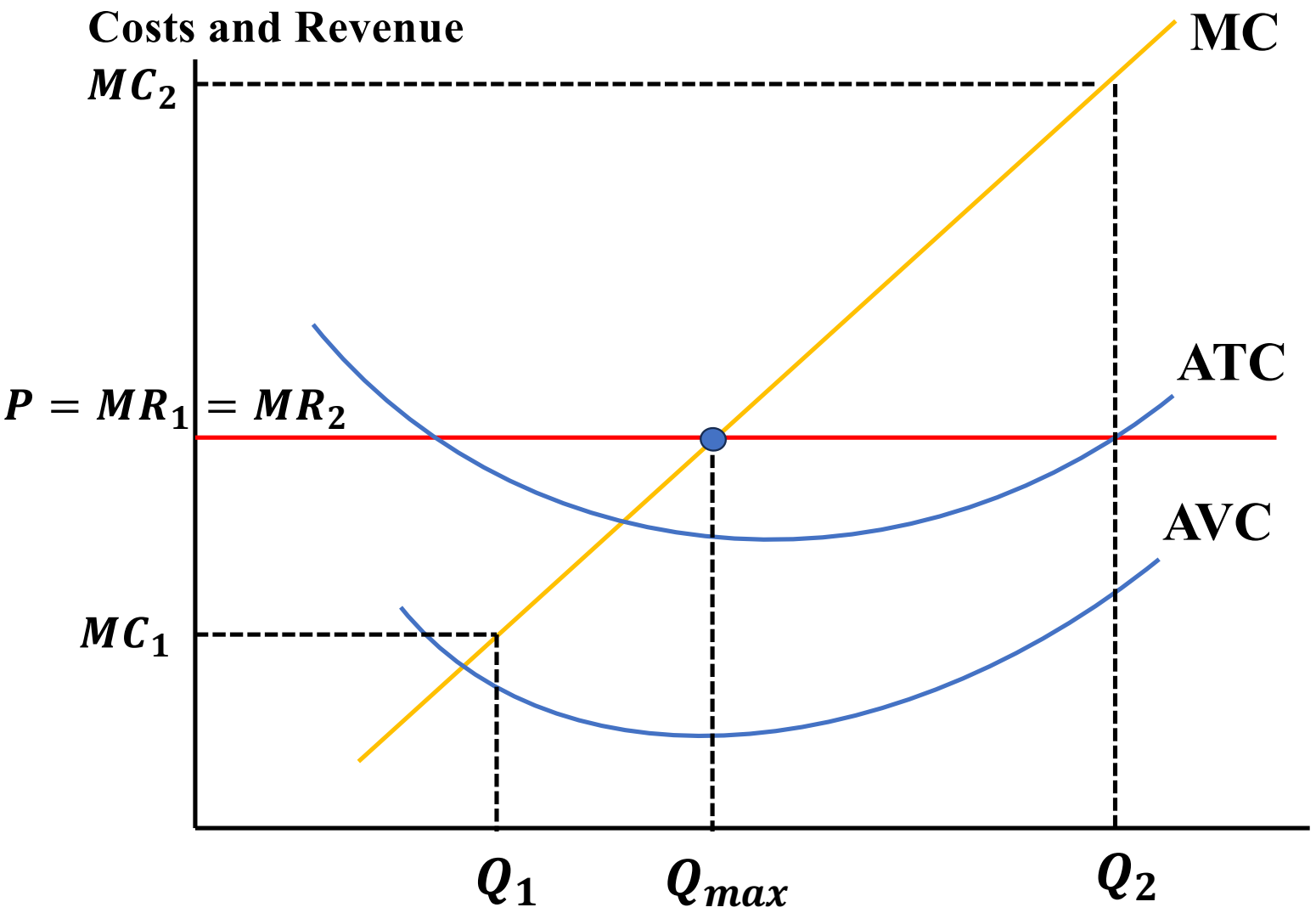



**Figure 1 : Profit Maximization for a Competitive Firm**

- At level $\boldsymbol{Q_1}$, the MR curve is above the MC curve, indicating the MR is greater than MC - This means that if the firm were to raise production by 1 unit, the additional revenue ($\boldsymbol{MR_1}$) would exceed the additional cost ($\boldsymbol{MC_1}$).
- Profit, which equals total revenue minus total cost, would increase.
- Hence, if the marginal revenue is greater than marginal cost, as it is at $\boldsymbol{Q_1}$, the firm can increase profit by increasing production.

- At level $\boldsymbol{Q_2}$, the MC curve is above the MR curve, indicating the MC is greater than MR - if the firm were to reduce production by 1 unit, the costs saved ($\boldsymbol{MC_2}$) would exceed the revenue lost ($\boldsymbol{MR_2}$).
- Therefore, if the marginal cost is greater than marginal revenue, as it is at $\boldsymbol{Q_2}$, the firm can increase profit by reducing production.

- The profit maximizing quantity, $\boldsymbol{Q_{max}}$, is found where the horizontal line representing the price intersects the marginal-cost curve

# Profit Maximization

- What Q maximizes the firm's profit?
- To find the answer, "think at the margin"

If increase Q by one unit, revenue rises by MR, cost rises by MC

- If MR>MC, then increase Q to raise profit
- If MR<MC, then reduce Q to raise profit

This analysis yields three rules for profit maximization

- If marginal revenue exceeds marginal cost, the firm should increase its output
- If marginal cost exceeds marginal revenue, the firm should decrease its output
- At the profit-maximizing level of output, marginal revenue equals marginal cost

# The Optimal Output Rule

- The optimal output rule says that profit is maximized by producing the quantity of output at which the marginal cost of the last unit produced is equal to its marginal revenue

# Short-Run Decisions
# Rules for All Profit-Maximizing Firms

Two rules apply to all profit maximizing firms, whether or not they operate in perfectly competitive firms

1. Whether the firm should produce at all
2. How much it should produce?

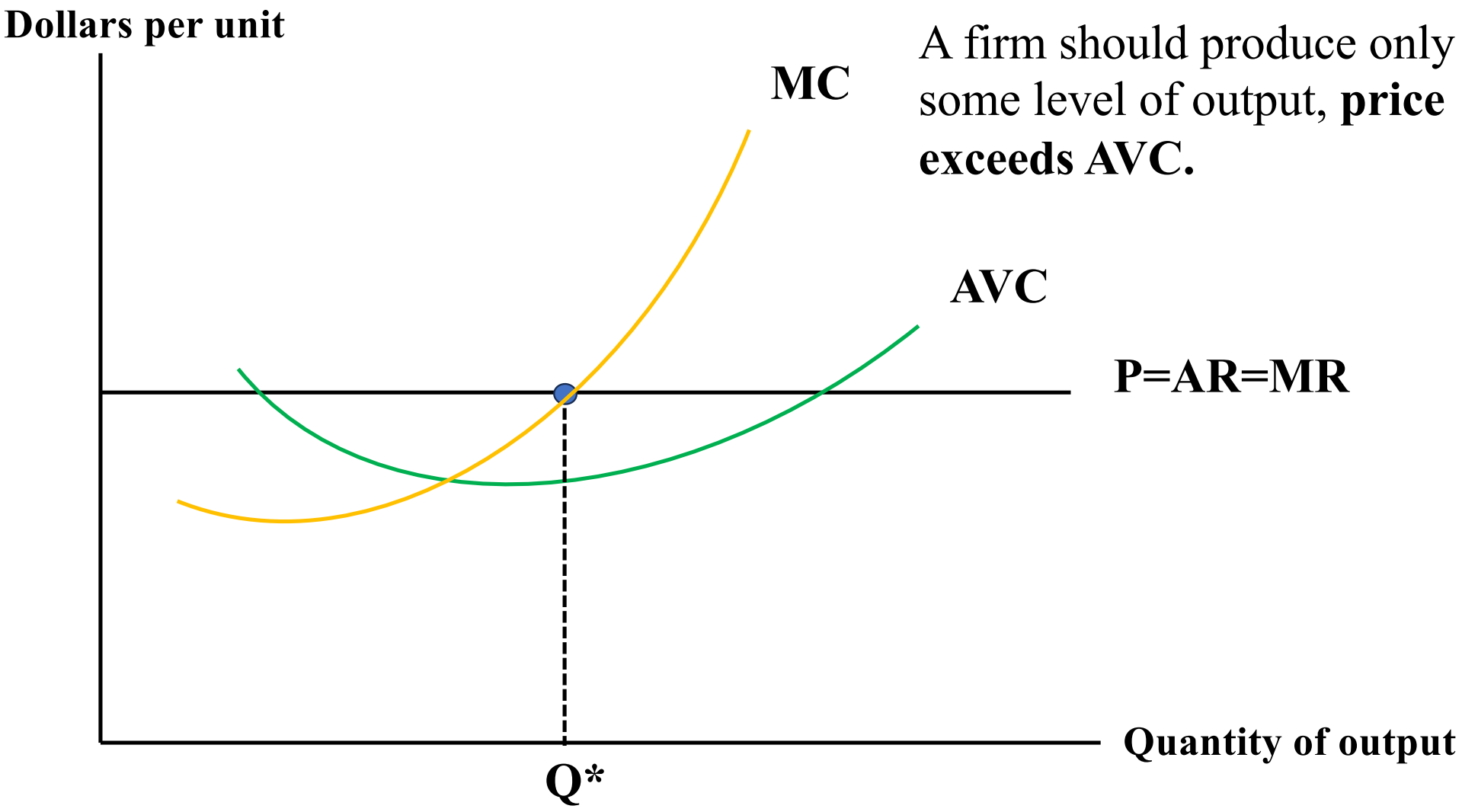
# Should the firm produce at all?

The firm always has the option of producing nothing

- If it produces nothing, it will have an operating loss that is equal to its fixed costs
- If is decides to produce, it will add the variable cost of production to its costs and the receipts from the sale of its product to its revenue

Therefore, because it must pay its fixed costs in any event, it will be worthwhile for the firm to produce as long as it can find some level of output for which revenue exceeds variable cost

If its revenue is less than its variable cost at every level of output, the firm will actually lose more by producing any level of output than by not producing at all




A firm should produce only if at some level of output, **price exceeds AVC.**

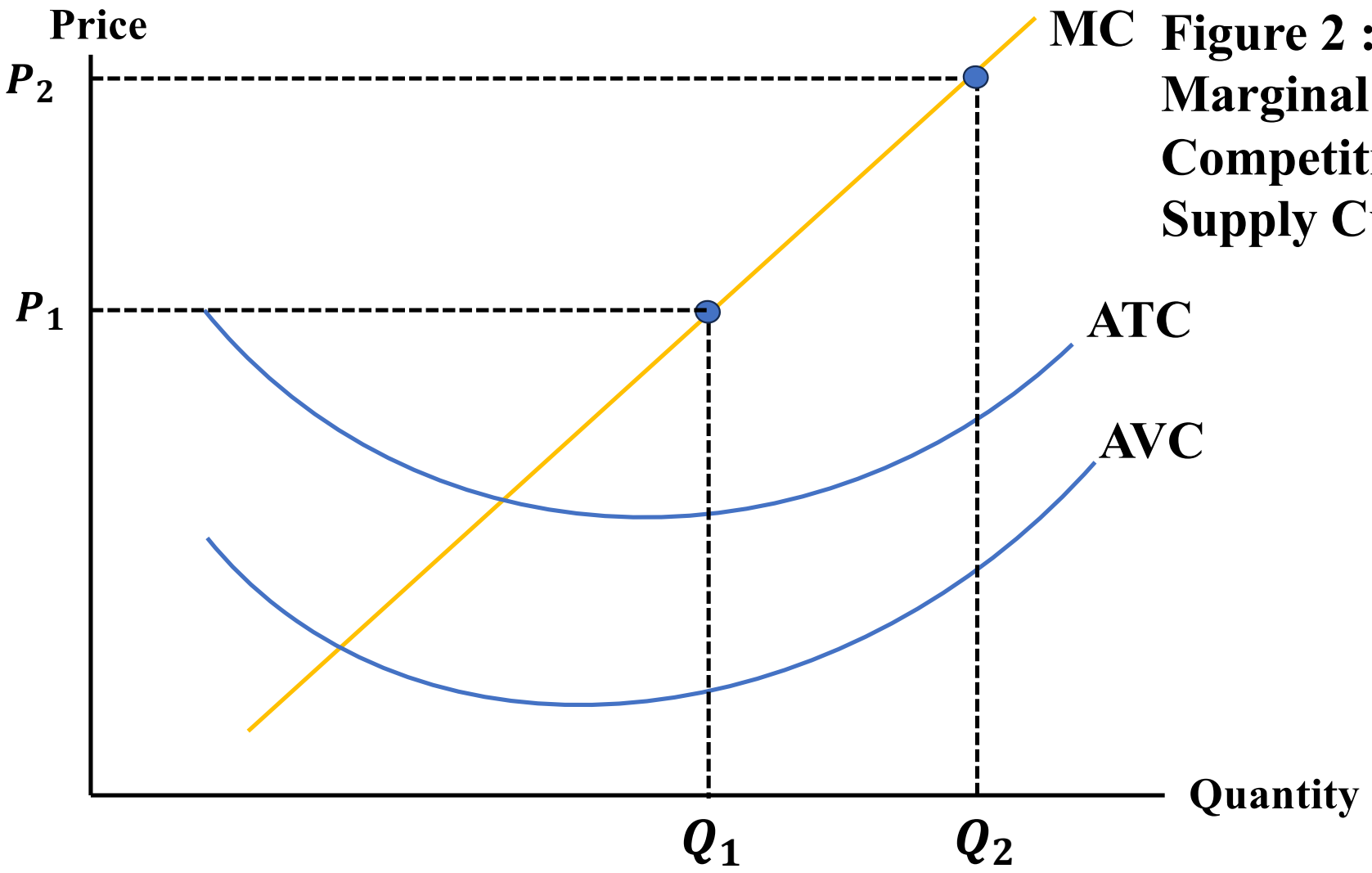



**Figure 2 : Marginal Cost as the Competitive Firm's Supply Curve**

An increase in the price from $P_1$ to $P_2$ leads to an increase in the firm's profit maximizing quantity from $Q_1$ to $Q_2$. Because the marginal cost curve shows the quantity supplied at any price, it is the firm's supply curve.

# Figure 2 :Marginal Cost as the Competitive Firm's Supply Curve

- How a competitive firm responds to the price increase
- When the price is $\boldsymbol{P_1}$, the firm produces quantity $\boldsymbol{Q_1}$, the quantity that equates marginal cost to the price
- When the price rises to $\boldsymbol{P_2}$, the firm finds that marginal revenue is higher than marginal cost at the previous level of output, so it increases production
- The new profit-maximizing quantity is $\boldsymbol{Q_2}$, at which marginal cost equals the new, higher price.
- **Because the firm's marginal cost curve determines the quantity of the good the firm is willing to supply at any price, the marginal-cost curve is also the competitive firm's supply curve**

# The Shutdown Condition

- **Shutdown condition** if price falls below the minimum of average variable cost, the firm should shut down in the short run

- The **short-run supply curve** of the perfectly competitive firm is the rising portion of the short-run marginal cost curve that lies above the minimum value of the average variable cost curve

# The Firm's Short-run Decision to Shutdown

- **Cost of shutting down: revenue loss = TR**
- **Benefit of shutting down: cost savings = VC**

**(Firm must still pay FC)**

- **So, shut down if TR < VC**
- **Divide both sides by Q : TR/Q < VC/Q**
- **So firm's decision rule is :**

**Shut down if P < AVC**

$AR = \frac{TR}{Q}$

$= AR$

# The Firm's Short-Run Decision to Shut Down

- A **shut down** refers to a short-run decision not to produce anything during a specific period because of current market conditions.
- **Exit** refers to a long-run decision to leave the market
- The short-run and long-run decisions differ because most firms cannot avoid their fixed costs in the short run but can do so in the long run.
- A firm that shuts down temporarily still must pay its fixed costs, while a firm that exits the market doesn't pay any costs at all, fixed or variable

- For example, consider production decisions at a farm
- The cost of the land is a fixed cost. If the farm owners decide not to produce any crops one season, the land lies fallow, and they cannot recover this cost. **When making the short-run decision of whether to shut down for a season, the fixed cost of land is said to be a sunk cost.**
- By contrast, if the farm owners decide to leave farming altogether, they can sell the land. When making the long-run decision of whether to exit the market, the cost of land is not sunk.

# What determines a firm's shutdown decision?

- If the firm shuts down, it loses all revenue from the sale of its product. At the same time, it saves the variable costs of making the product (but must still pay the fixed costs).
- **Therefore, the firm shuts down if the revenue that it would earn from producing is less than its variable costs of production.**

**Shut down if $TR < VC$**

**Shut down if $\mathbf{TR < VC}$**

**Shut down if $\mathbf{TR/Q < VC/Q}$**

**Shut down if $\mathbf{P < AVC}$**

A firm shuts down if the price of the good is less than the average variable cost of production

**The competitive firm's short-run supply curve is the portion of its marginal cost curve that lies above the average variable cost curve.**

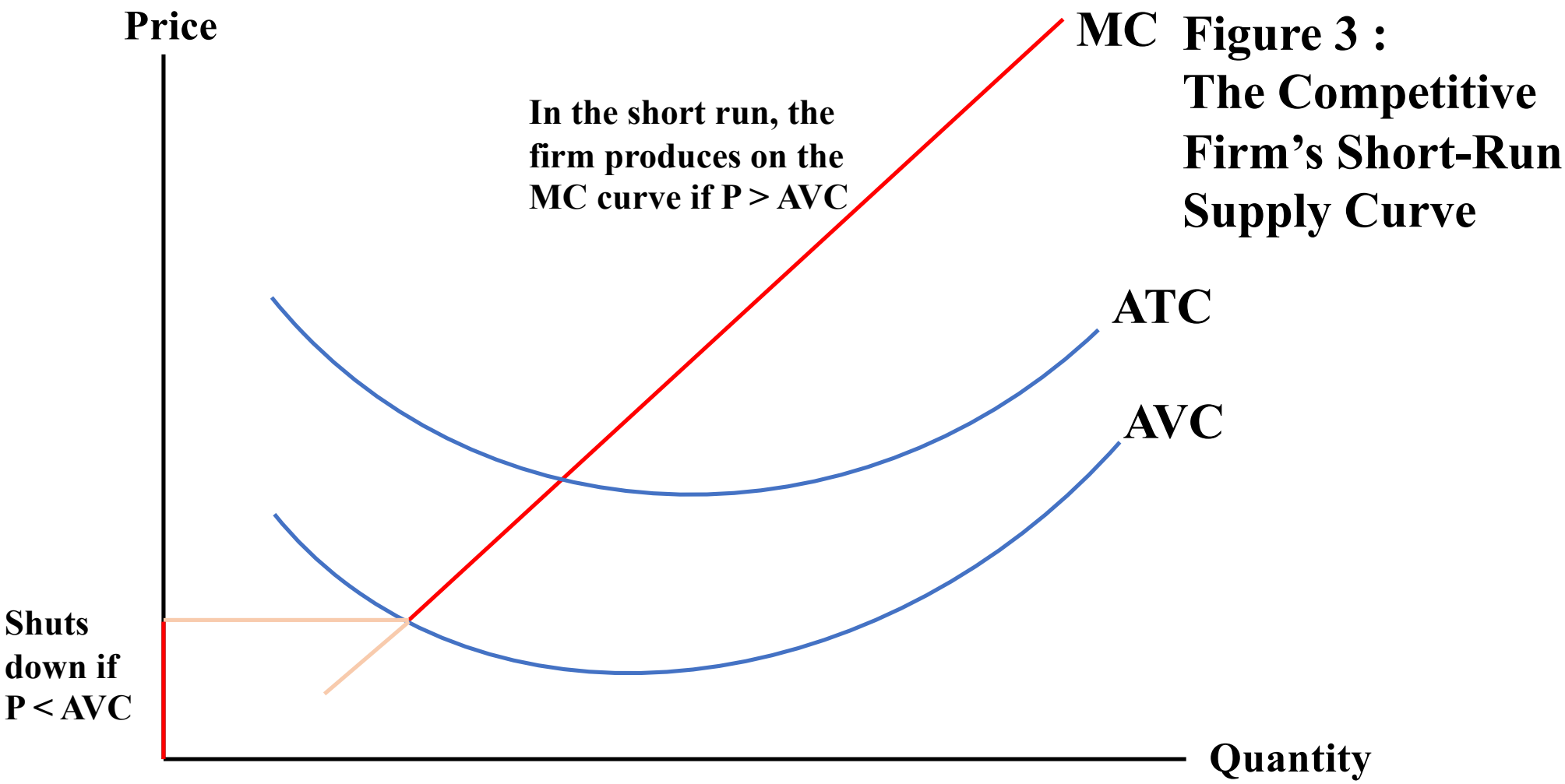



**Figure 3 : The Competitive Firm's Short-Run Supply Curve**

In the short run, the competitive firm's supply curve is the portion of its marginal cost curve (MC) that lies above its average-variable cost curve (AVC). If the price falls below average variable cost, the firm is better off shutting down temporarily

# Production Decision

At the shut-down price the firm can just cover its average variable cost, and so is indifferent between producing and not producing.

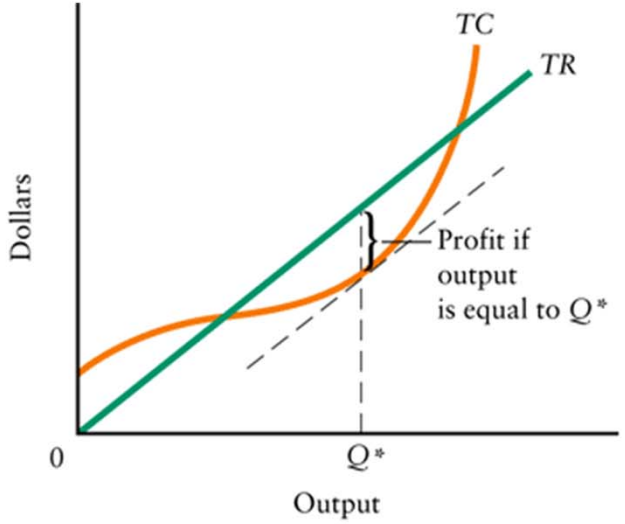
**How Much Should the Firm Produce?**

When p > AVC, the firm does not shut down.

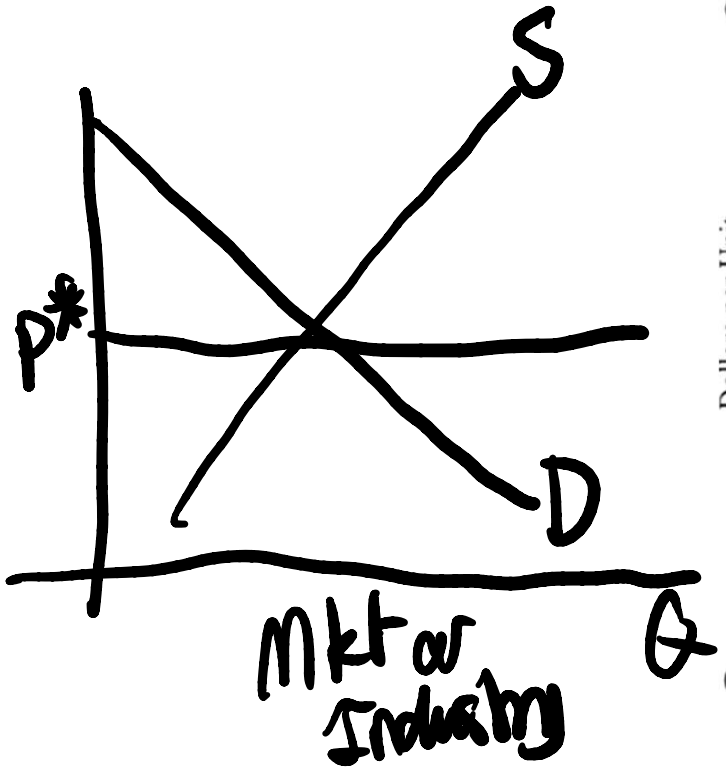
To maximize profits, the firm chooses the output where *MR* = *MC*. But for a competitive firm, *MR* = *p*:

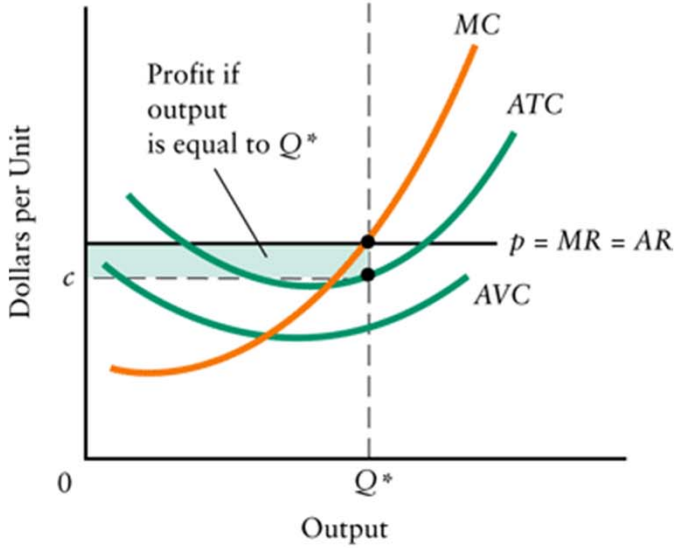
The rule: choose output where *p* = *MC*.

# Profit Maximization for a Competitive Firm




(i) Total costs and total revenues




(ii) Marginal cost and marginal revenue

# Example Profit Maximization

At any ***Q*** with *MR* > *MC*, increasing ***Q*** raises profit.

At any ***Q*** with *MR* < *MC*, reducing ***Q*** raises profit.

| ***Q*** | *TR* | *TC* | Profit | *MR* | *MC* | ΔProfit = *MR* – *MC* |
|---|---|---|---|---|---|---|
| 0 | $0 | $5 | –$5 | | | |
| | | | | $10 | $4 | $6 |
| 1 | 10 | 9 | 1 | | | |
| | | | | 10 | 6 | 4 |
| 2 | 20 | 15 | 5 | | | |
| | | | | 10 | 8 | 2 |
| 3 | 30 | 23 | 7 | | | |
| | | | | 10 | 10 | 0 |
| 4 | 40 | 33 | 7 | | | |
| | | | | 10 | 12 | –2 |
| 5 | 50 | 45 | 5 | | | |

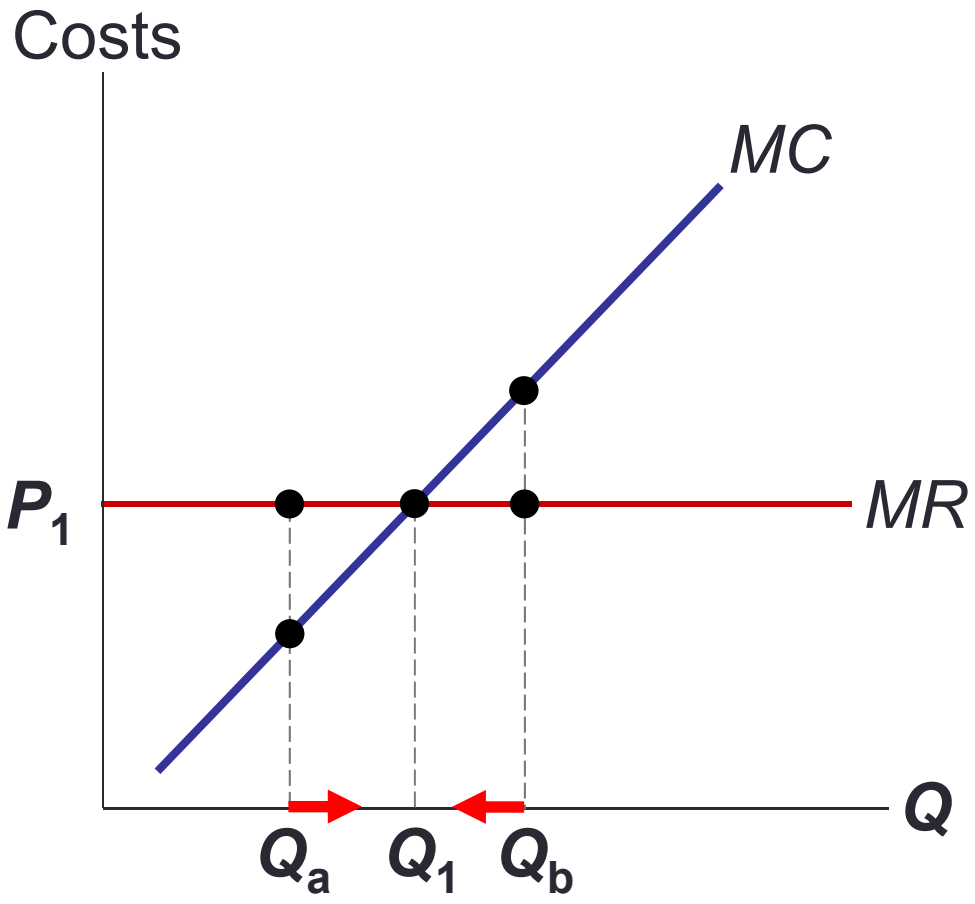
# MC and the Firm's Supply Decision

Rule: *MR* = *MC* at the profit-maximizing ***Q***.

At $Q_a$, *MC* < *MR*.
So, increase ***Q***
to raise profit.

At $Q_b$, *MC* > *MR*.
So, reduce ***Q***
to raise profit.

At $Q_1$, *MC* = *MR*.
Changing ***Q***
would lower profit.



# MC and the Firm's Supply Decision

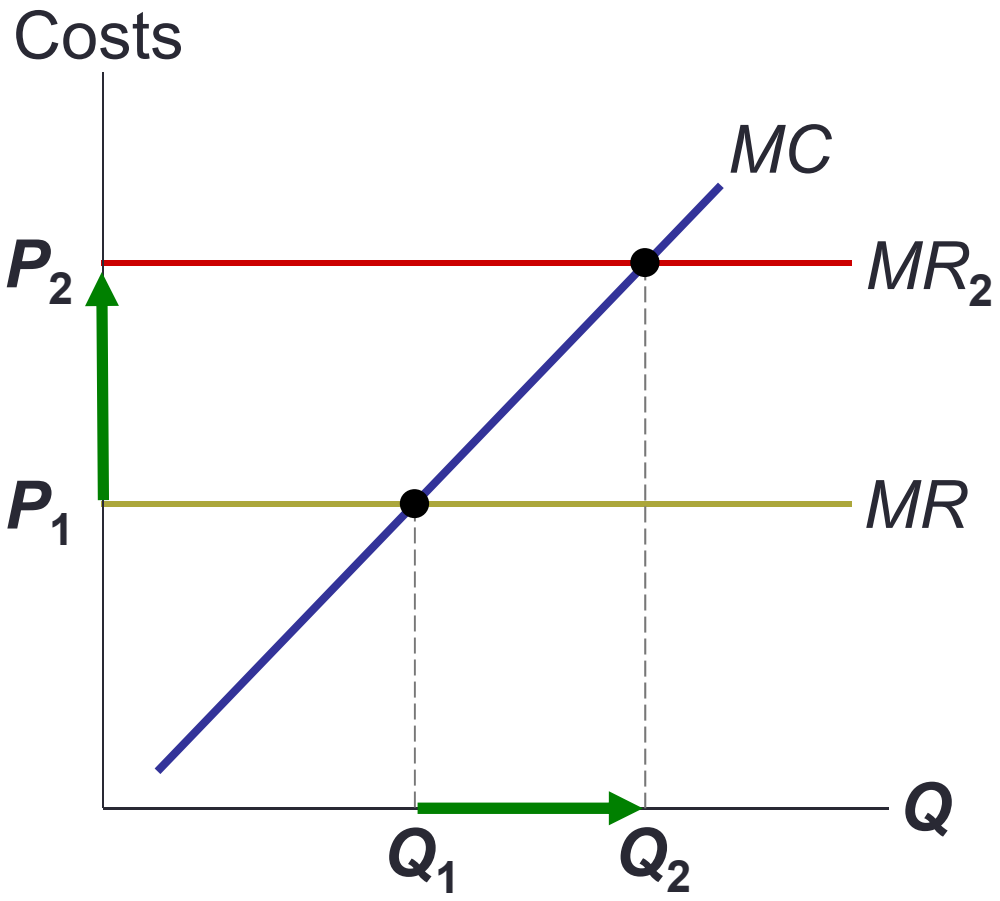
If price rises to $P_2$,

then the profit-maximizing quantity rises to $Q_2$.

The *MC* curve determines the firm's **Q** at any price.

Hence,

the *MC* curve is the firm's supply curve.



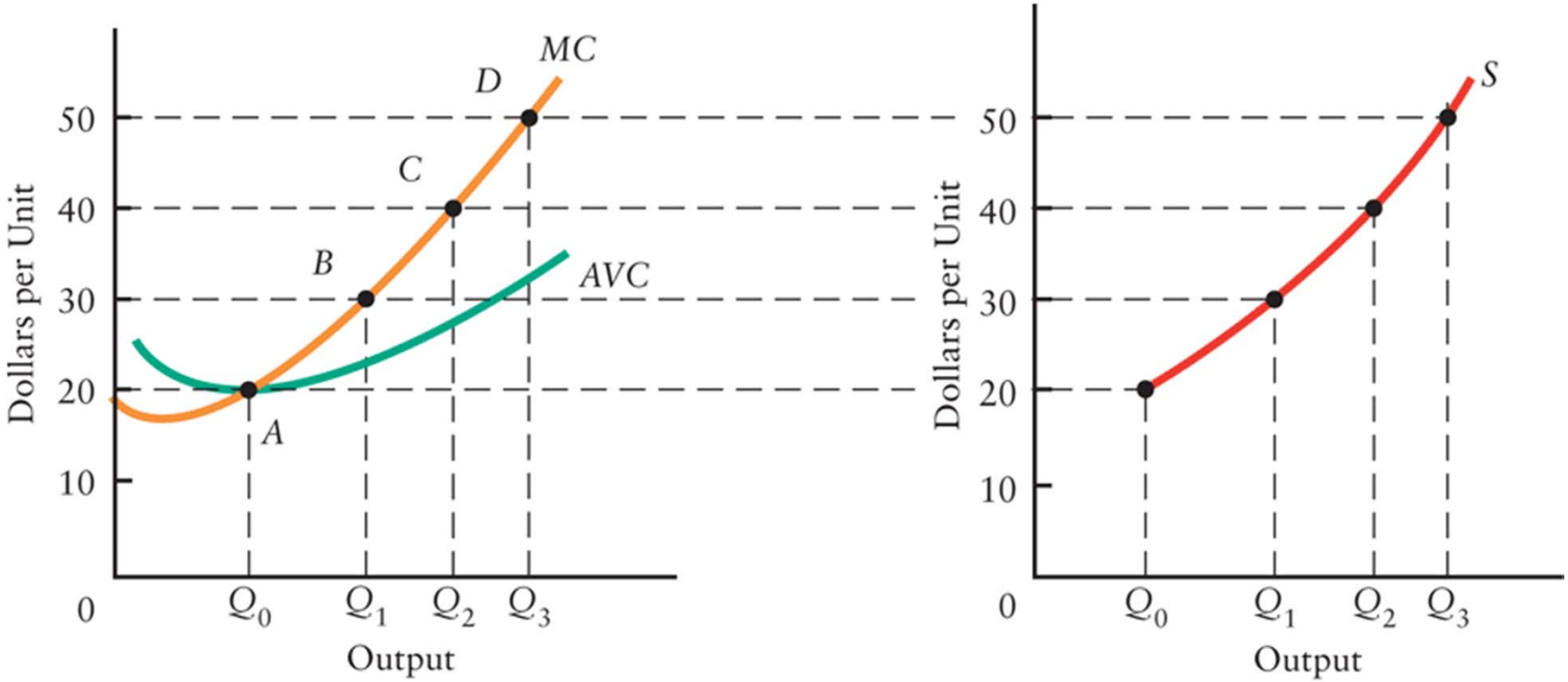
# Short-Run Supply Curves

**The Supply Curve for One Firm**

- The firm's MC curve gives the MC corresponding to each level of output
- For prices below AVC, the firm will supply zero units
- For prices above AVC, the competitive firm will choose its level of output to equate price and MC

*A competitive firm's supply curve is given by the portion of its MC curve that is above its AVC curve*

# The Derivation of the Supply Curve for a Competitive Firm

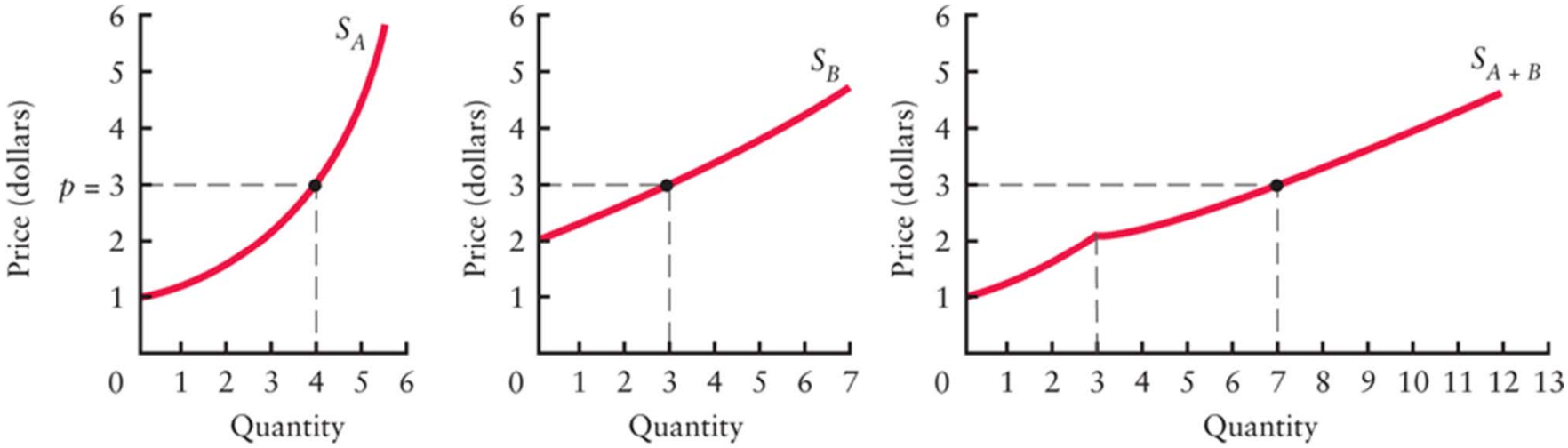



(i) Marginal cost and average variable cost curves

(ii) Firm's supply curve

- **The Supply Curve for an Industry**
- In perfect competition, the industry supply curve is the horizontal sum of the MC curves (above the level of AVC) of all firms in the industry
-

# The Derivation of a Competitive Industry's Supply Curve




(i) Firm A's supply curve (ii) Firm B's supply curve (iii) Industry supply curve

# Short-Run Equilibrium in the Competitive Market

- When an industry is in short-run equilibrium, quantity demanded equals quantity supplied, and each firm is maximizing its profits given the market price

- Three possible positions for a firm when the industry is in short-run equilibrium
  - The firm is suffering losses
  - The firm is breaking even
  - The firm is making profits

# Profit, Break-even or Loss

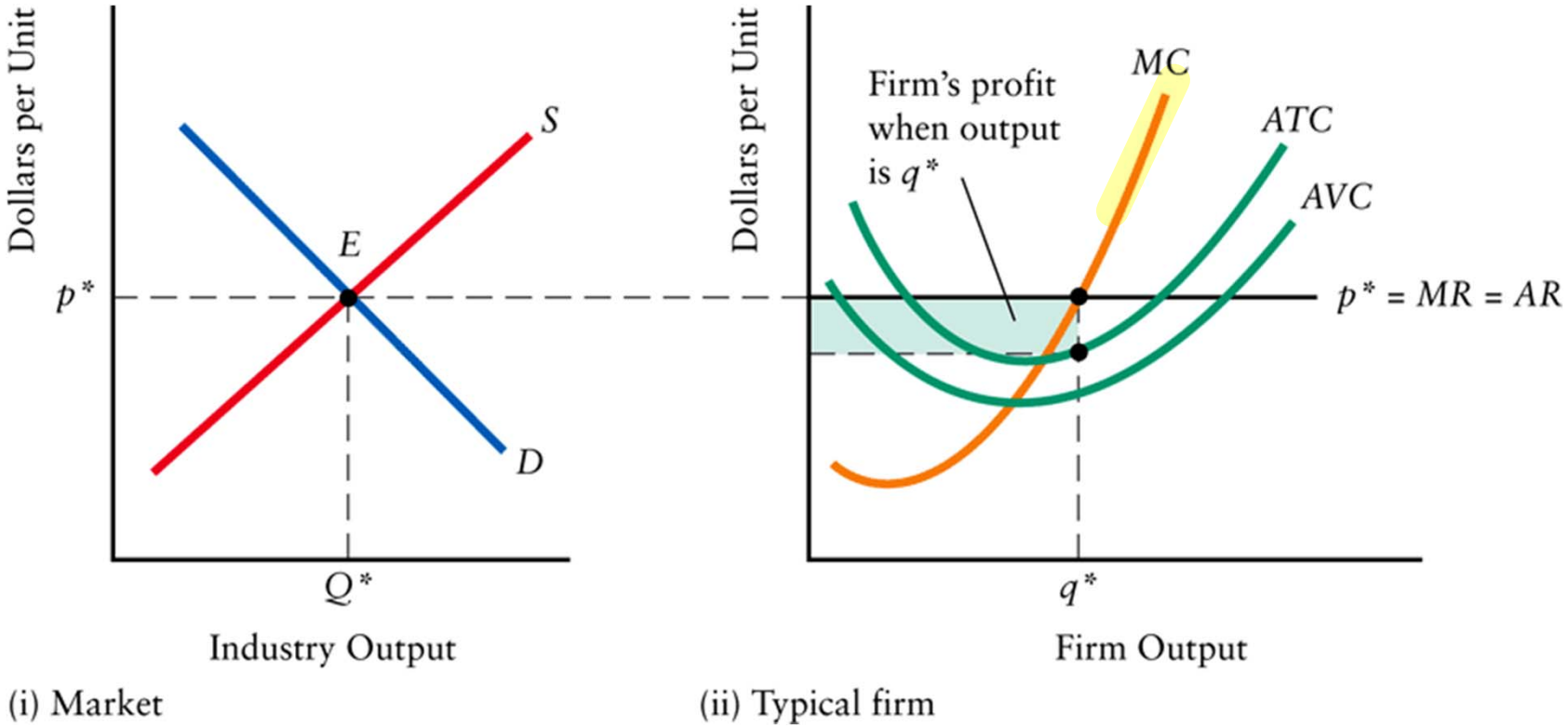
- The **break-even price** of a price-taking firm is the market price at which it earns zero profits.

- Whenever market price exceeds minimum average total cost, the producer is profitable.

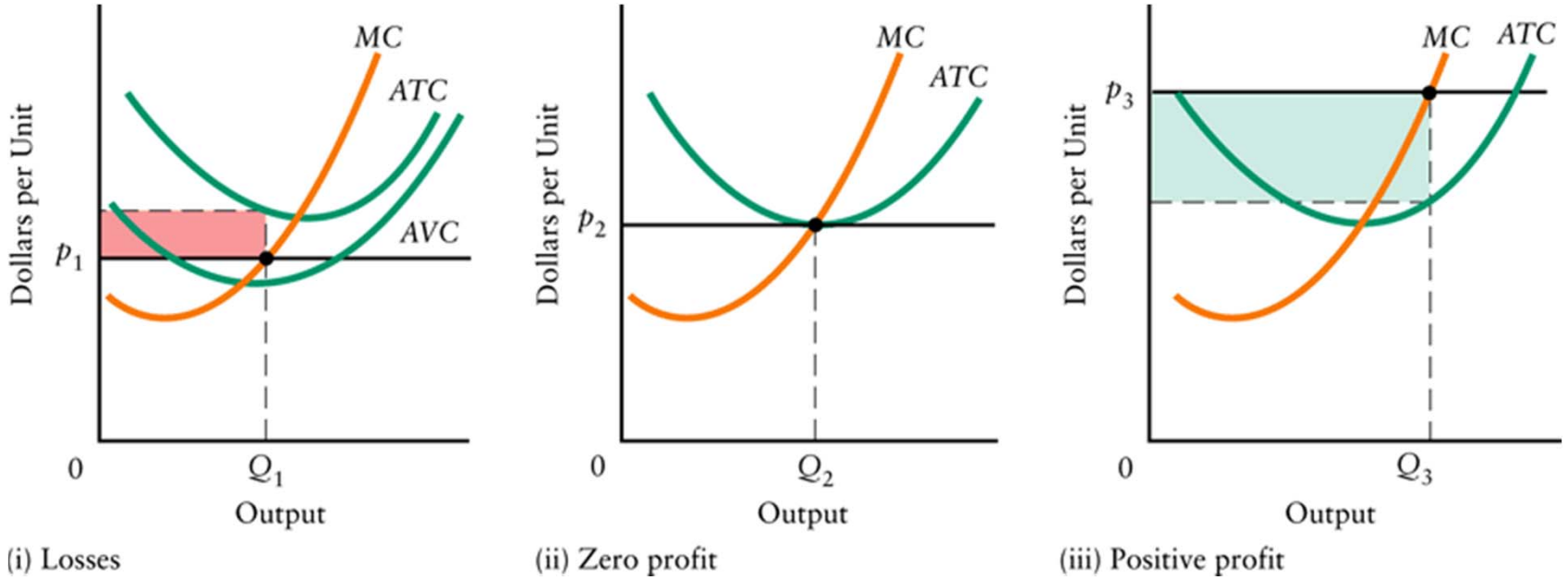
- Whenever the market price equals minimum average total cost, the producer breaks even.

- Whenever market price is less than minimum average total cost, the producer is unprofitable.

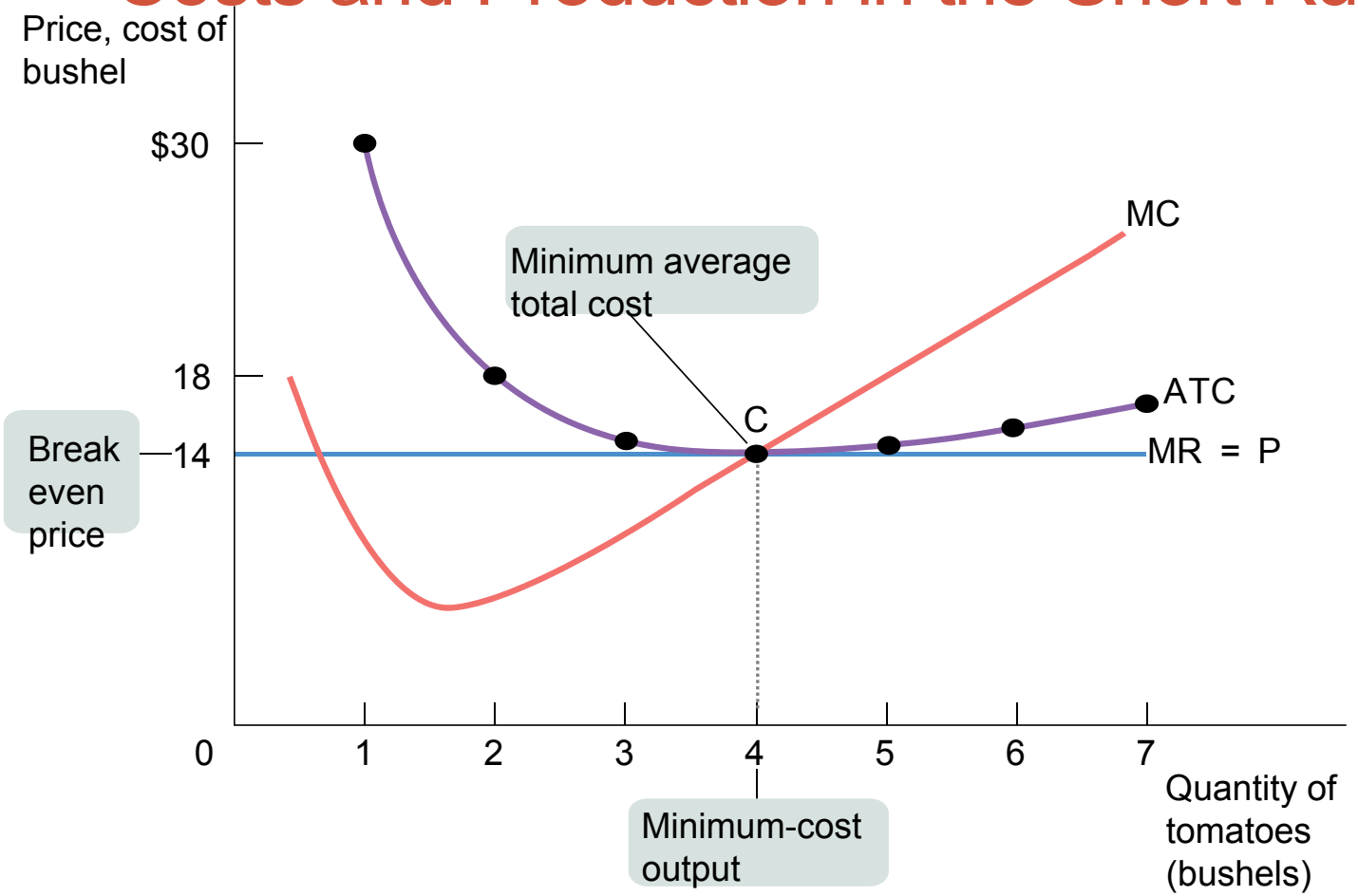
# A Typical Firm When the Competitive Market Is in Short-Run Equilibrium



# Alternative Short-Run Profits of a Competitive Firm



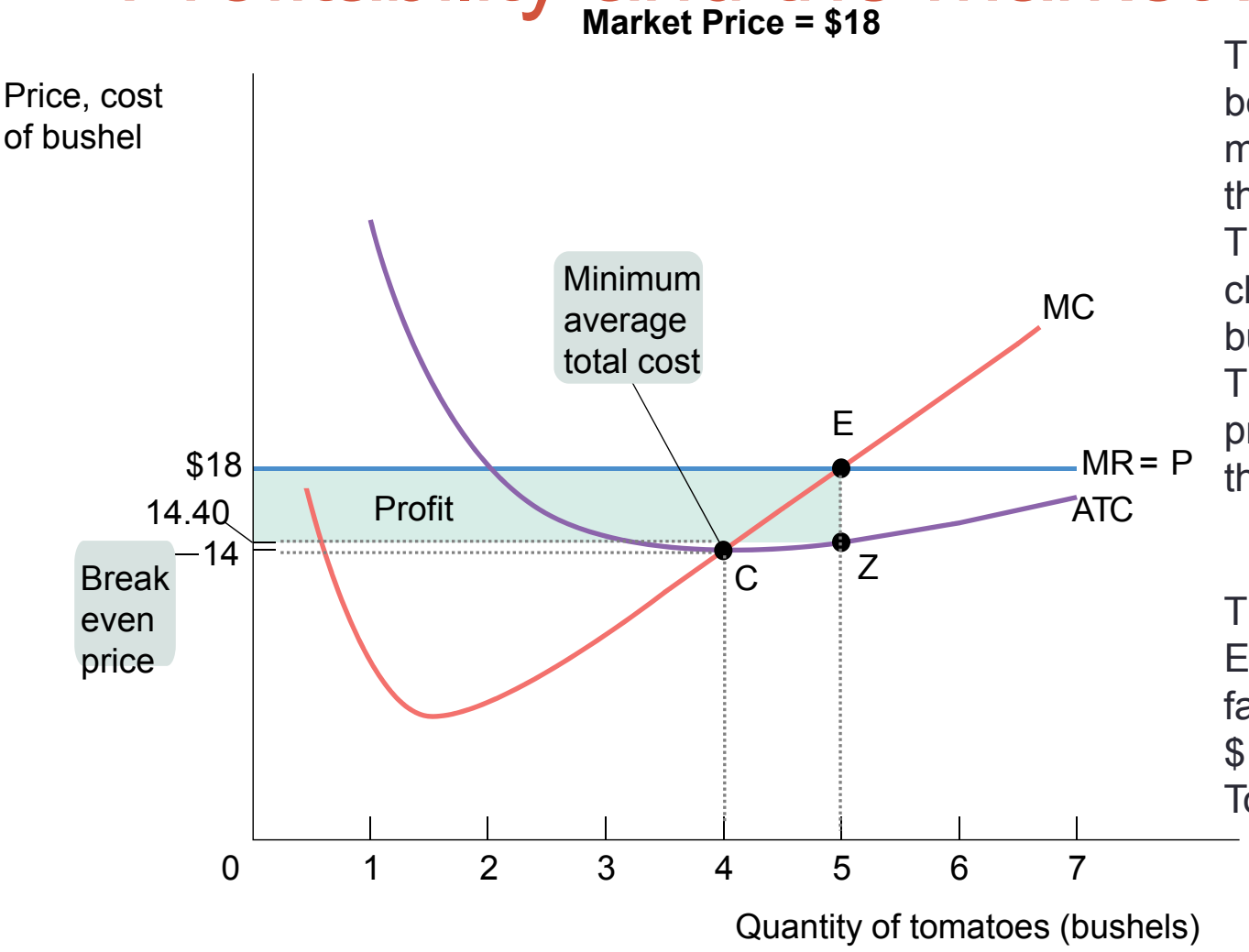
# Costs and Production in the Short Run




At point *C* (the minimum average total cost), the market price is $14 and output is 4 bushels of tomatoes (the minimum-cost output).

**This is where MC cuts the ATC curve at its minimum.**
**Minimum average total cost is equal to the firm's *break-even price*.**

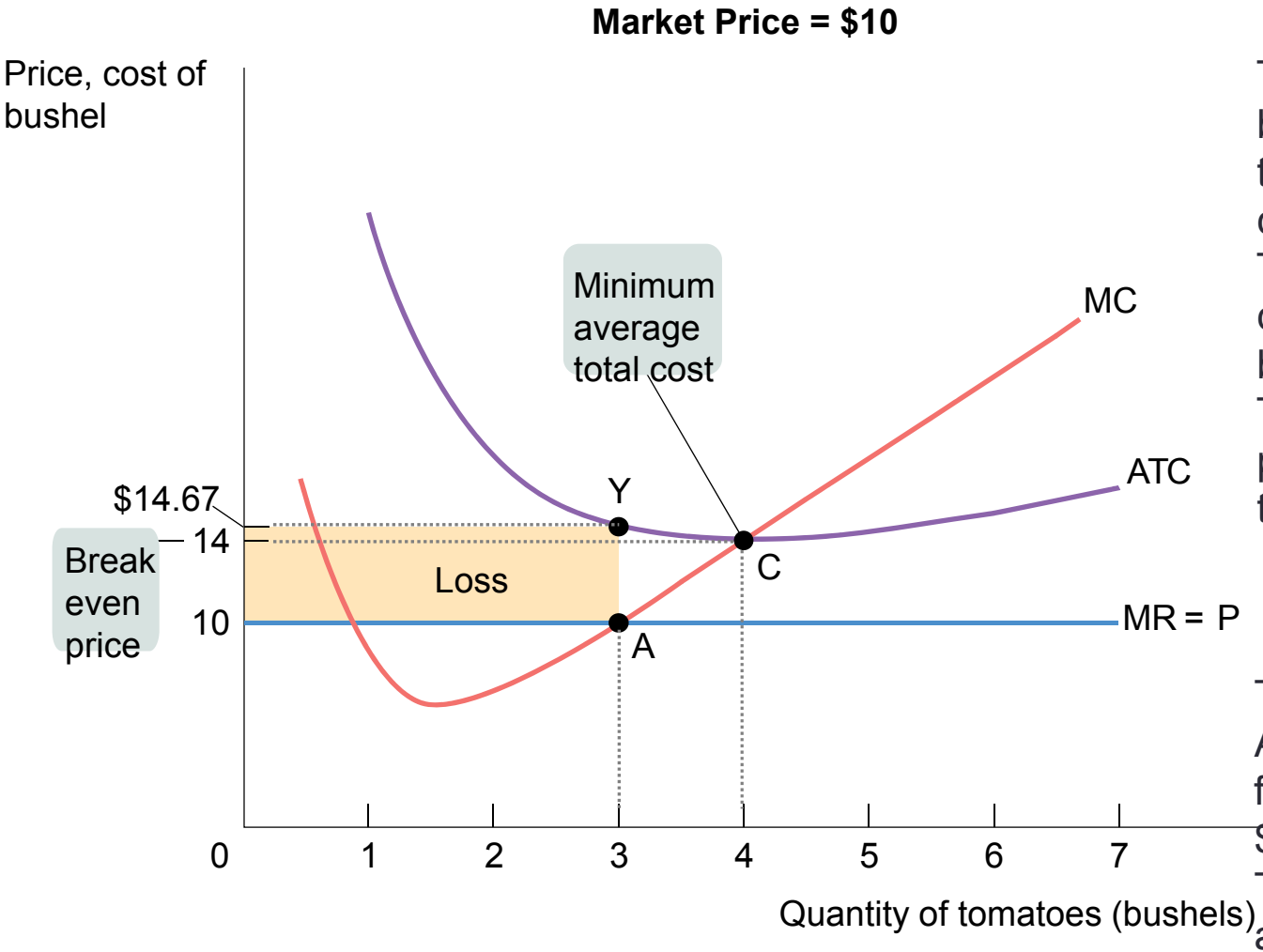
# Profitability and the Market Price




The farm is profitable because price exceeds minimum average total cost, the break-even price, $14.
The farm's optimal output choice is (E) → output of 5 bushels.
The average total cost of producing bushels is (Z on the *ATC* curve) →$14.40

The vertical distance between E and Z:
farm's per unit profit, $18.00 − $14.40 = $3.60
Total profit:5 × $3.60 = $18.00

# Profitability and the Market Price




The farm is unprofitable because the price falls below the minimum average total cost, $14.

The farm's optimal output choice is (A) → output of 3 bushels.

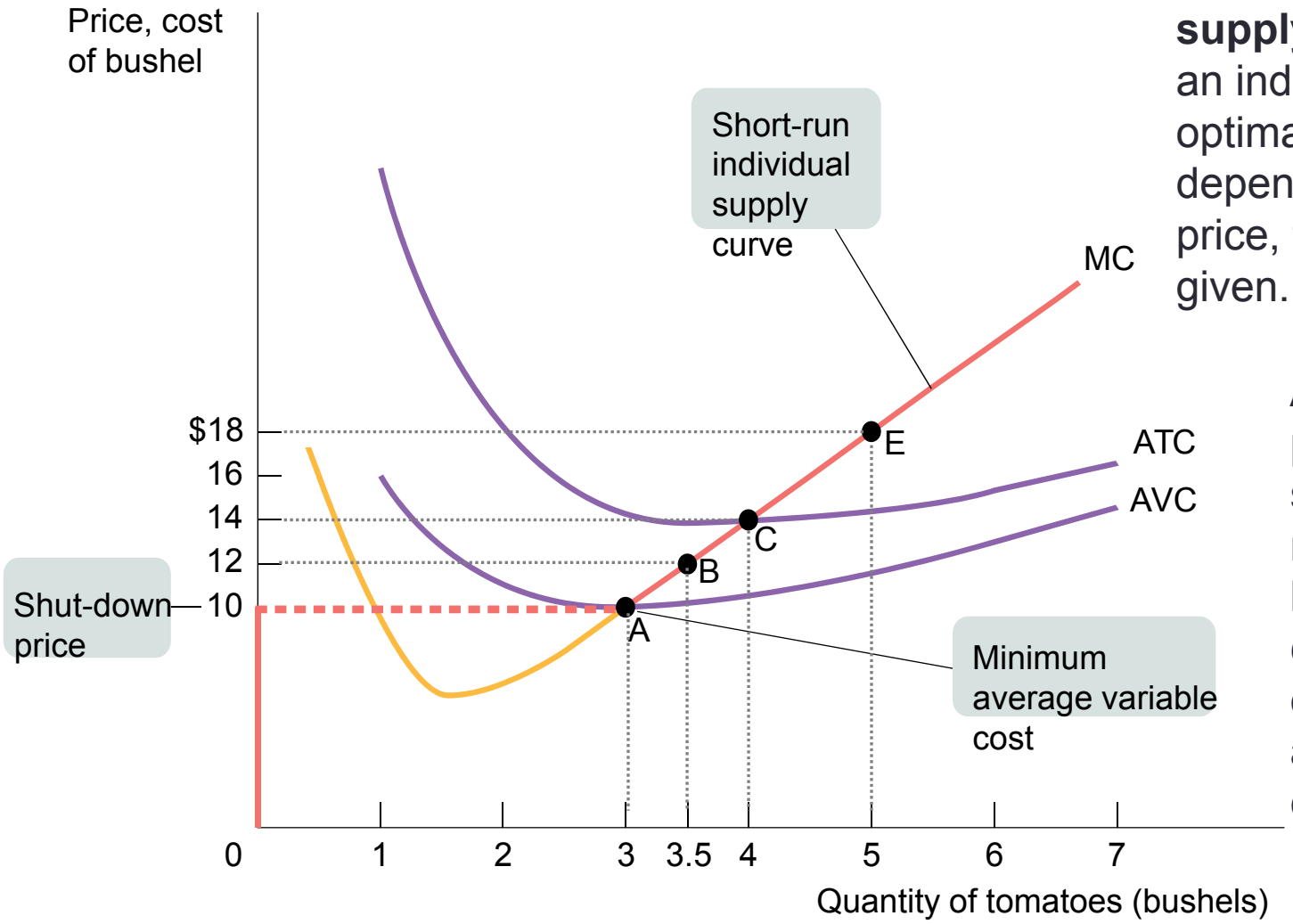
The average total cost of producing bushels is (Y on the *ATC* curve) →$14.67

The vertical distance between A and Y:

farm's per unit loss, $14.67 − $10.00 = $4.67

Total profit:3 × $4.67 = approx. $14.00

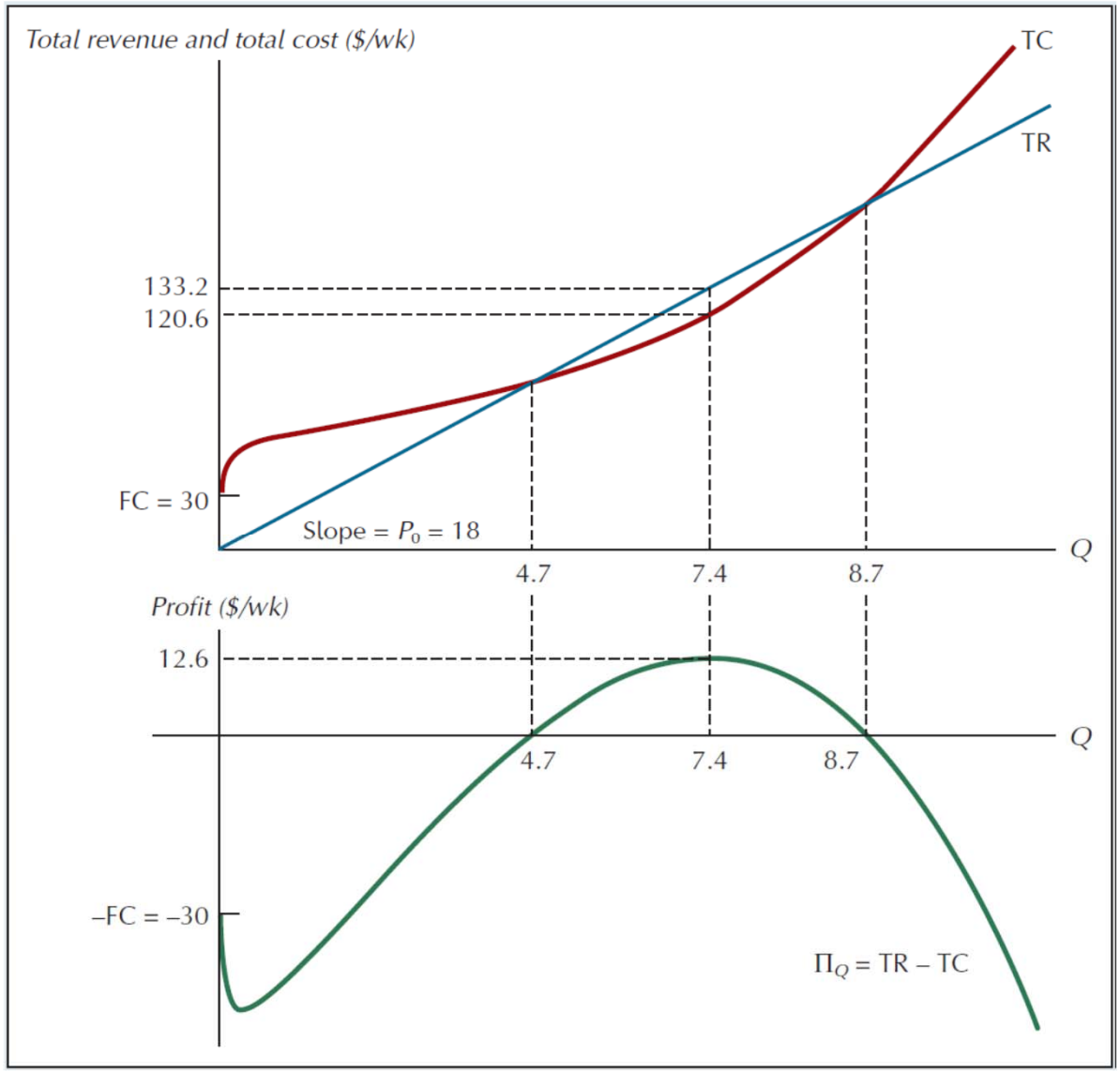
# The Short-Run Individual Supply Curve




The **short-run individual supply curve** shows how an individual producer's optimal output quantity depends on the market price, taking fixed cost as given.

A firm will cease production in the short run if the market price falls below the **shut-down price**, which is equal to minimum average variable cost.

# Revenue, Cost and Economic Profit



# Summary of the Competitive Firm's Profitability and Production Conditions

| Profitability Condition (minimum *ATC* = break-even price) | Result |
|---|---|
| $P >$ minimum *ATC* | Firm profitable. Entry into industry in the long run. |
| $P =$ minimum *ATC* | Firm breaks even. No entry into or exit from industry in the long run. |
| $P <$ minimum *ATC* | Firm unprofitable. Exit from industry in the long run. |
| **Production Condition (minimum *AVC* = shut-down price)** | **Result** |
| $P >$ minimum *AVC* | Firm produces in the short run. If $P <$ minimum *ATC*, firm covers variable cost and some but not all of fixed cost. If $P >$ minimum *ATC*, firm covers all variable cost and fixed cost. |
| $P =$ minimum *AVC* | Firm indifferent between producing in the short run or not. Just covers variable cost. |
| $P <$ minimum *AVC* | Firm shuts down in the short run. Does not cover variable cost. |

# The Efficiency Of Short-run Competitive Equilibrium

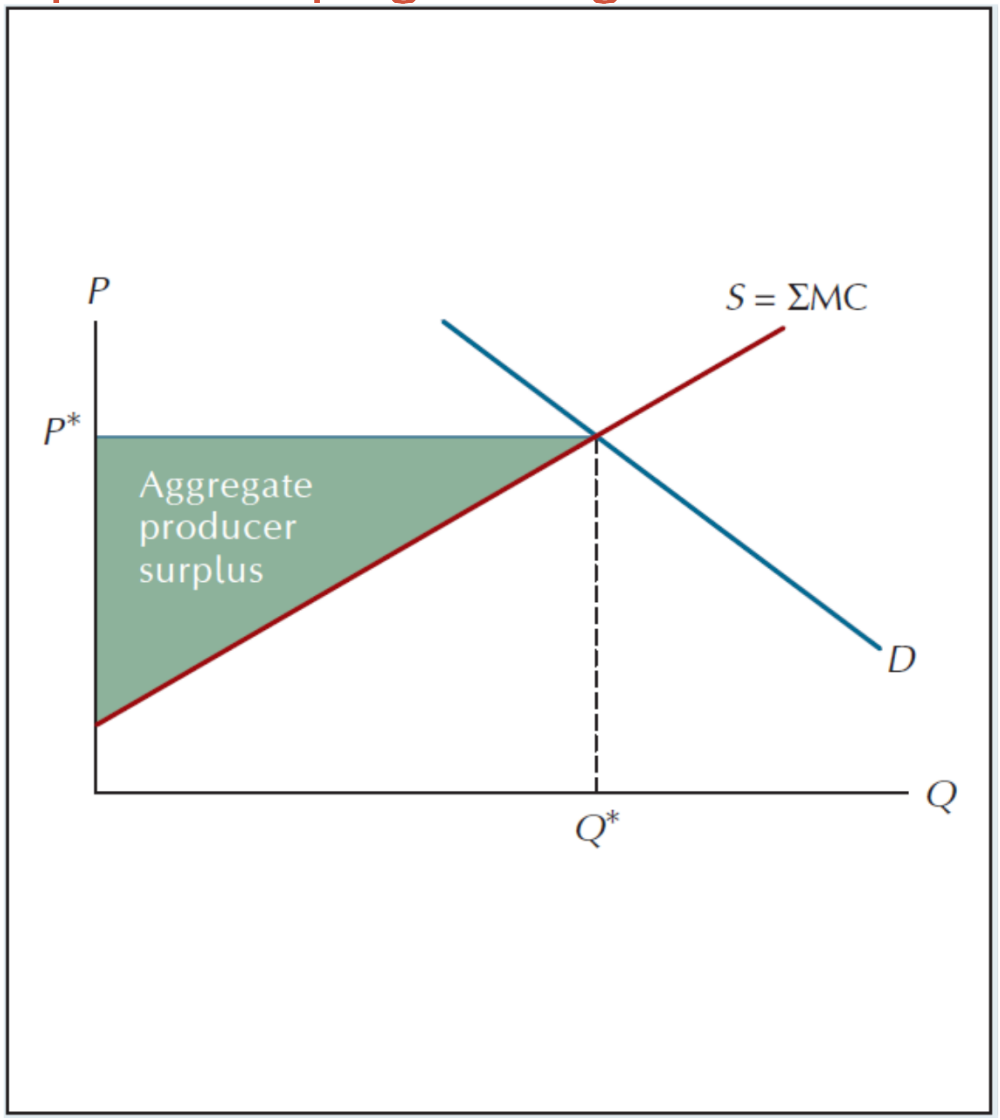
- ***Allocative efficiency:*** a condition in which all possible gains from exchange are realized.

# Producer Surplus

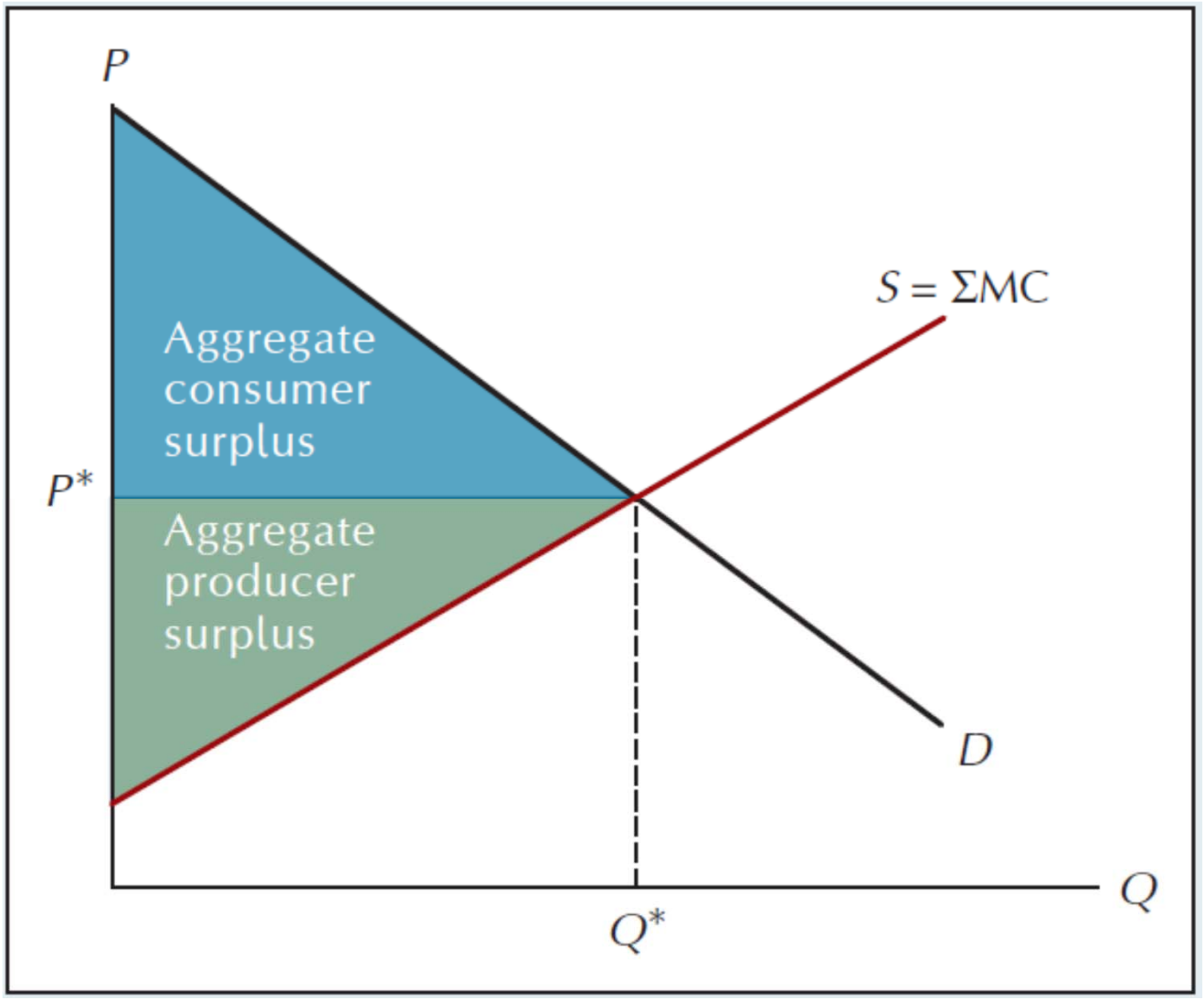
- A competitive market is efficient when it maximizes the net benefits to its participants.

- ***Producer surplus:*** the dollar amount by which a firm benefits by producing a profit-maximizing level of output.

# Aggregate Producer Surplus When Individual Marginal Cost Curves are Upward Sloping Throughout



# The Total Benefit from Exchange in a Market



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