Economics 2
Fall 2024

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LECTURE 7
Firms and Profit Maximization

I. Firms and the Decisions They Make

Three Decisions a Firm Has to Make

- Short-run choice of output: How much to produce today with the existing set-up?
- Long-run choice of output: Expand or contract? Exit the industry? Enter the industry?
- Both short-run and long-run – the choice of input mix: What combination of inputs (labor, capital, raw materials, and so on) to use to produce the output?

Profit Maximization

- We assume that firms' objective is to maximize their economic profits.
  - In reality, firms can also care about their workers, customers, communities
- The definition of economic profits:

  Profits = Total Revenue – Total Costs,

  where:
  - Total Revenue = Price * Quantity Sold
  - Total Cost = Opportunity Cost of All Inputs

What Is the Opportunity Cost to a Firm of:

- Raw materials the firm buys?
  - It's just what the firm pays.
- Unpaid labor the owner of the firm provides?
  - It's what the owner could have earned in their next best alternative job.
- Money the owner puts into the firm?
  - It's what the money what would earn in the next best alternative investment.

Quiz:

Question: Consider a family running a restaurant and owning the place where it operates. As a result, they don't pay rent, only property taxes. What's the opportunity cost of using the place for the restaurant?

- A. Zero, because they don't pay rent
- B. Only the property taxes
- C. The money they could get if they rented out the place to another business.
- D. None of A, B, C

II. Perfect Competition

Perfect Competition

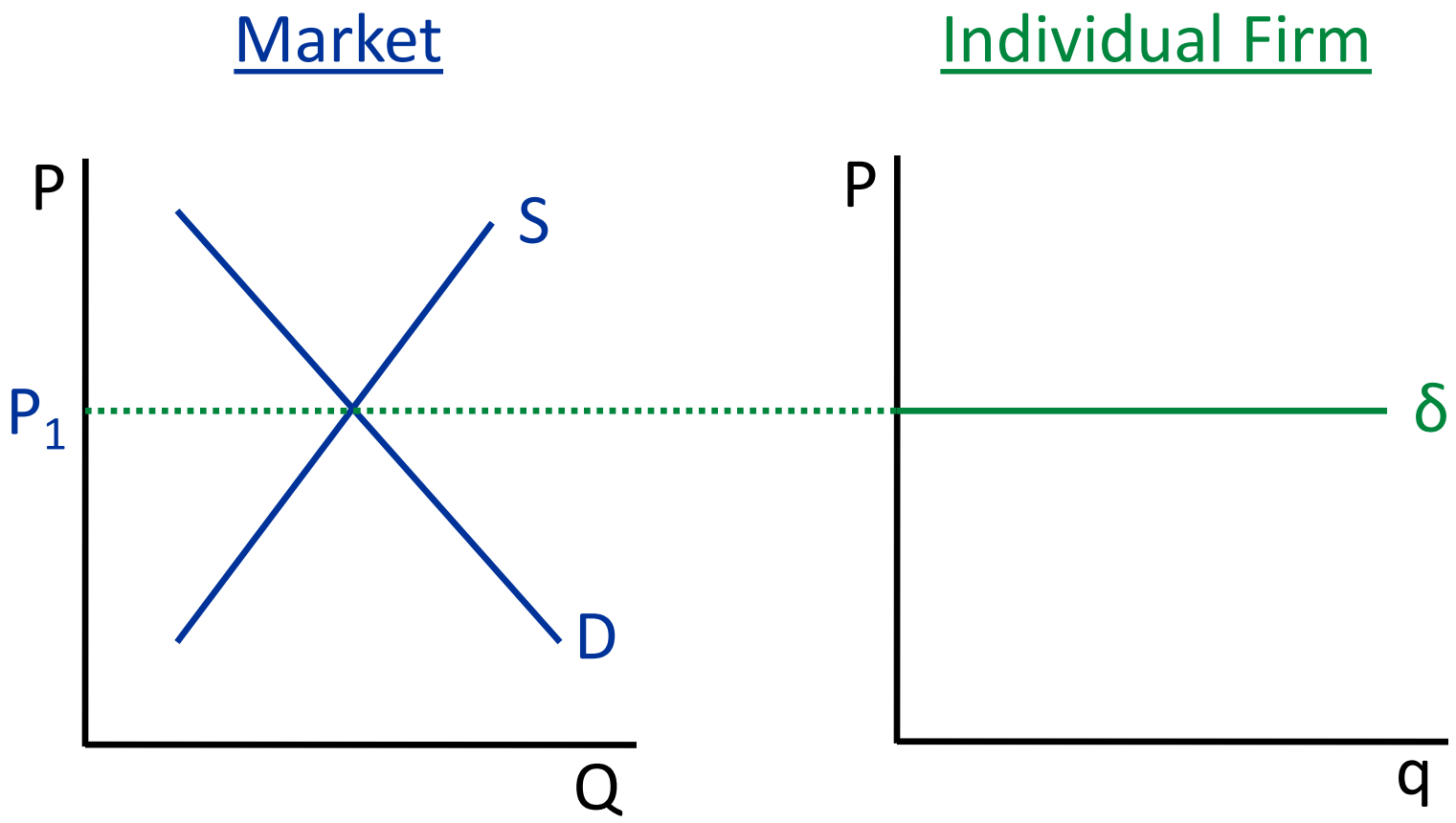
- Each firm is sufficiently small that its behavior has no impact on the prevailing market price.
- Occurs in industries with many firms, each of which is small relative to the overall size of the market.
- Small firms tend to predominate in industries where:
  - Output is fairly similar across firms.
  - It’s easy for new firms to enter.

Oil rig in North Dakota takes world oil prices as given

Why Do We Start with the Case of Perfect Competition?

- It's relatively simple
- It's an important reference point for economists (markets work well with perfect competition)
- We will study firms with market power later

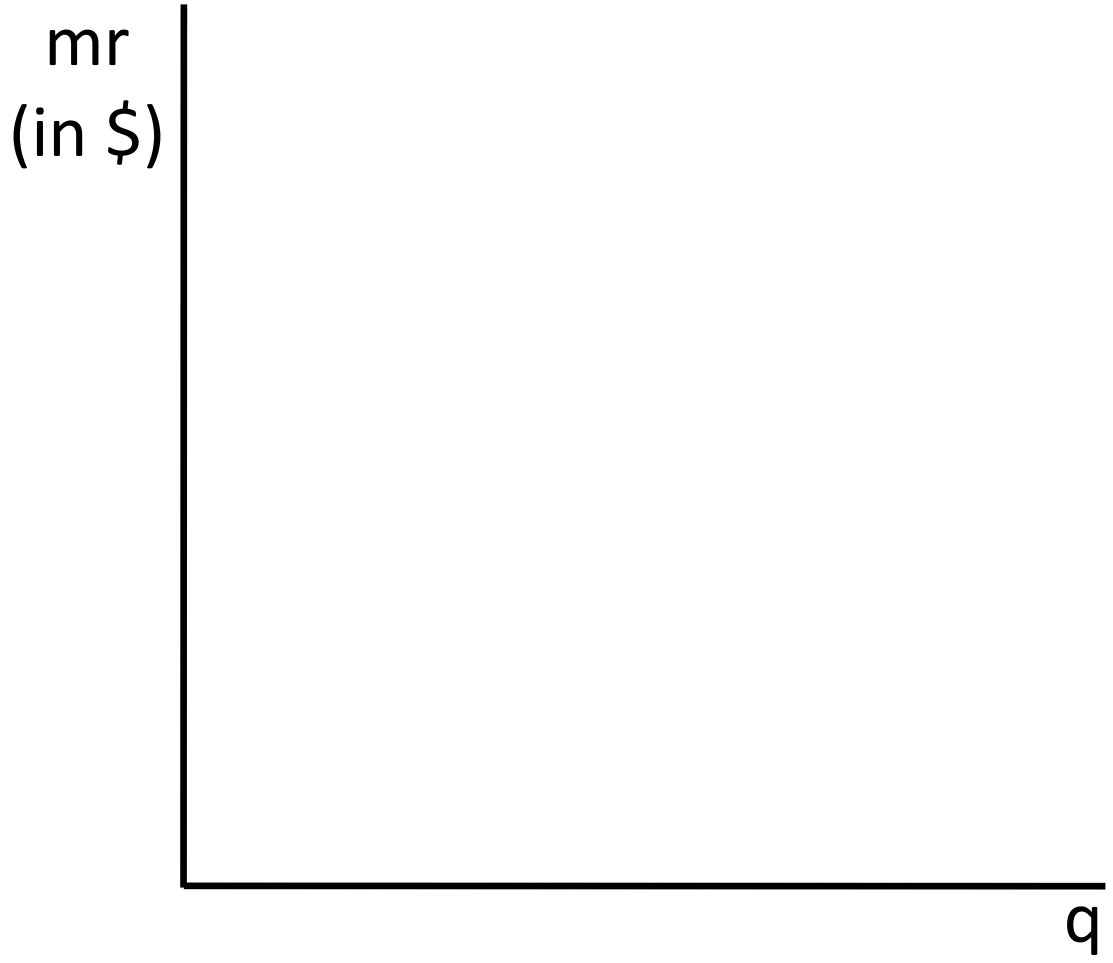
Market and Individual-Firm Demand Curves



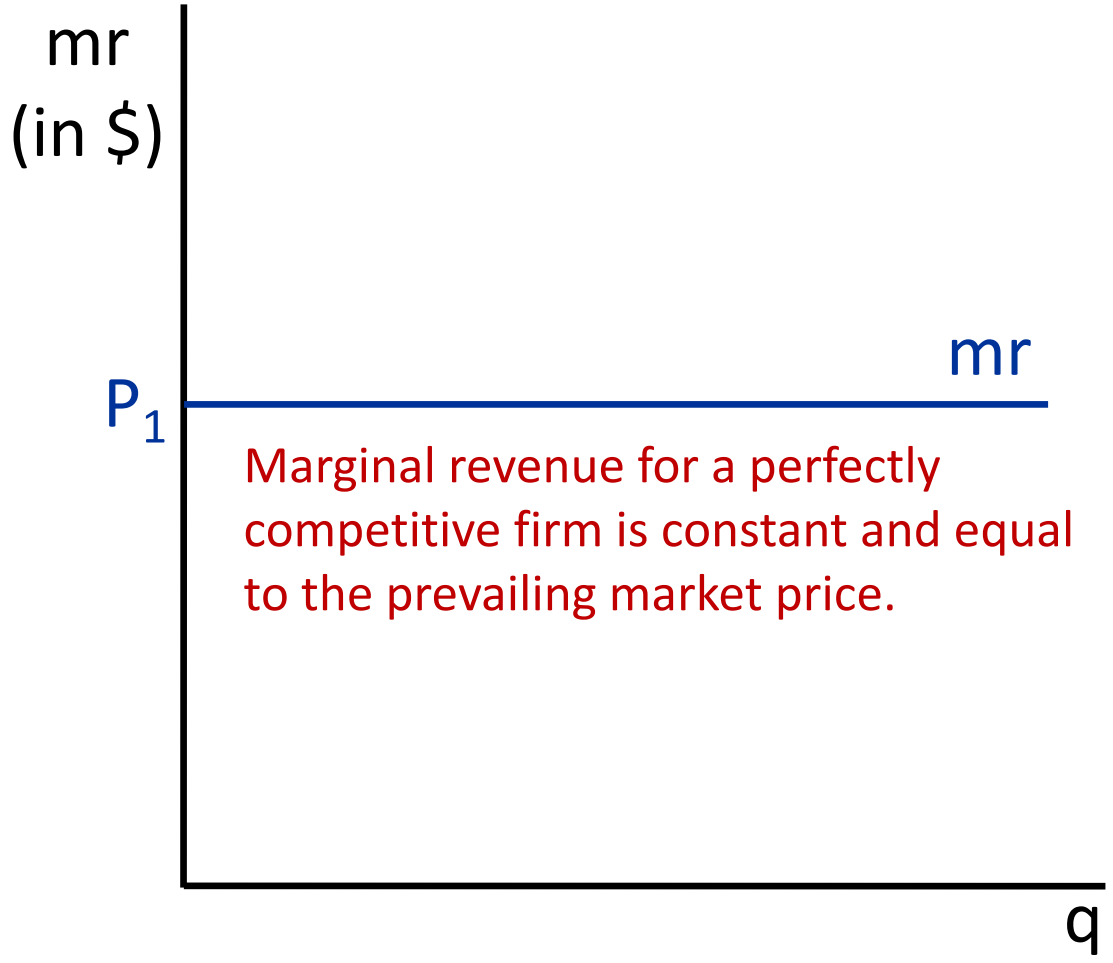
The demand curve facing a perfectly competitive firm is perfectly elastic at the prevailing market price.

III. Short-Run Profit Maximization

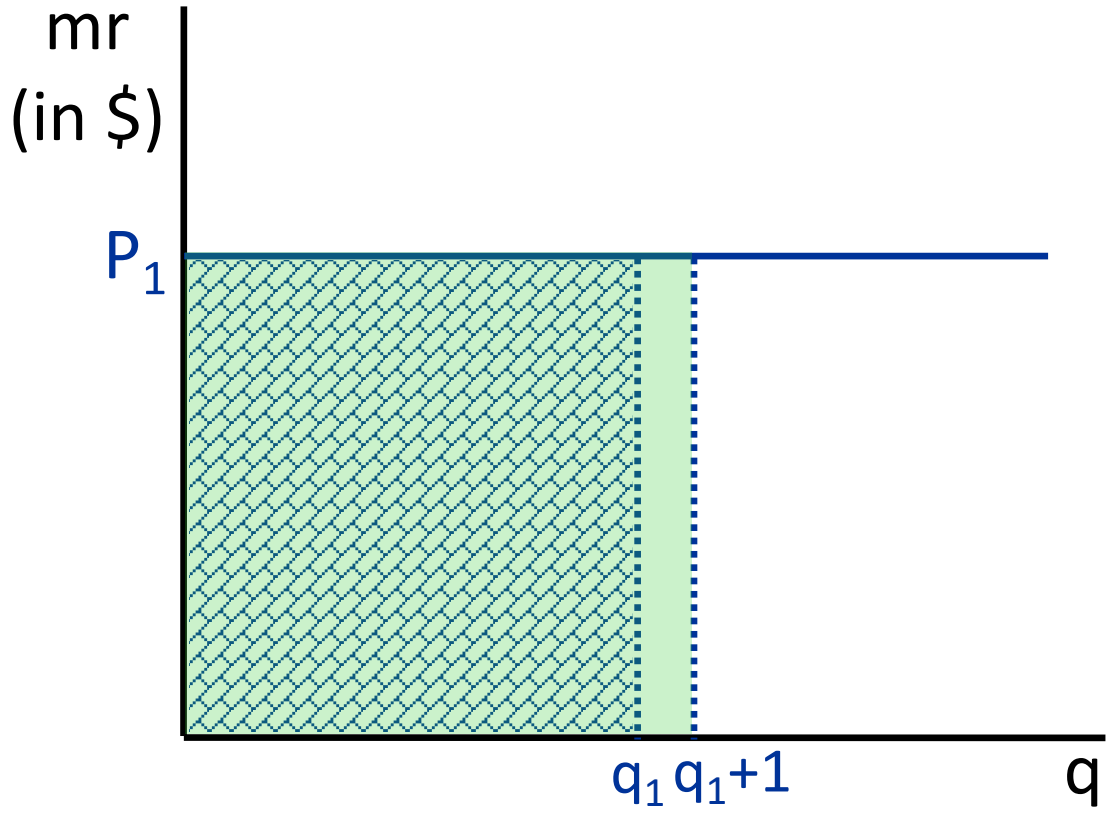
The Marginal Revenue Curve of a Perfectly Competitive Firm



The Marginal Revenue Curve of a Perfectly Competitive Firm



Marginal Revenue: The ***Additional*** Revenue Associated with Producing One More Unit



Total revenue at q_1: The rectangle with width q_1 and height P_1.

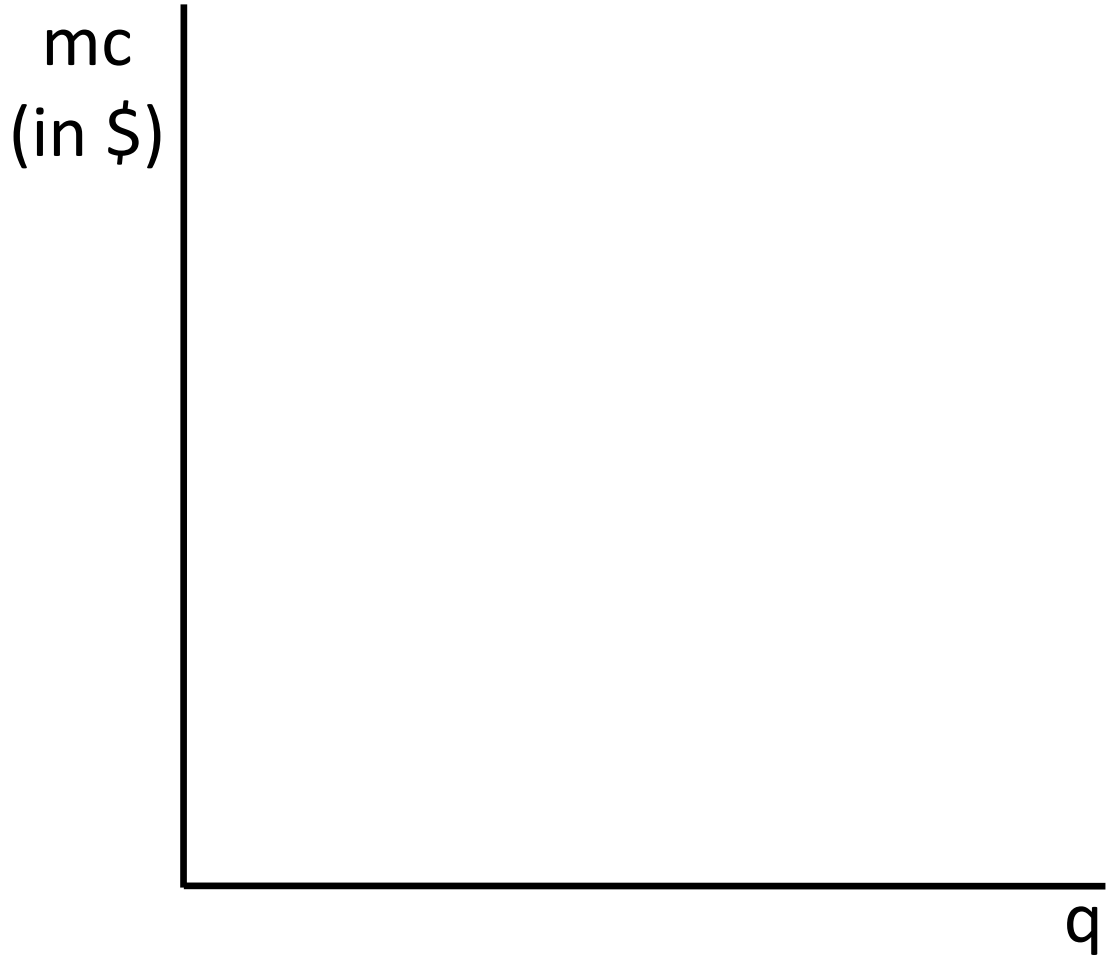
Total revenue at q_1+1: The rectangle with width q_1+1 and height P_1.

Marginal revenue at q_1: The rectangle with width 1 and height P_1.

Different Types of Costs

- Fixed costs: Costs that do not depend on how much is produced: C_f (drilling the oil well)
- Variable costs: Costs that do vary with how much is produced: $C_v(q)$ (pumping quantity q of oil out)
- Total costs: The sum of fixed and variable costs: $C(q)= C_f+C_v(q)$
- Marginal cost: The change in total costs from producing one more unit: $mc=C'(q)= C'_v(q)$
  - Note: Since fixed costs do not change when one more unit is produced, marginal cost is also equal to the change in variable costs from producing one more unit.

Marginal Cost: The Additional Cost Associated with Producing One More Unit



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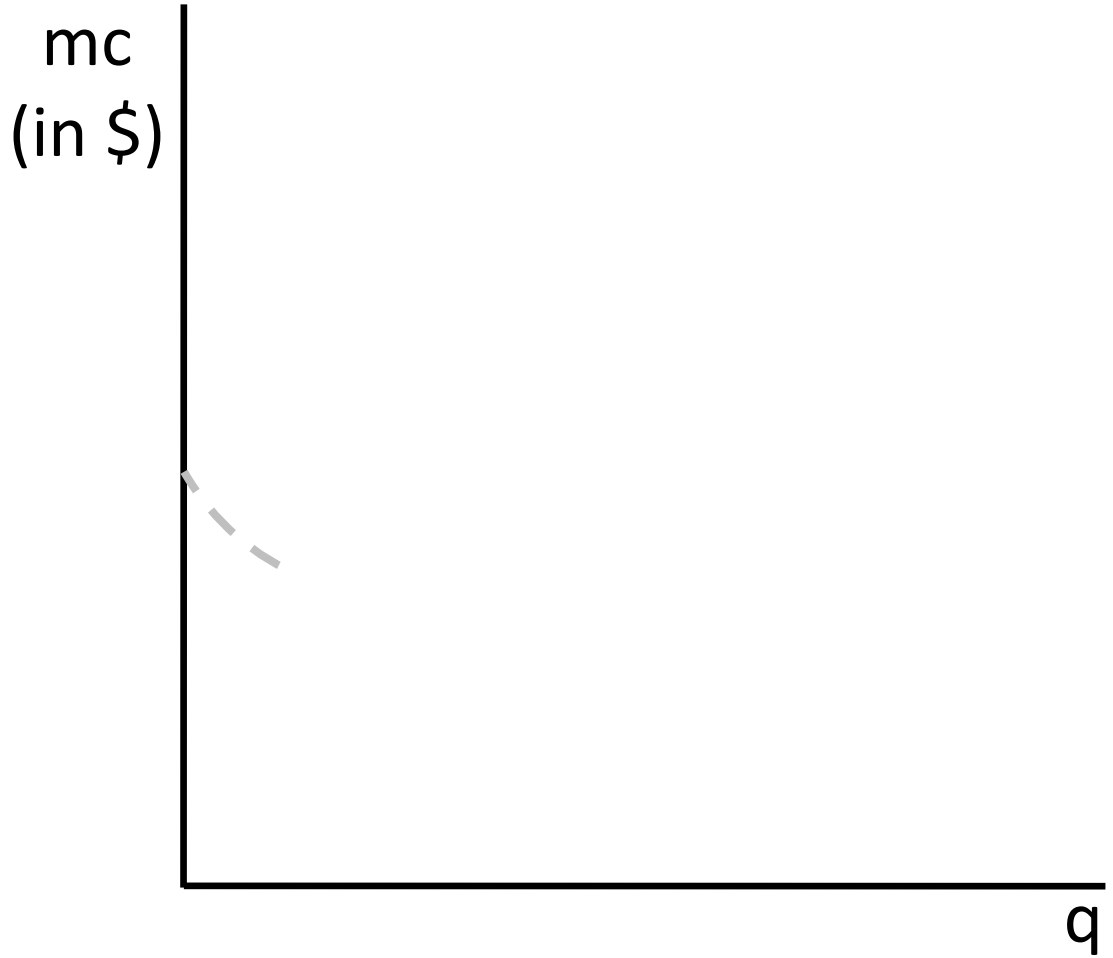
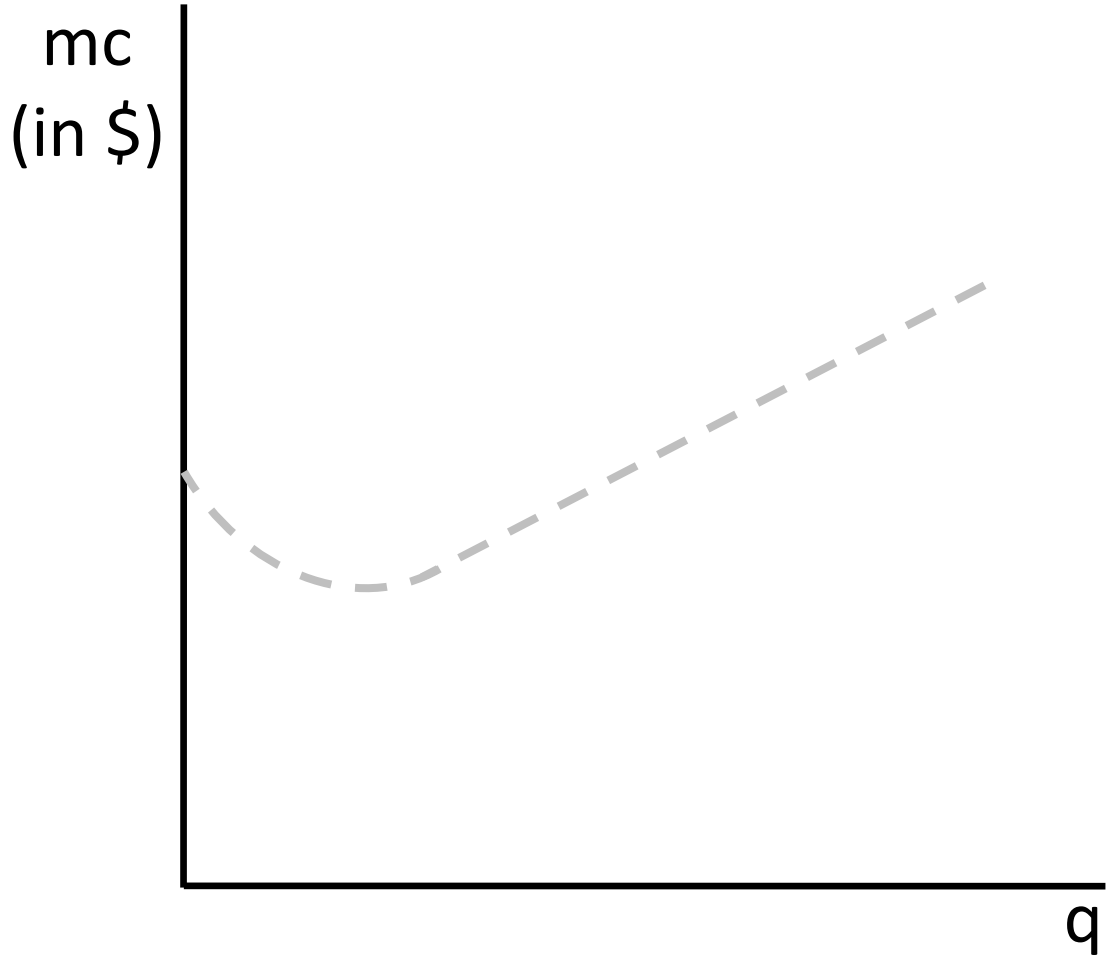


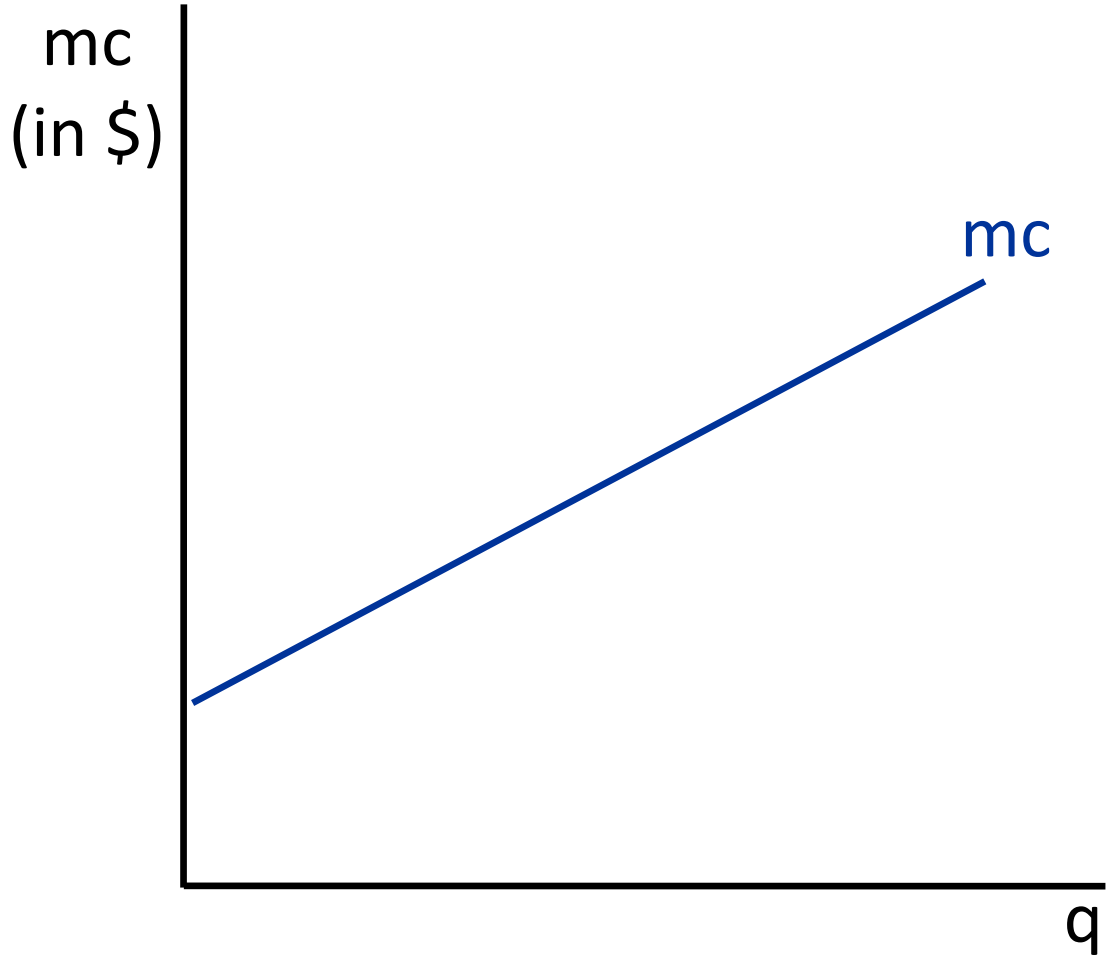
First there are economies of scale in production as it's less costly (per unit) to produce in bulk

Marginal Cost: The Additional Cost Associated with Producing One More Unit



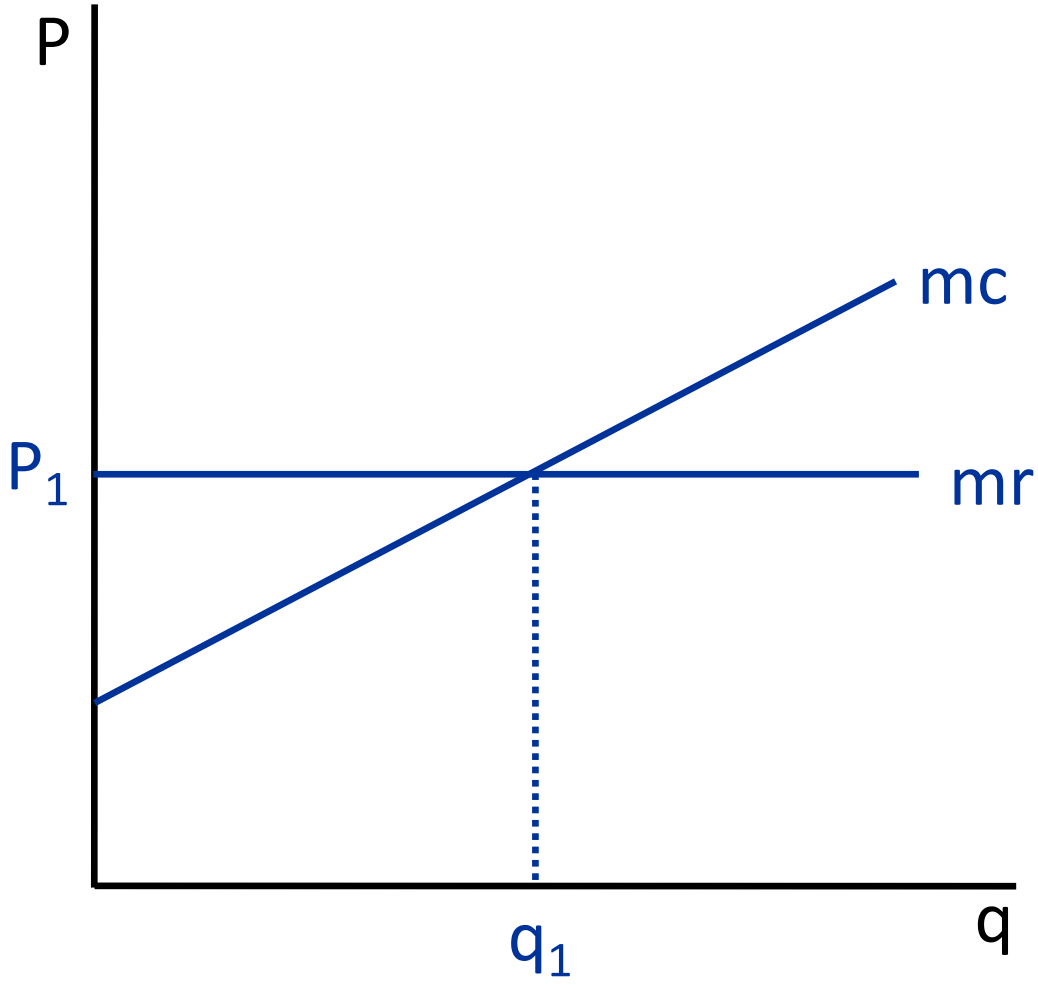
Second, there are diseconomies of scale in production due to constraints (for example only 1 factory)

Marginal Cost: The Additional Cost Associated with Producing One More Unit

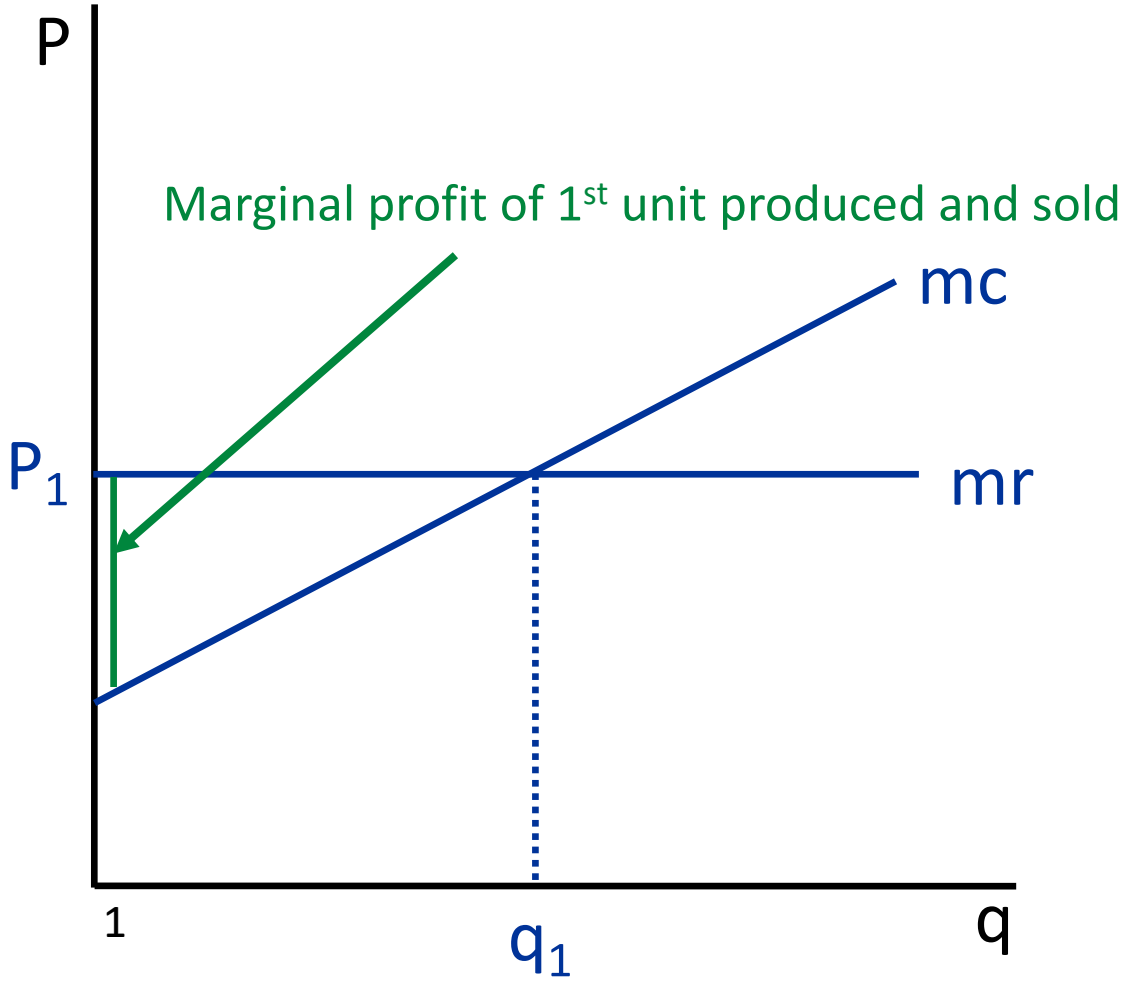


We assume upward mc because competitive model does not work well with declining mc (leads to monopoly)

The Profit-Maximizing Level of Output for a Perfectly Competitive Firm



Marginal profit is marginal revenue minus marginal cost



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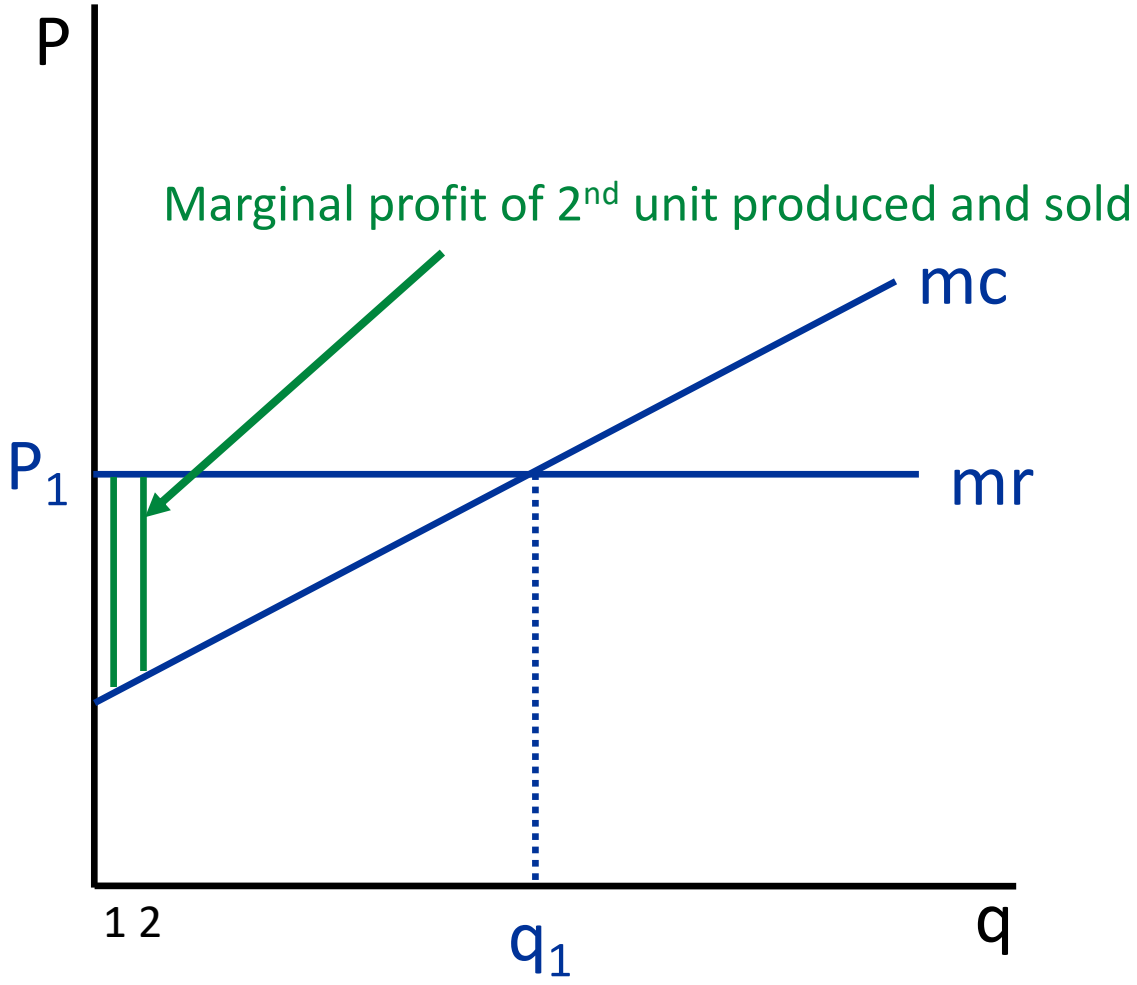
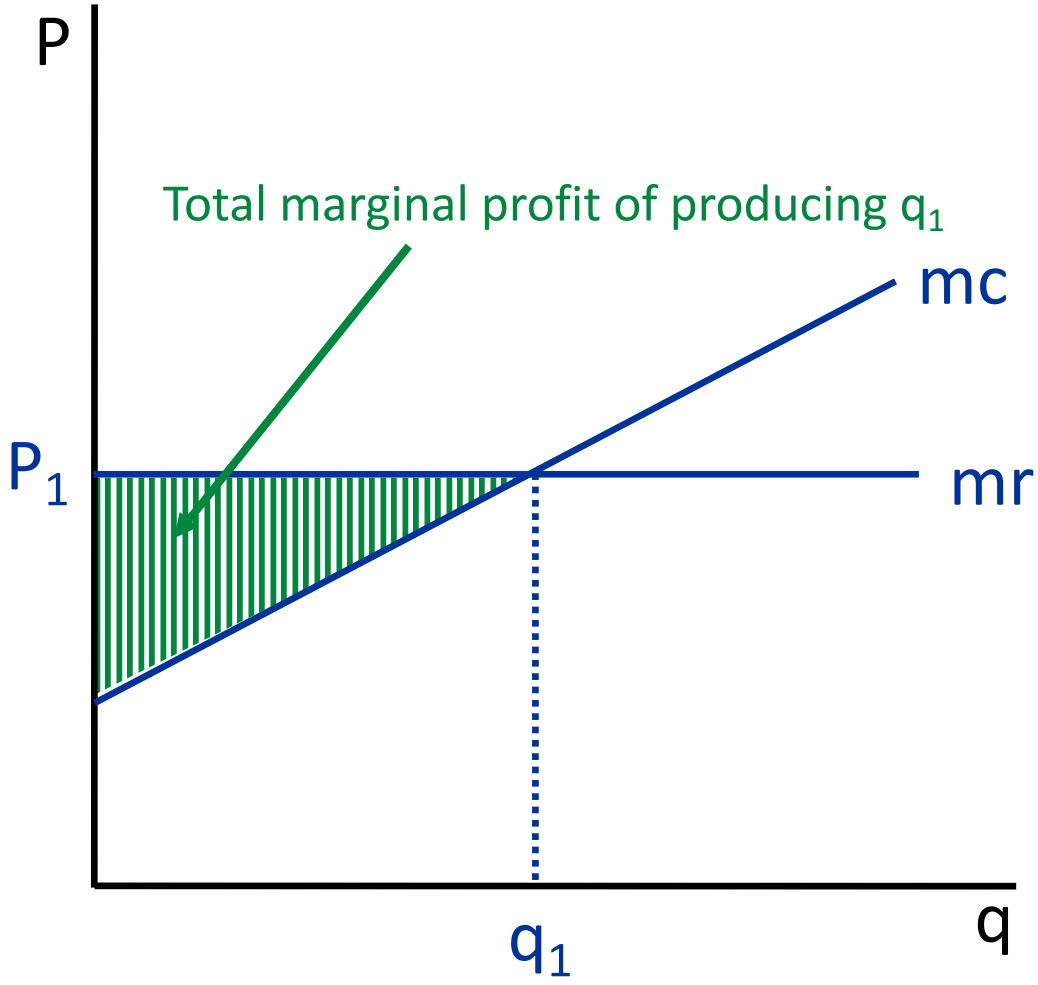


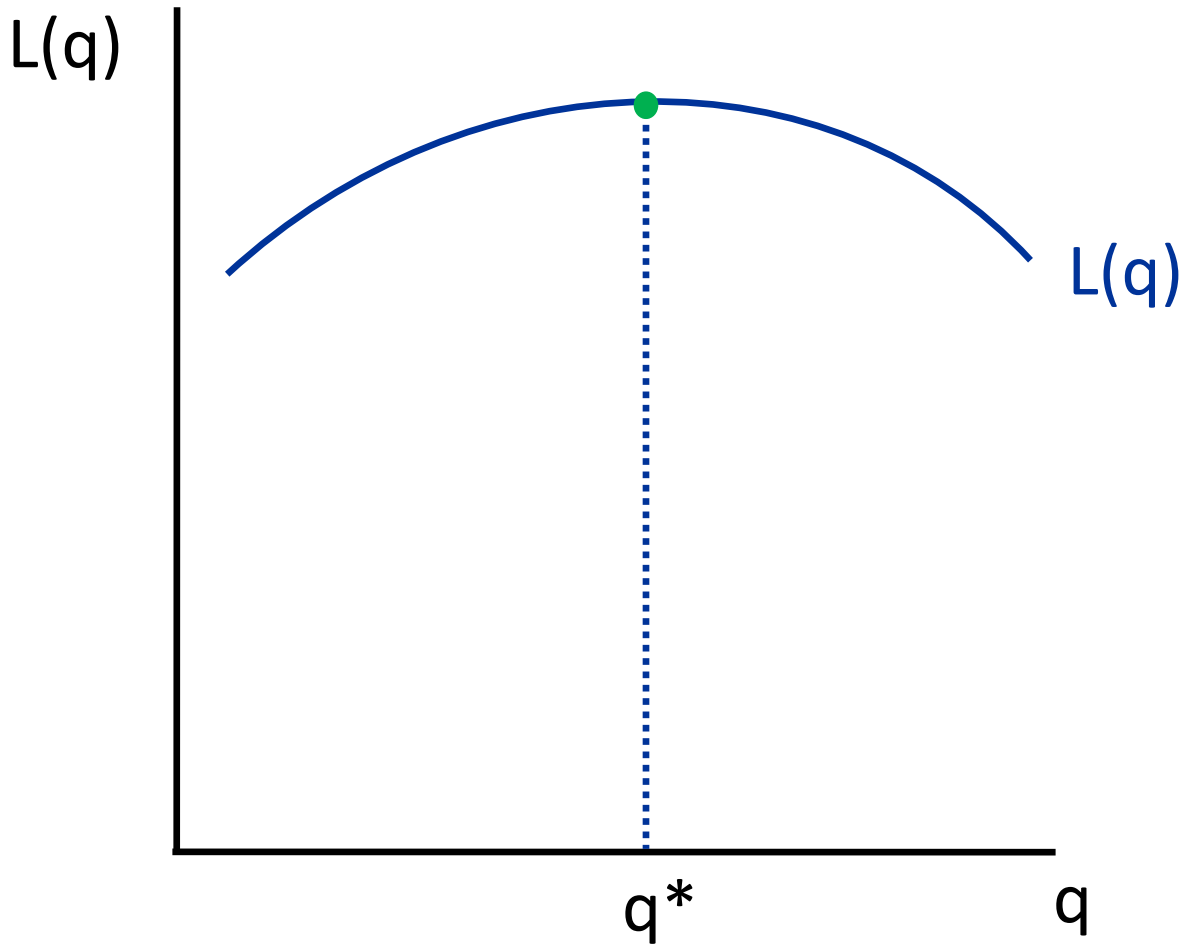
Competitive firm produces up to point where mc=mr



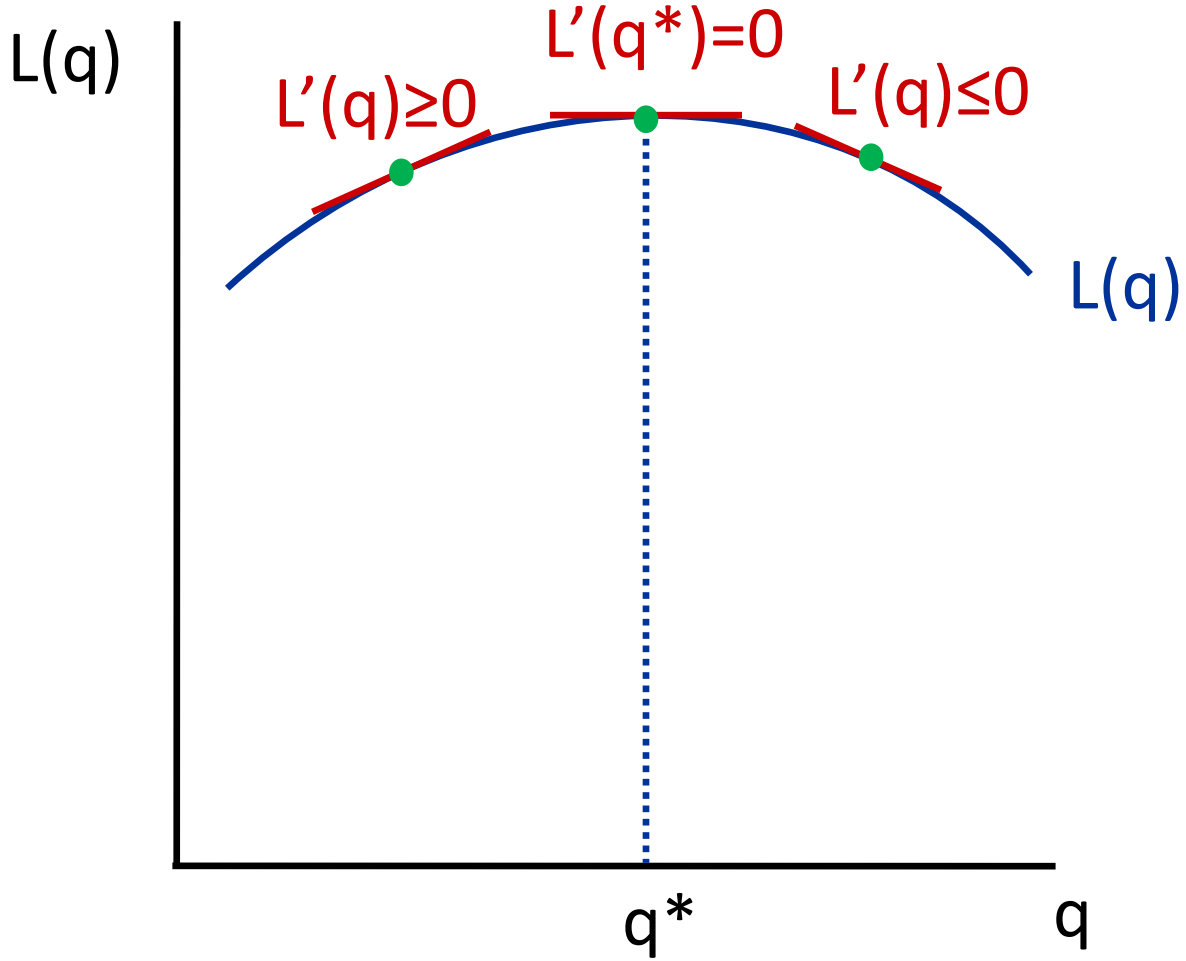
Mathematical maximization

- Consider a smooth function q → L(q)
- If L(q) is maximized at q* (interior) then:
- L’(q*)=0 (slope is zero at the top of the smooth hill): this is called the **FIRST ORDER CONDITION**
- L’(q) ≥ 0 for q just below q* and L’(q) ≤ 0 for q just below q*: this is the **SECOND ORDER CONDITION**
- First and second order conditions are necessary at interior maximum but not always sufficient

Mathematical maximization



Mathematical maximization



Slope is flat at top of the hill (L’(q*)=0), uphill below q* (L’(q) ≥0) and downhill below q* (L’(q)≤0)

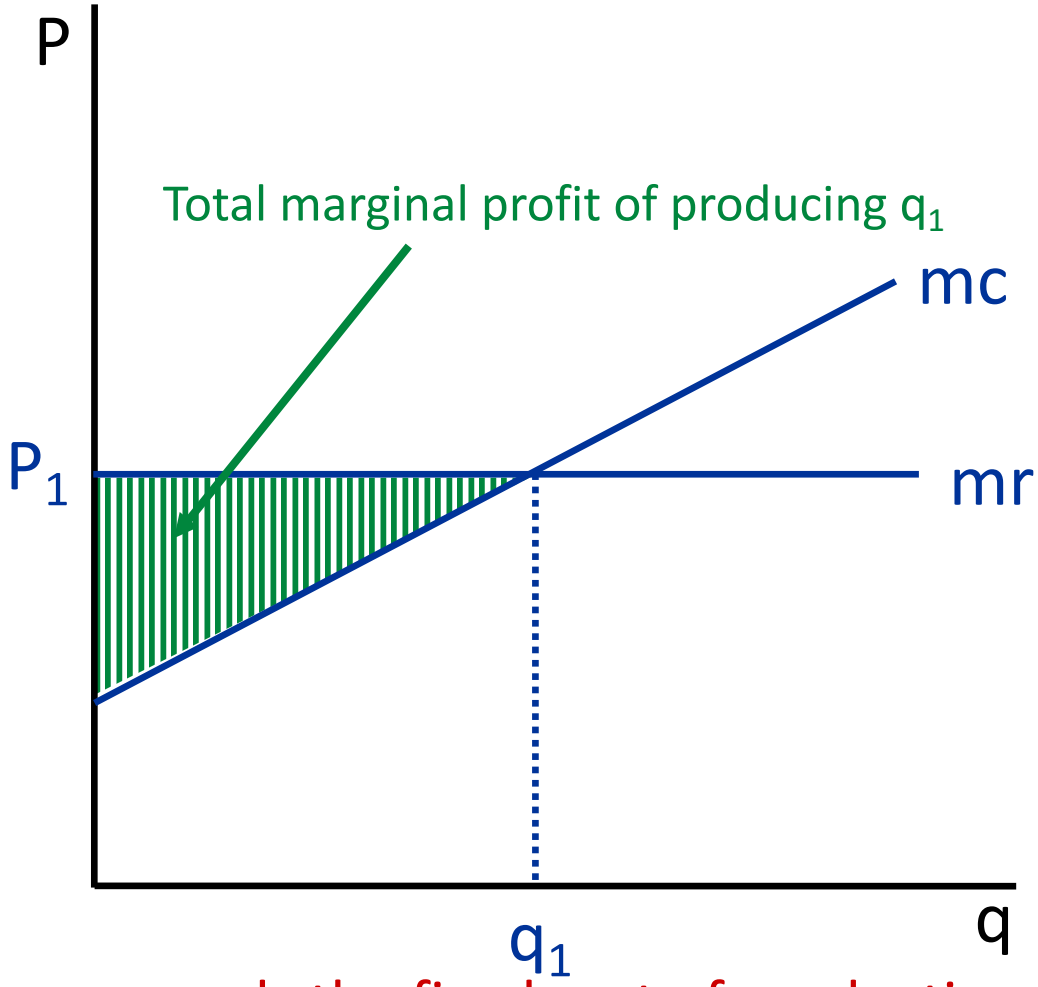
Condition for Profit-Maximization

- Marginal Revenue = Marginal Cost (mr = mc)
- For a perfectly competitive firm, this is same as:

  Price = Marginal Cost (P = mc).

- Mathematically: choose q to maximize P×q-C(q)
  - where C(q) is total cost of producing quantity q
  - Function is maximized when derivative with respect to q is zero (taking P as fixed parameter)
  - Implies P-C'(q)=0, which is P=C'(q)=mc

Entry decision of competitive firm: Compare total marginal profits and fixed costs



If green area exceeds the fixed cost of production C_f then the firm enters and produces q_1.

Quiz 1:

Question: Consider an existing oil drill in North Dakota with marginal cost of producing 1 barrel of oil at $50. Suppose, price of oil falls permanently from $80 to $60. What should the business do?

- A. Keep pumping oil out
- B. Keep pumping oil only if this can recoup the fixed cost
- C. Stop pumping oil.
- D. A, B, C could be true, it depends on parameters

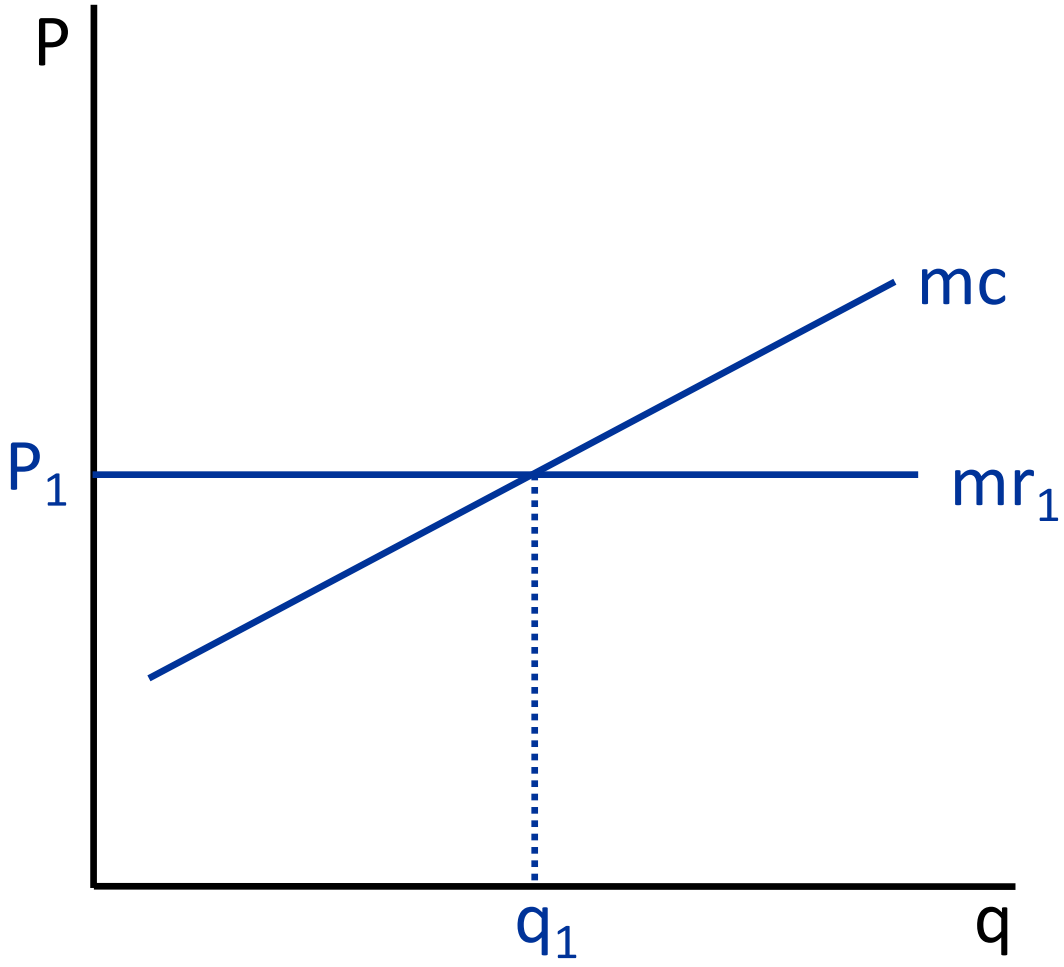
Quiz 2:

Question: Consider an oil drill project in North Dakota with marginal cost of producing 1 barrel of oil at $50. Suppose the price of oil is expected to be $60. Should the project go ahead?

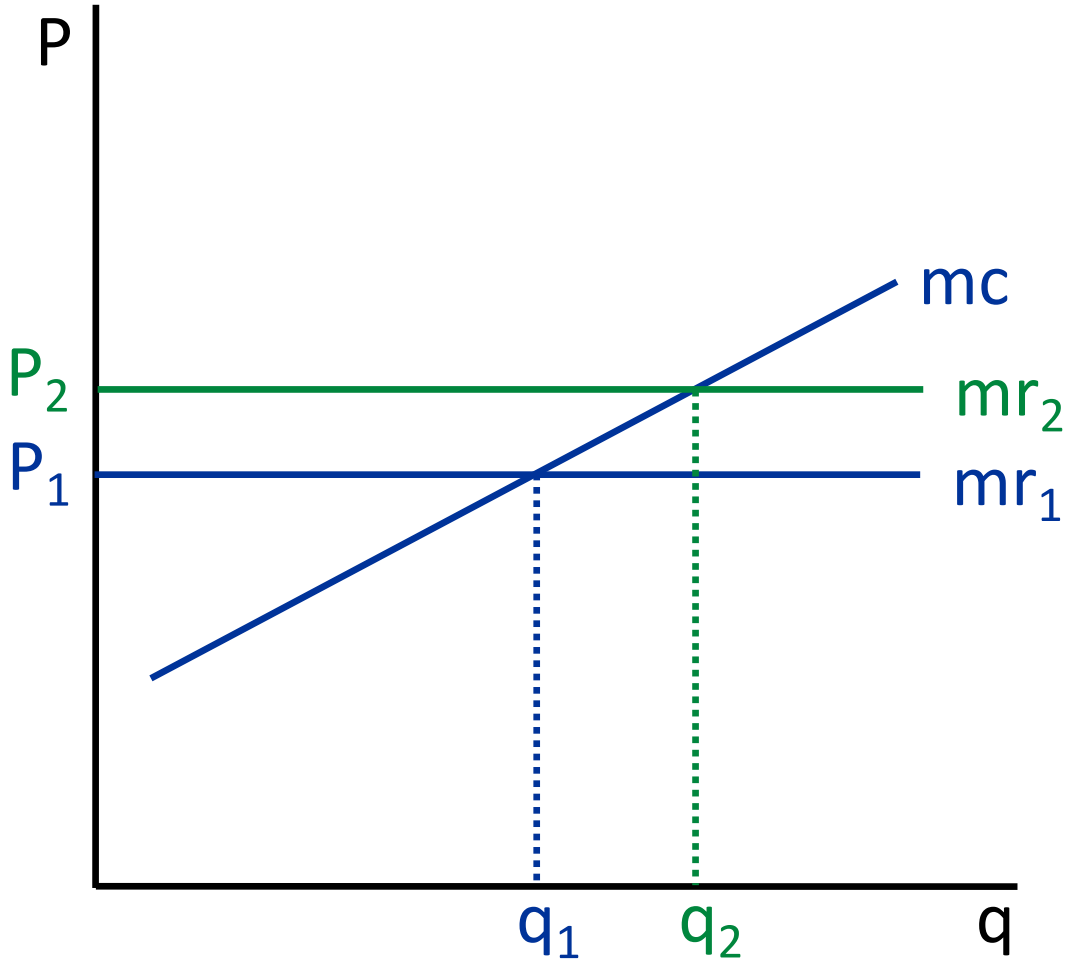
- A. Yes
- B. Yes if fixed costs are small enough
- C. Yes if fixed costs are large enough
- D. No
- E. Either A, B, C, D could be true, it depends.

IV. Why Supply Curves Slope Up

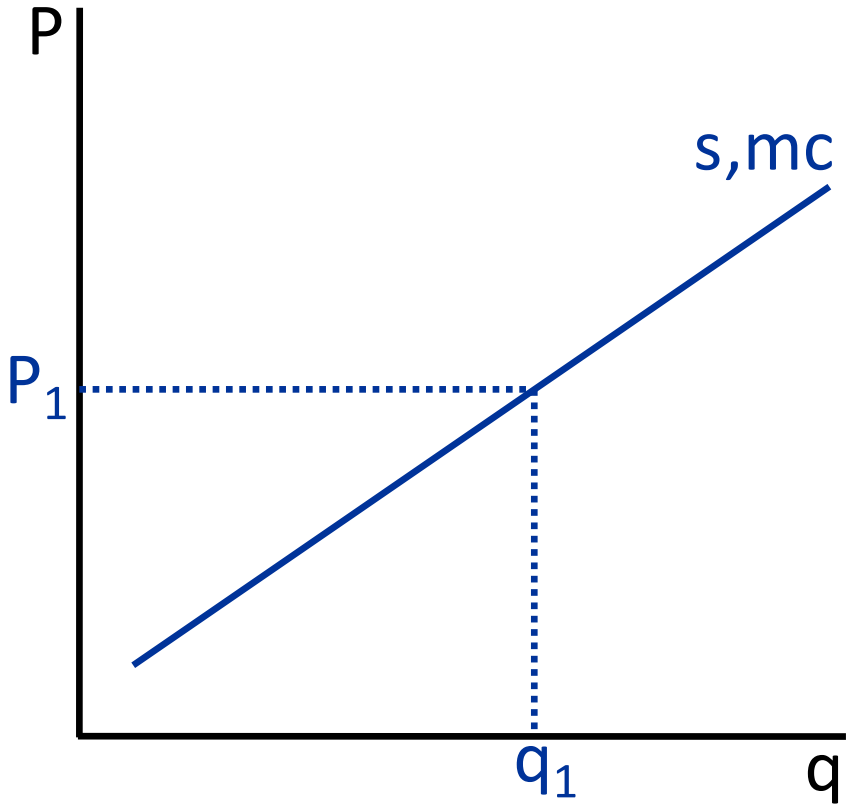
Impact of a Rise in the Market Price



Impact of a Rise in the Market Price



A Firm's Supply Curve



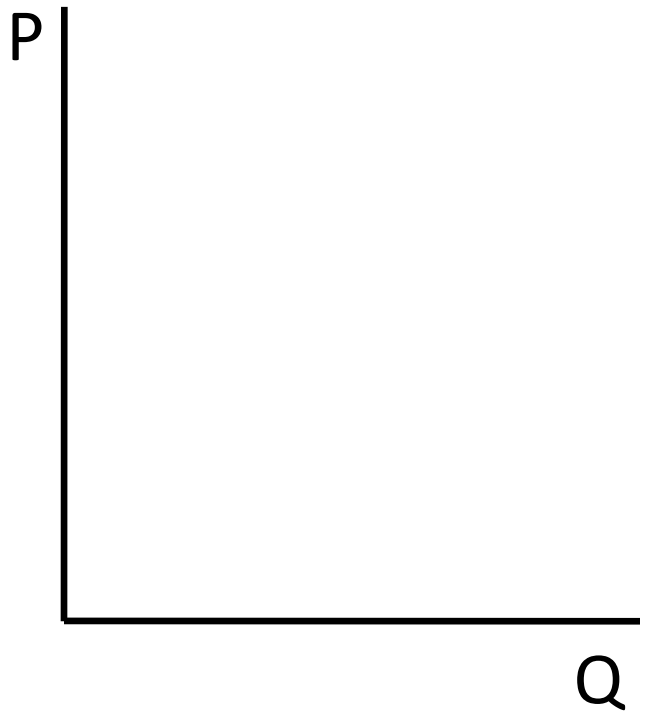
- It shows the quantity the firm supplies as a function of price.
- It also shows the price it takes to get the firm to supply a given quantity. Since that price is the firm's marginal cost at that quantity, this means that the firm's supply curve is also its marginal cost curve.

Two Ways of Thinking about an Individual Firm's Supply Curve

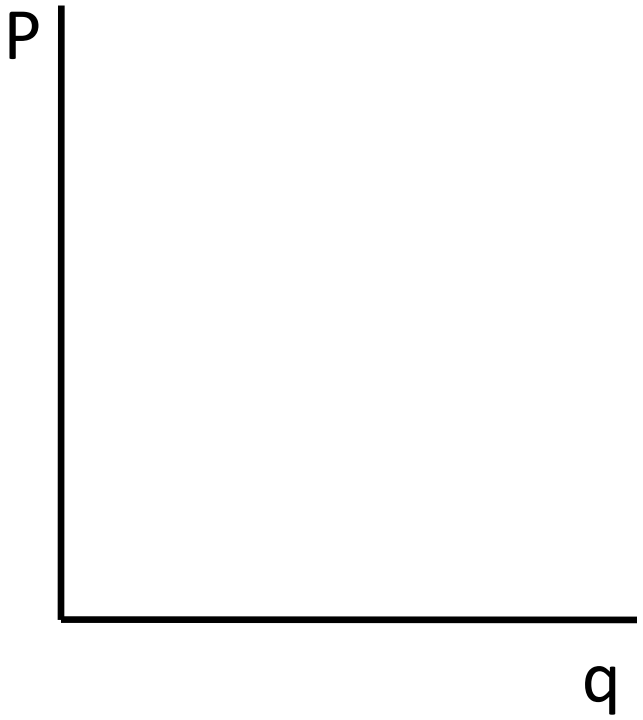
- The quantity supplied by the firm as a function of the market price ("horizontal" interpretation).
- The firm's marginal cost as a function of the quantity it produces ("vertical" interpretation).

Market and Individual-Firm Supply Curves

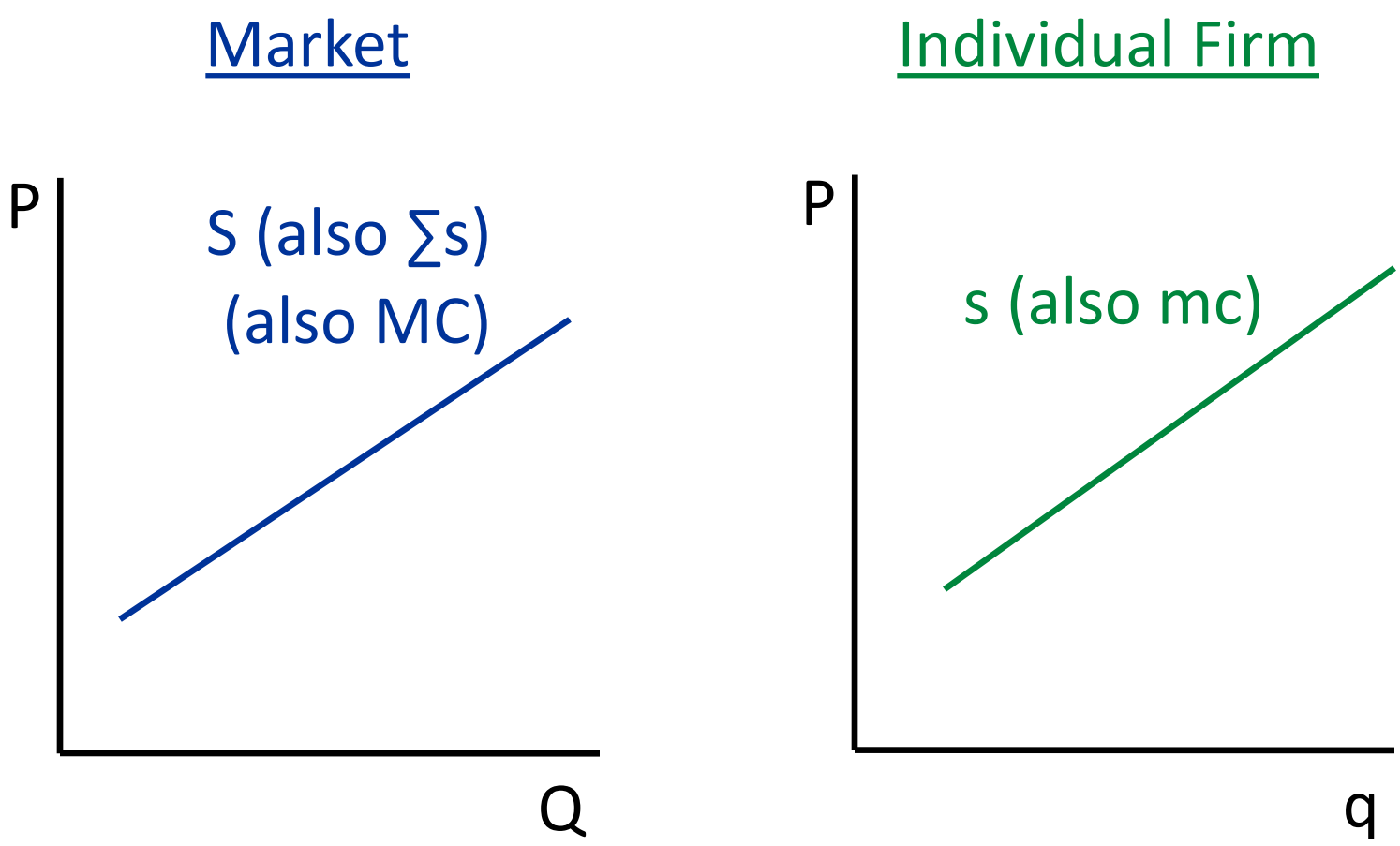
Market



Individual Firm



Market and Individual-Firm Supply Curves



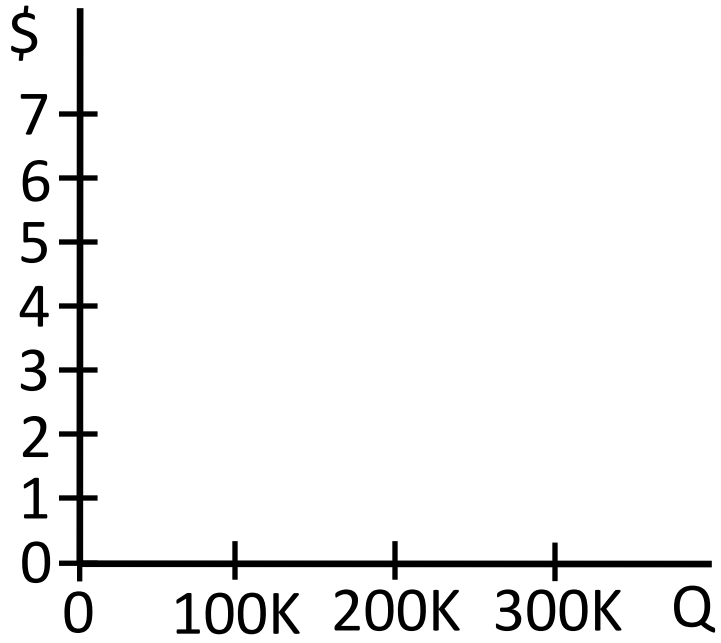
The market supply curve is also the marginal cost curve for the whole industry.

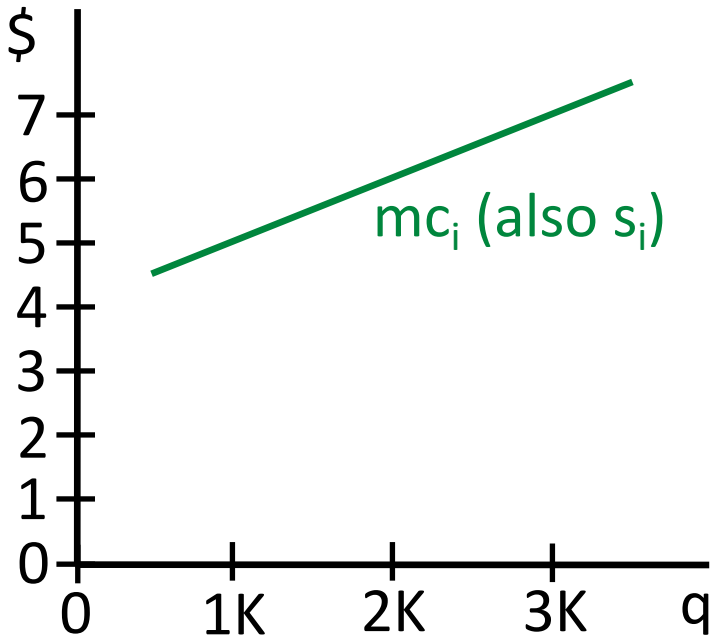
Two Ways of Thinking about the ***Market*** Supply Curve

- The **horizontal sum** of individual firms' supply curves.
- The industry's marginal cost curve.

The Industry Supply Curve Is the Industry Marginal Cost Curve – Example

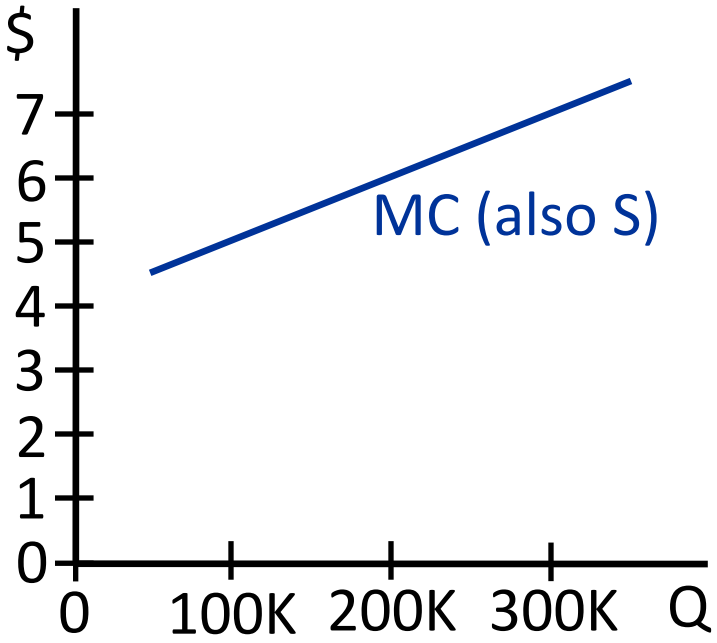
- Suppose there are 100 firms. Each has MC at 1000 units of $5, MC at 2000 units of $6, etc.

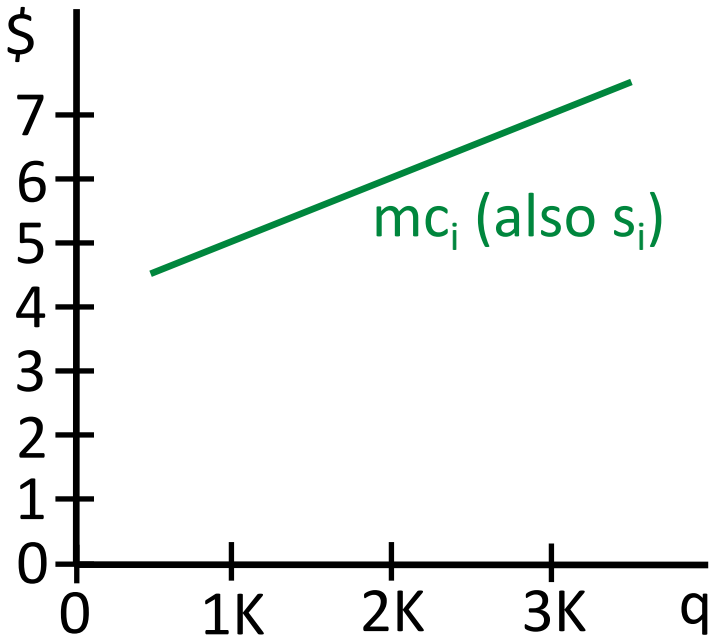




The Industry Supply Curve Is the Industry Marginal Cost Curve – Example

- Suppose there are 100 firms. Each has marginal cost at 1000 units of $5, marginal cost at 2000 units of $6, etc.
- Then the marginal cost of the *industry* at 100,000 units is $5, at 200,000 units is $6, etc.

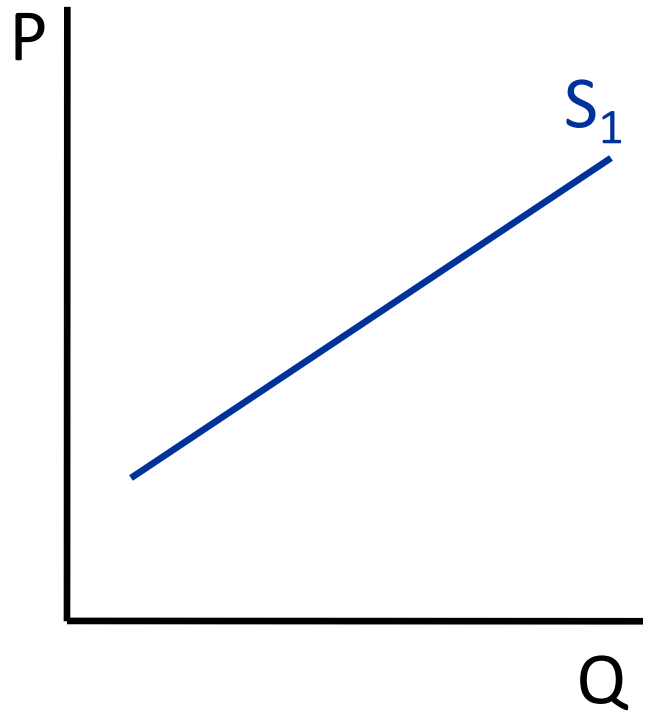




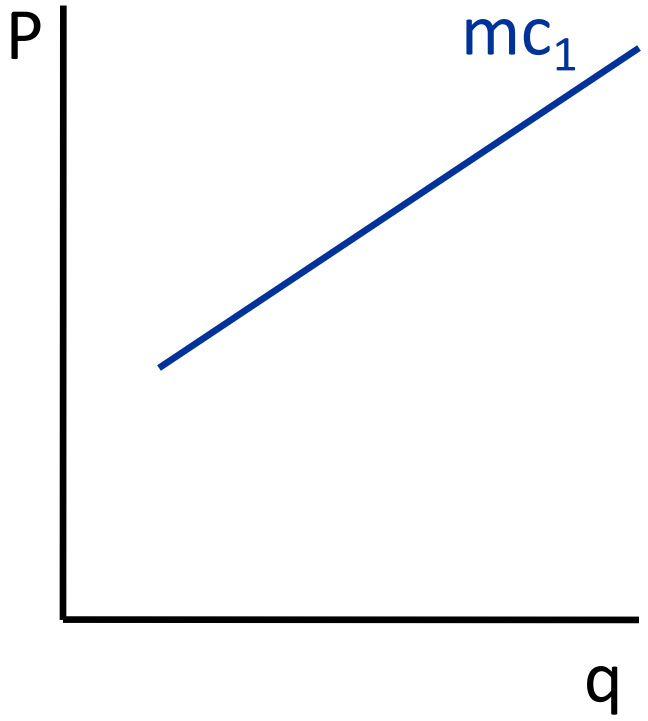
V. Why Supply Curves Shift

An Improved Production Technology

Market



Individual Firm



An Improved Production Technology

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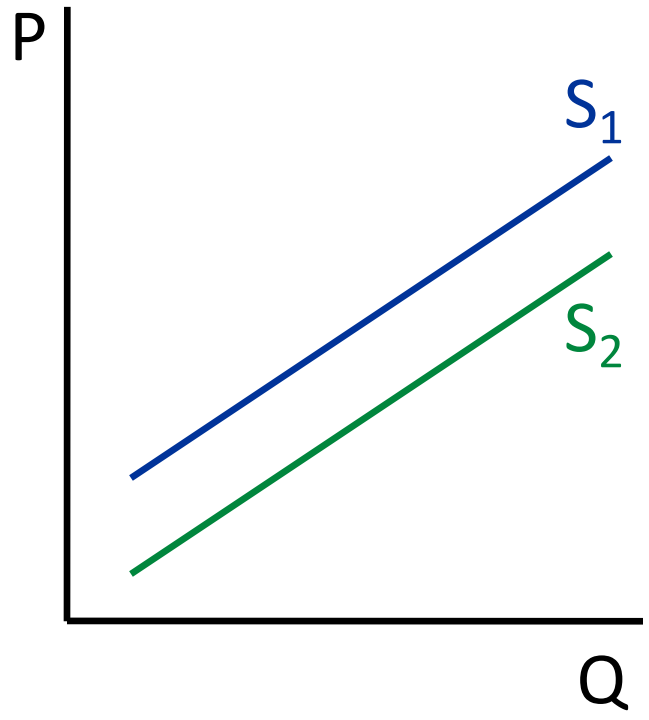
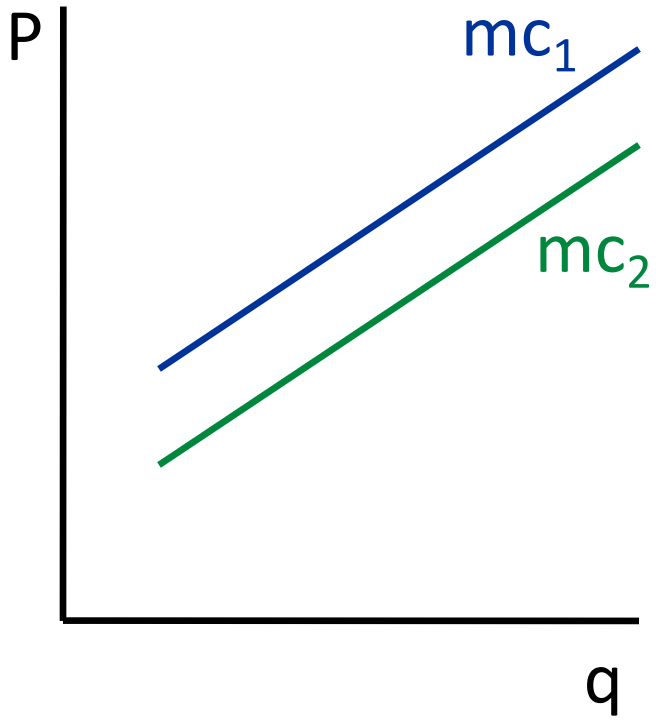
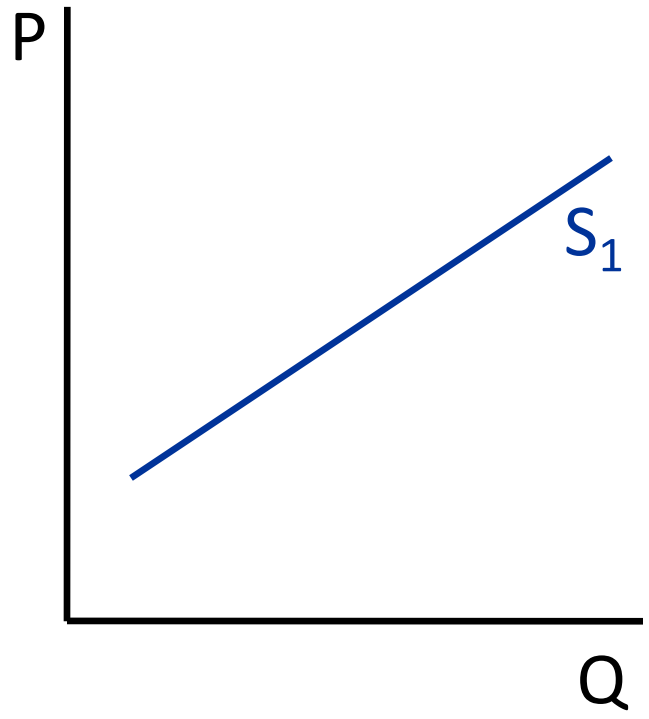


Individual Firm



An Increase in the Price of an Input

Market



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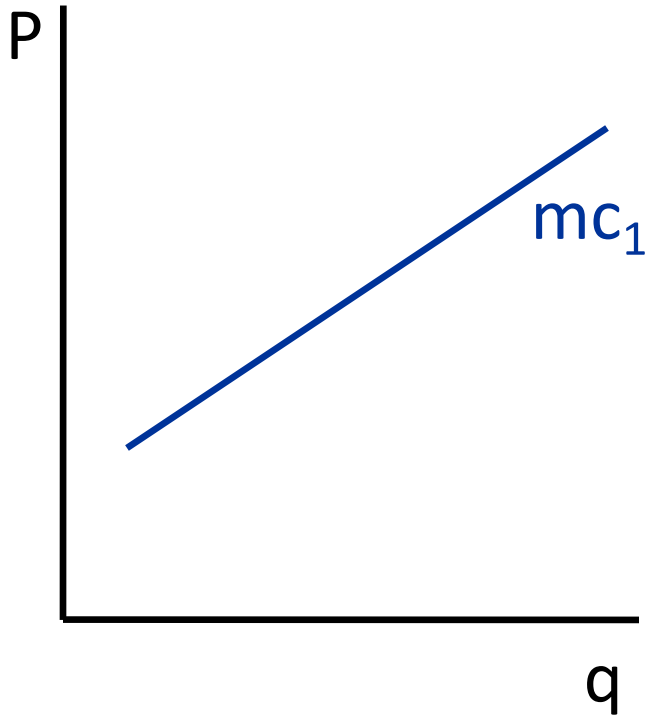

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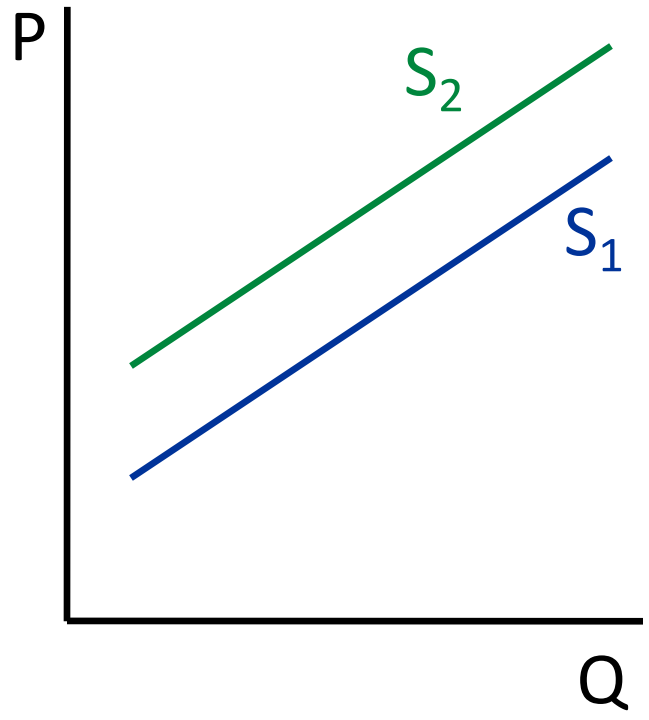
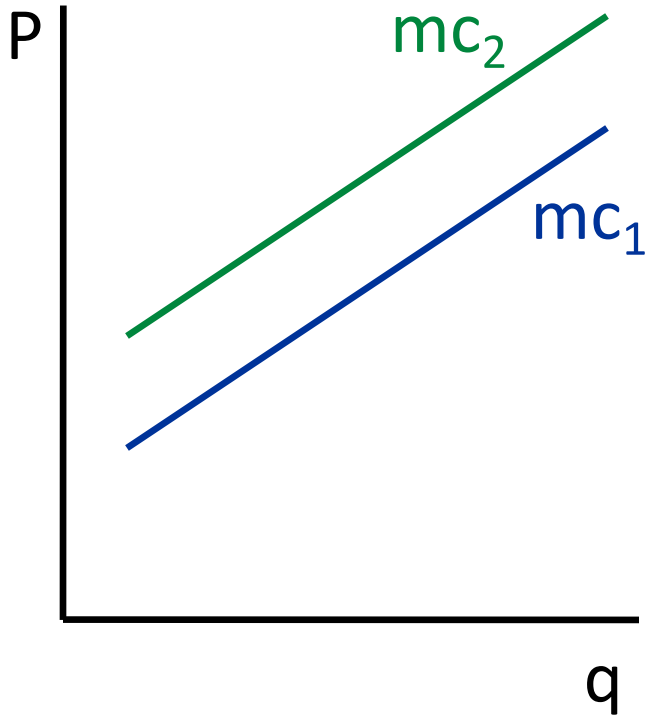
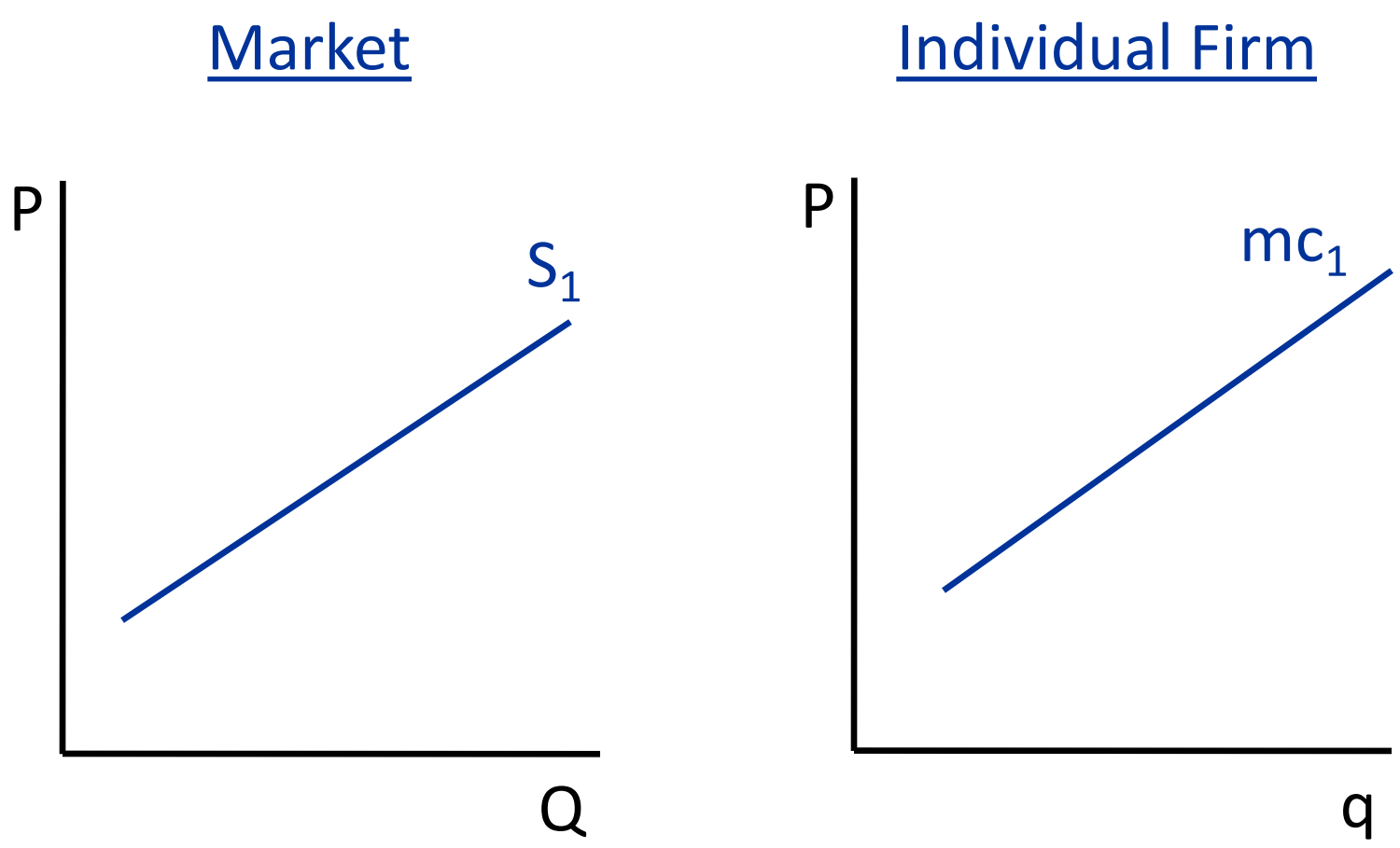


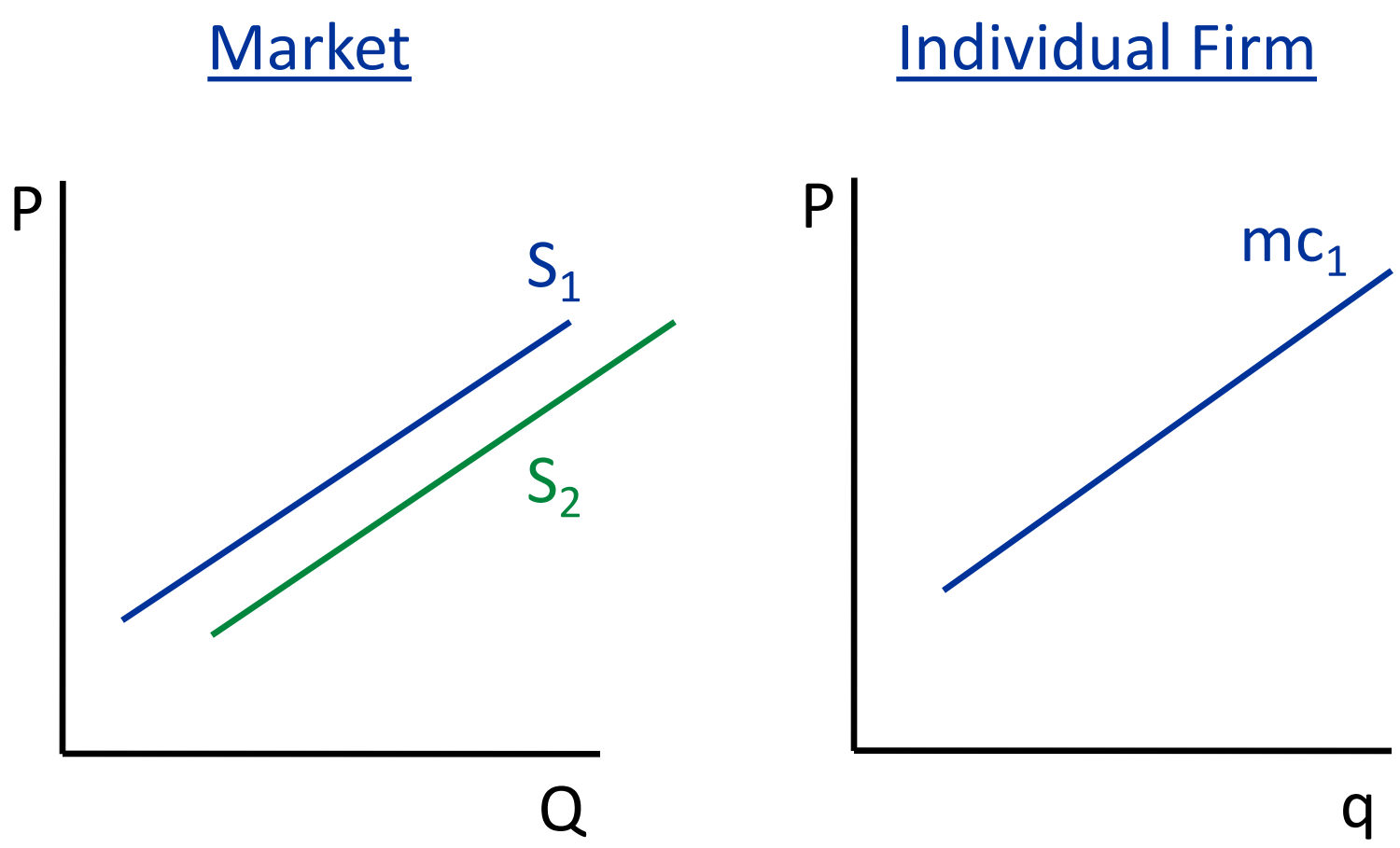
Individual Firm



Entry of a Large Number of New Firms



Entry of a Large Number of New Firms



Other Possible Reasons the Market Supply Curve Could Shift

- Taxes.
- Government regulations.
- Would a change in the price of the good shift the supply curve?
    - No—it would cause a movement along the supply curve.
- Try to think of more possibilities!

Quiz:

Question: Suppose the world price of oil increases due to developments outside the US (e.g. oil embargo on Russia). How does this shift the supply curve of US produced oil?

- A. The supply curve goes up
- B. The supply curve does not change
- C. The supply curve goes down
- D. Either A, B, C could be true, it depends.

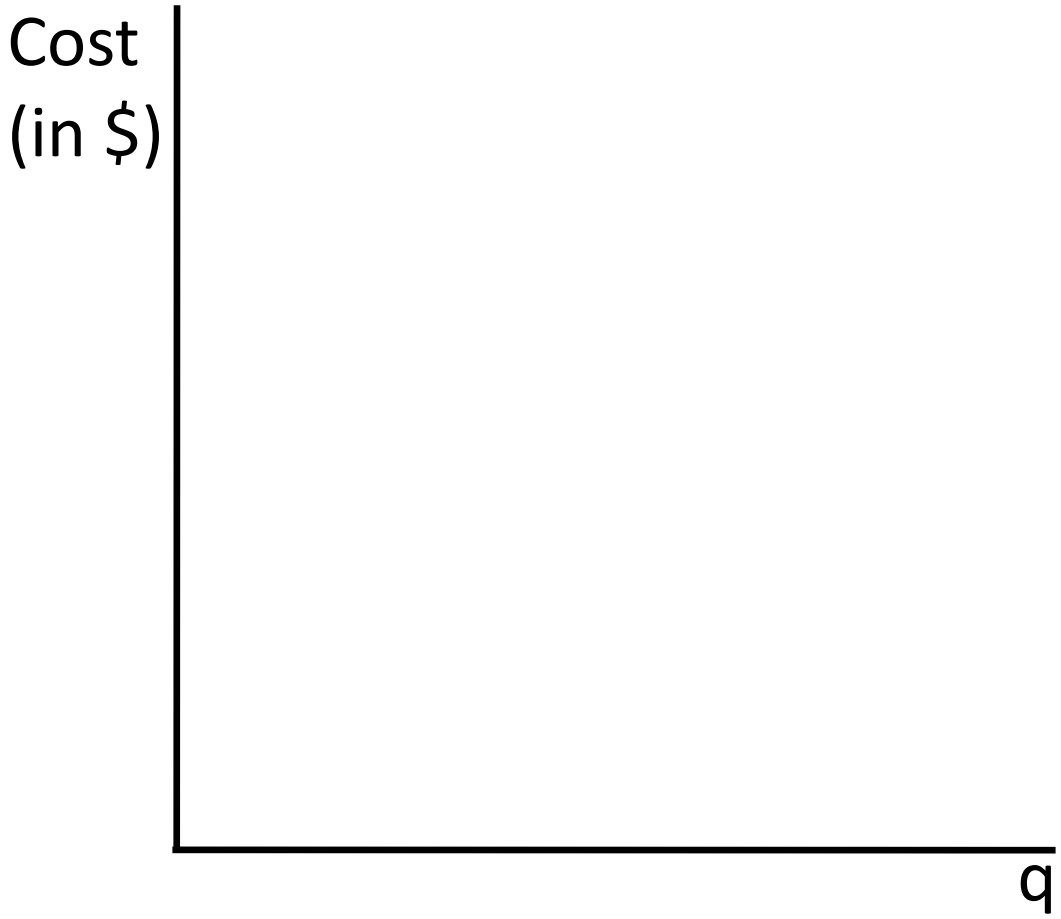
III. The Effects of Profit maximization in the Long Run

Average Total Cost

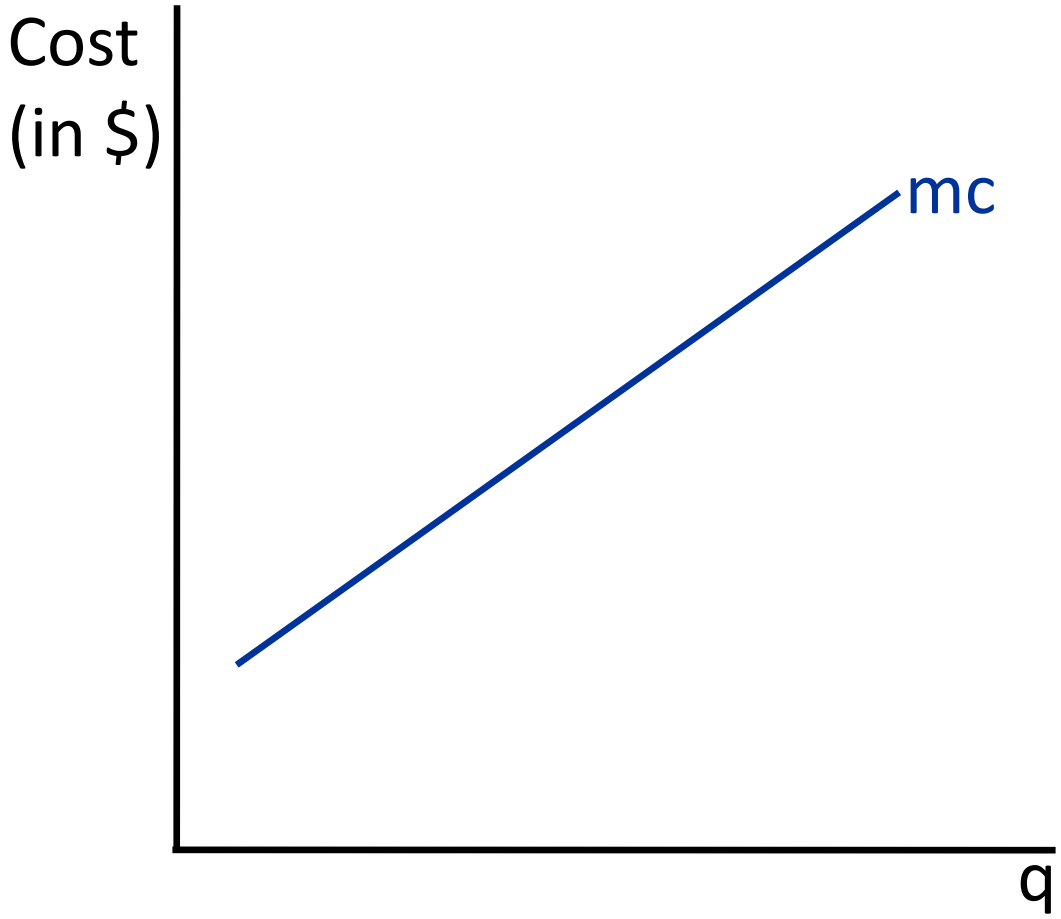
- Costs are measured as opportunity costs.
- Fixed costs: Costs that do not vary with how much is produced.
- Variable costs: Costs that do vary with how much is produced.
- Total cost: The sum of fixed and variable costs.

- **Average Total Cost = $\frac{\textbf{Total Cost}}{\textbf{Quantity}}$**
- **Mathematically:** cost of producing q is C(q). Marginal cost is C’(q). Average cost is C(q)/q.

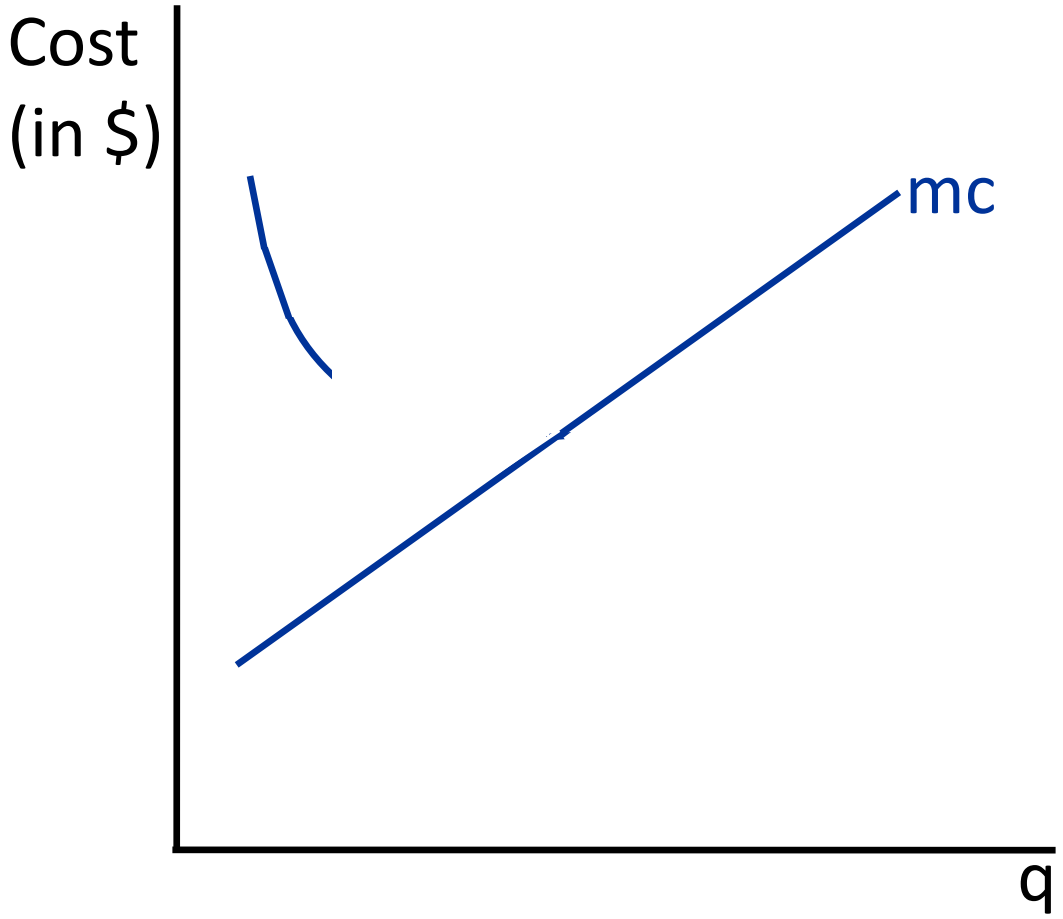
Marginal Cost and Average Total Cost



Marginal Cost and Average Total Cost



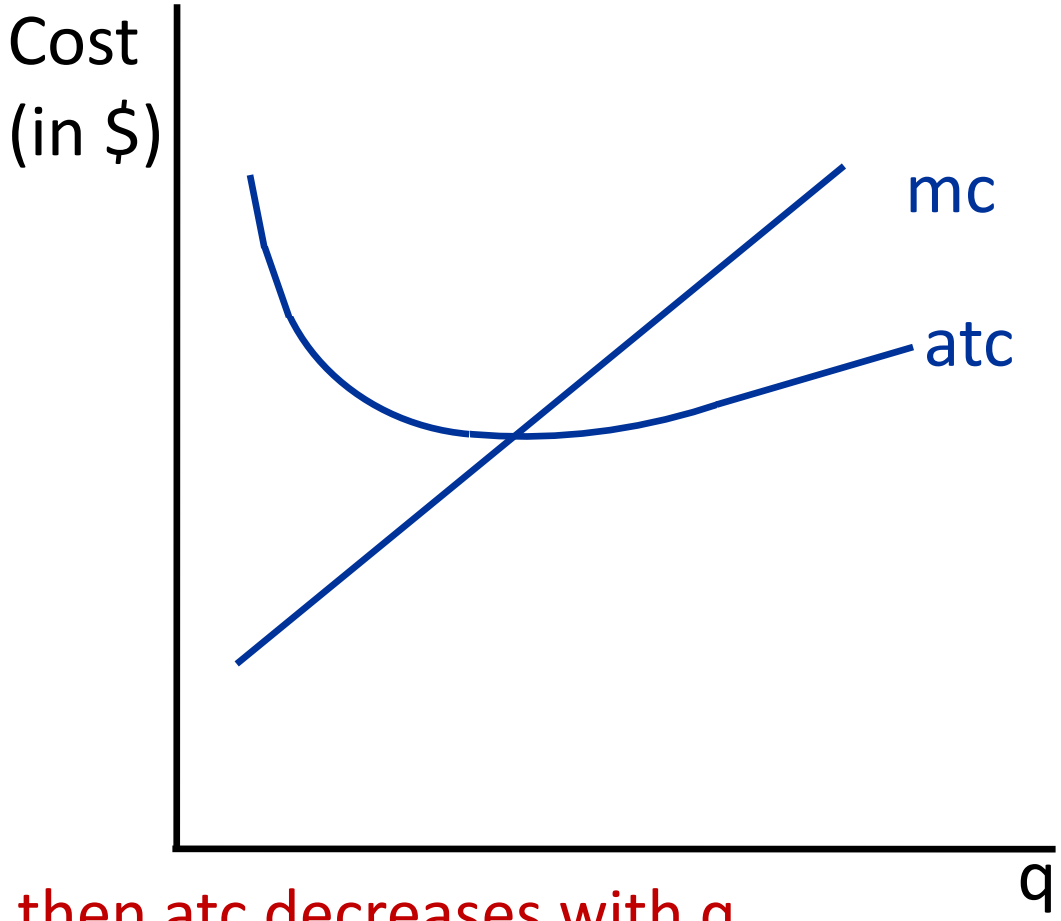
Marginal Cost and Average Total Cost



Average Total Cost is high with low q because of fixed costs:

$atc=C(q)/q=C_f/q+C_v(q)/q$

Marginal Cost and Average Total Cost

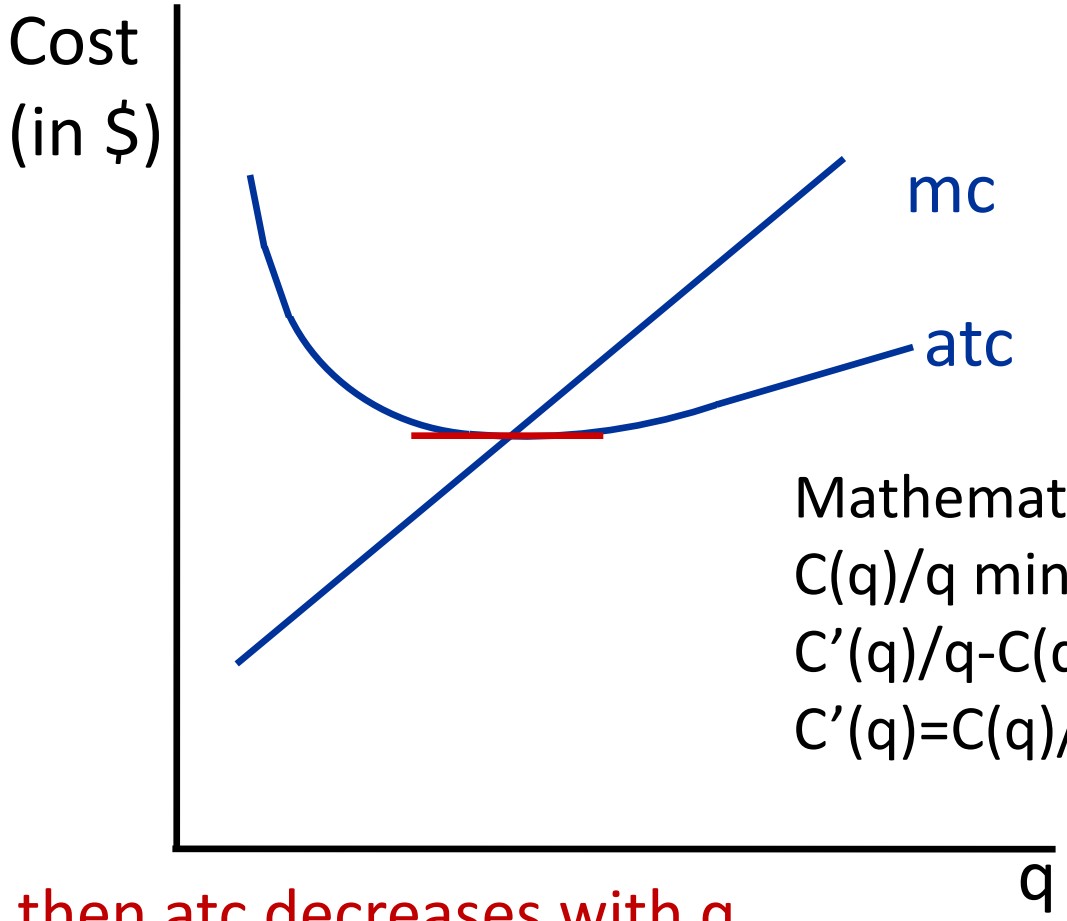


If atc>mc then atc decreases with q

If atc<mc then atc increases with q

=> The mc and atc curves cross at the lowest point of the atc curve

Marginal Cost and Average Total Cost



Mathematically:
C(q)/q minimized when
$C'(q)/q - C(q)/q^2 = 0 \Rightarrow$
$C'(q) = C(q)/q \Rightarrow mc = atc$

If atc>mc then atc decreases with q

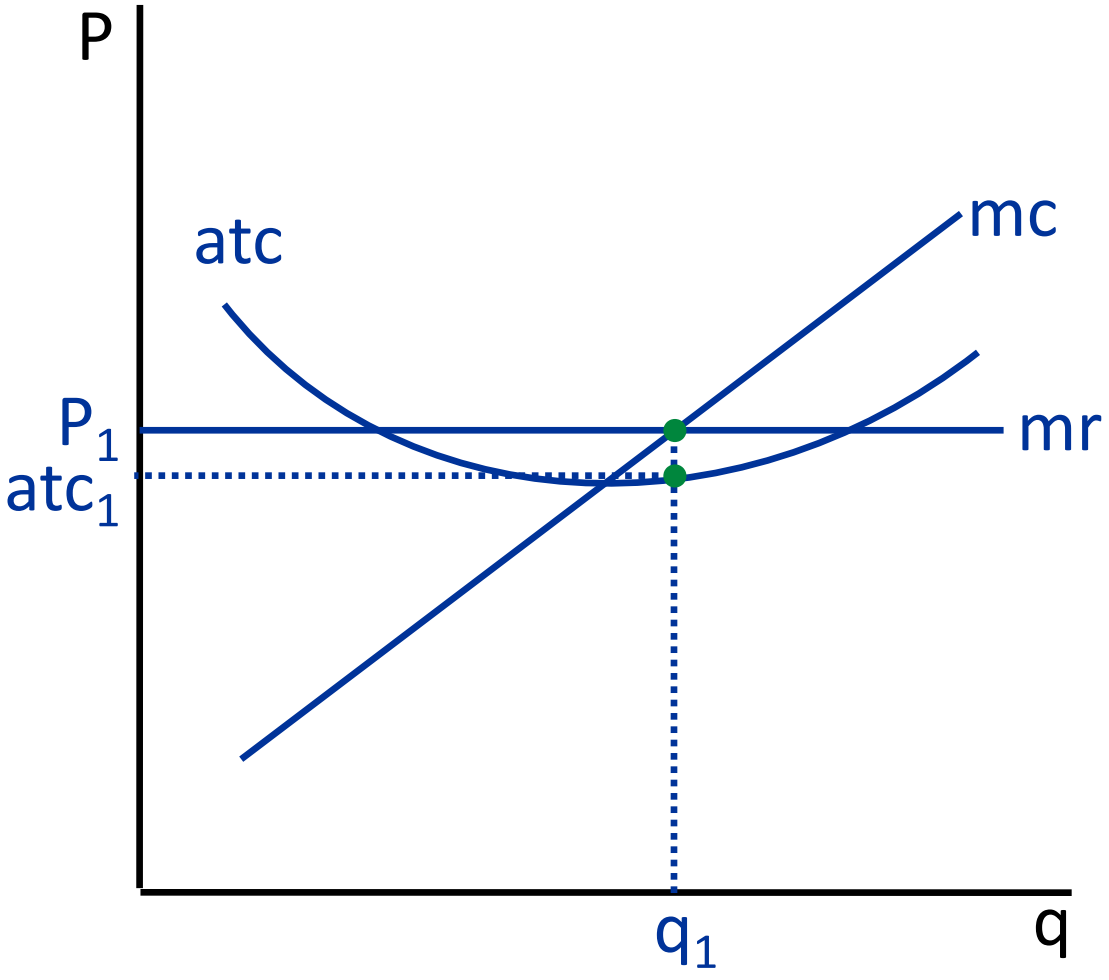
If atc<mc then atc increases with q

=> The mc and atc curves cross at the lowest point of the atc curve

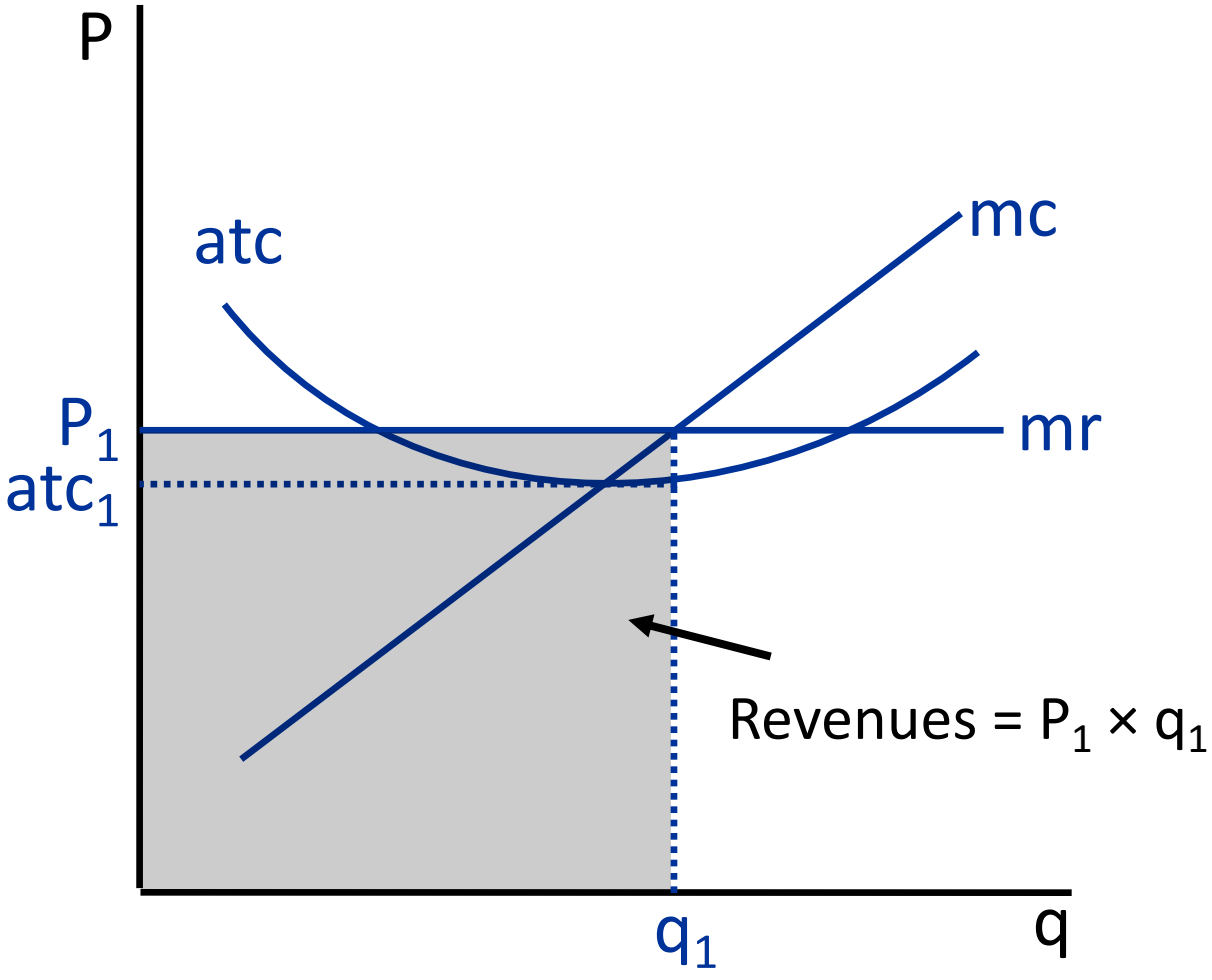
Average Total Cost (atc), Price, and Profits

- Recall:
  - Profits = Total Revenue – Total Cost
- Now:
  - Total Revenue = P × q
  - Total Cost = atc × q
- So: Profits = (P × q) – (atc × q)
  = (P – atc) × q
- So: Profits are positive, negative, or zero depending on whether P – atc is positive, negative, or zero.

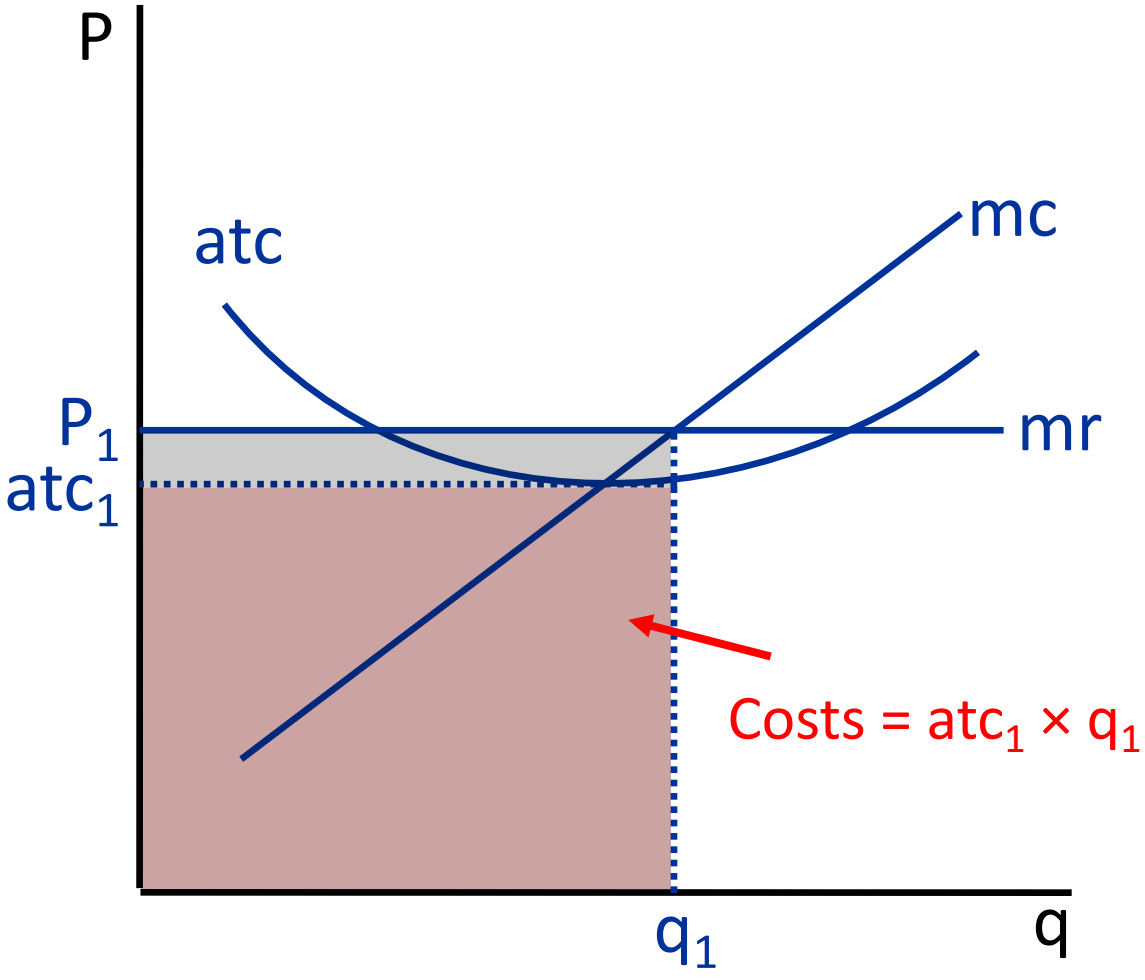
Revenues, Costs, and Profits



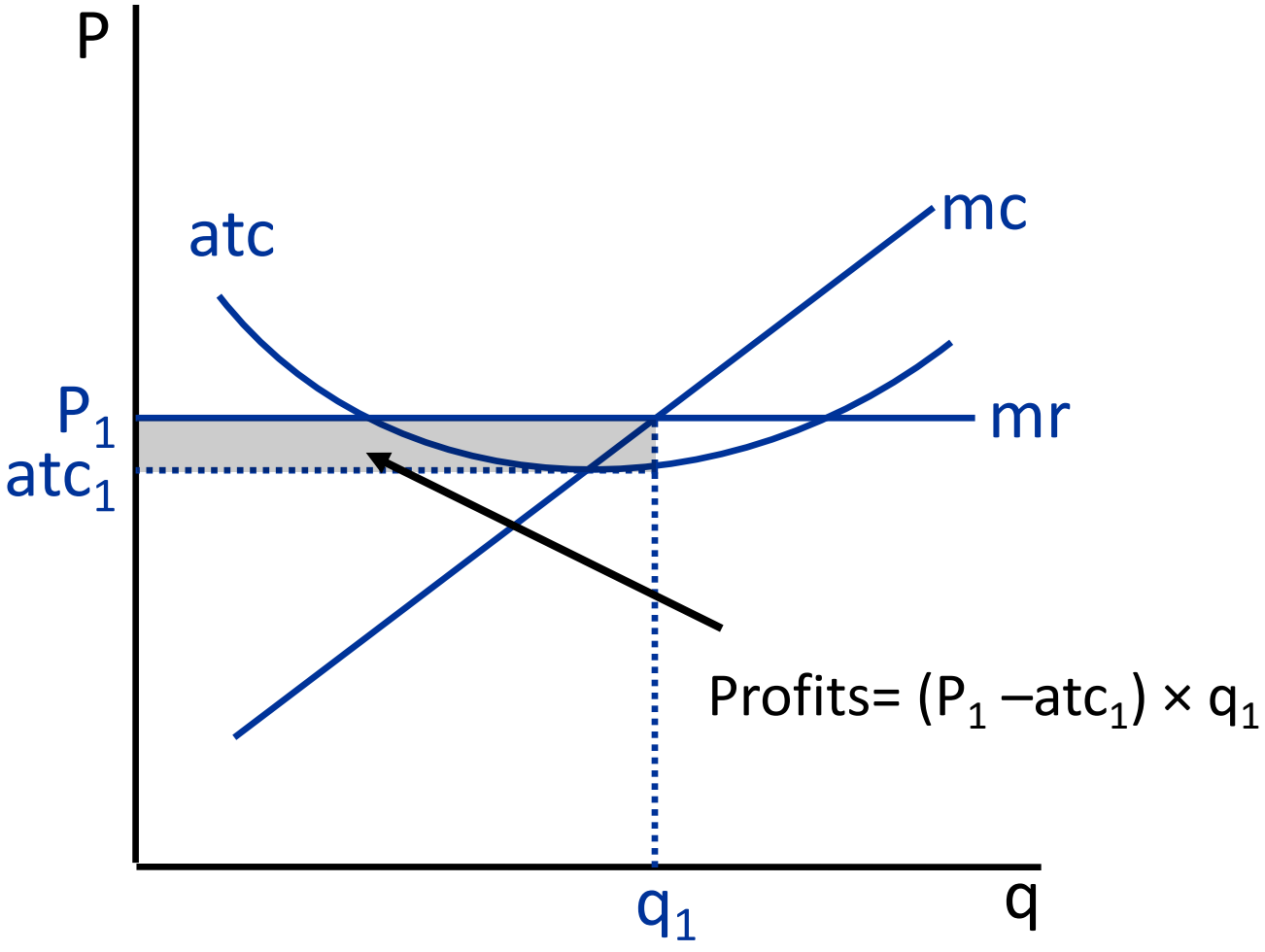
Revenues, Costs, and Profits



Revenues, Costs, and Profits



Revenues, Costs, and Profits



The Signals Sent by Profits

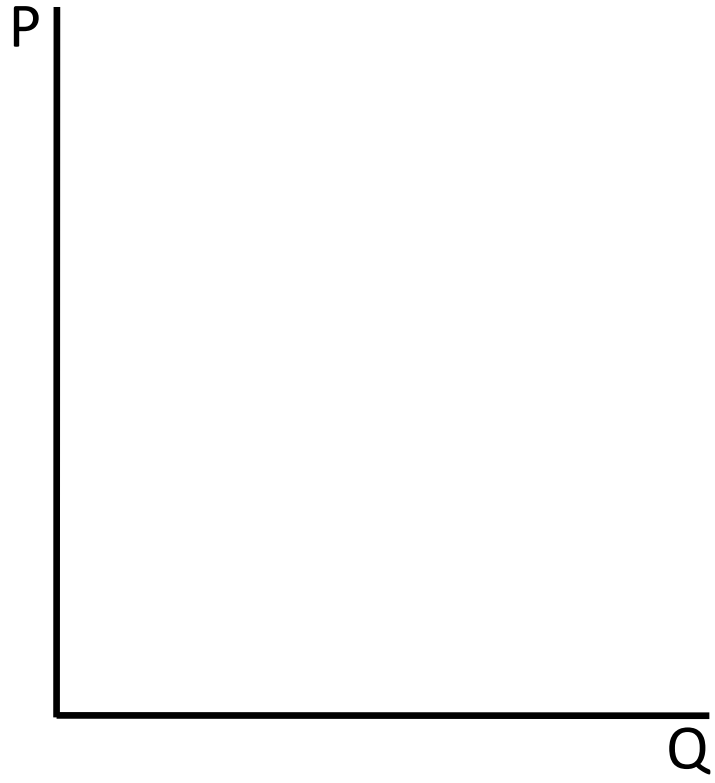
- If there are positive profits to be made: New firms will enter.
- If there are negative profits: Firms making negative profits will exit.
- If there are zero profits: There are no forces tending to cause either contraction or expansion of the industry.

Long-Run Industry Supply Curve when all firms in industry are identical

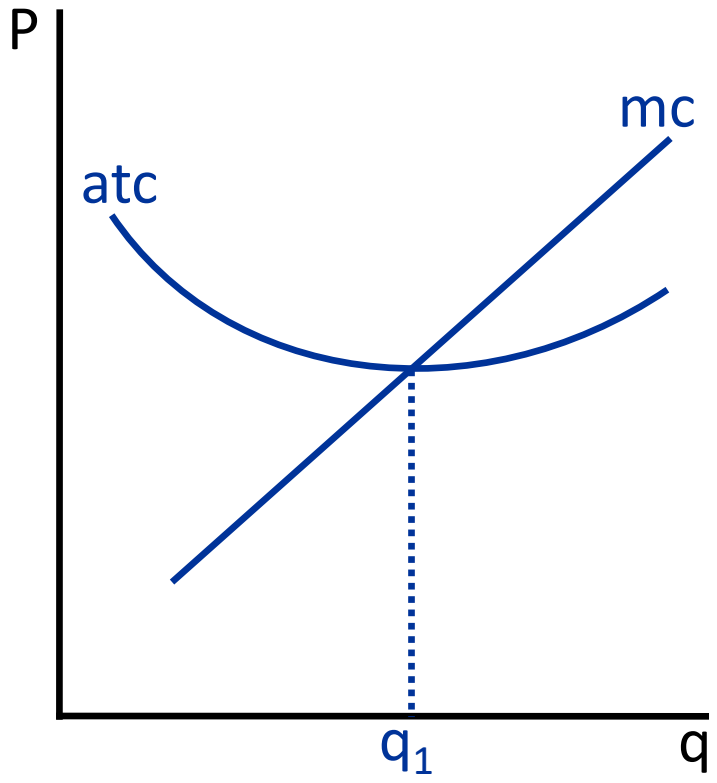
- Suppose firms are all identical (replicable industry)
- Example: manufacturing of a standard product with given technology and inputs
- In the long-run, supply is such that:
  - Zero profit for all firms (otherwise entry or exit)
  - P=mc=atc for all firms
  - Supply curve is perfectly elastic (horizontal line)

The Long-Run Industry Supply Curve When All Firms Are Identical

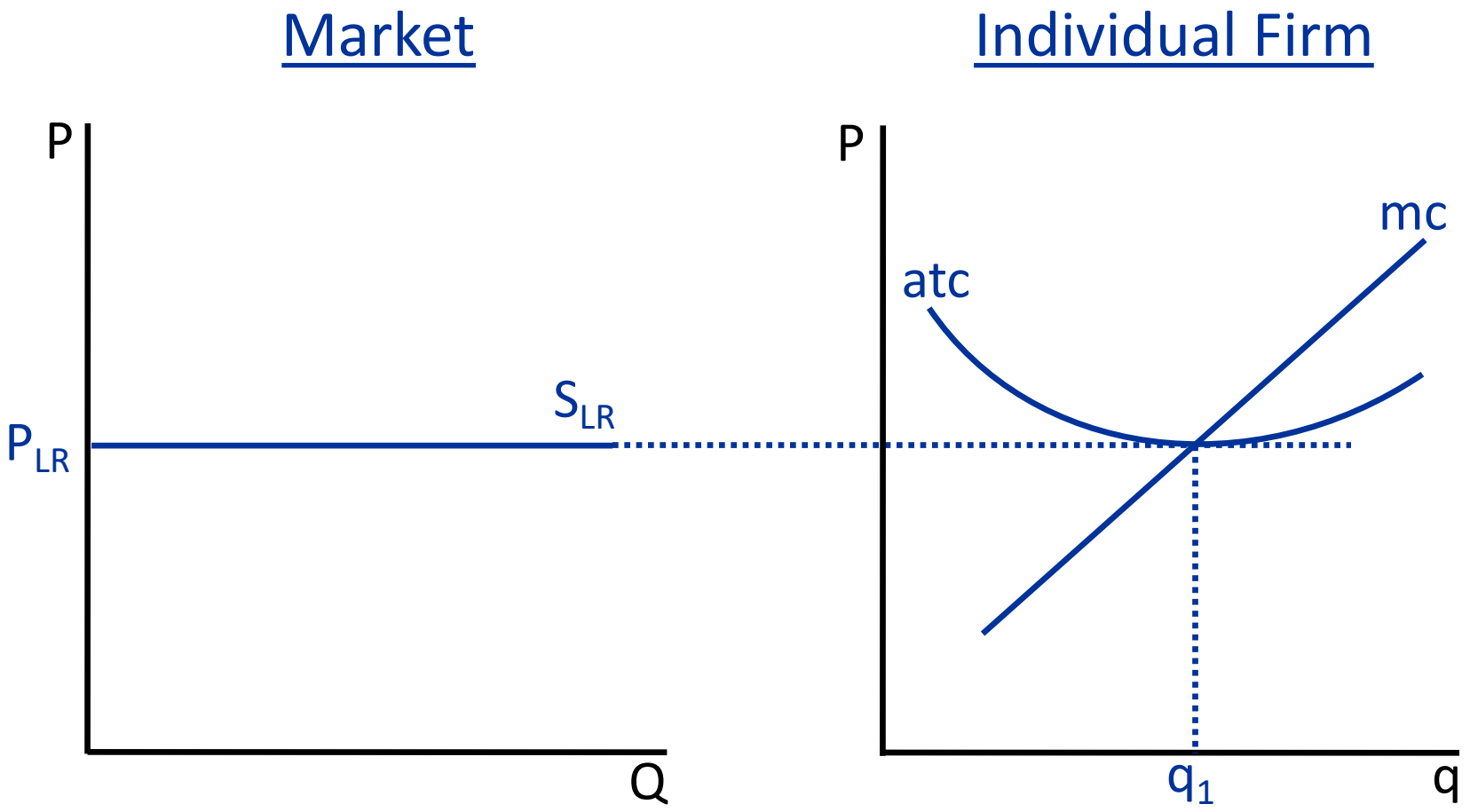
Market



Individual Firm



The Long-Run Industry Supply Curve When All Firms Are Identical



The long-run industry supply curve is perfectly elastic at the minimum of atc if all firms are identical

Long-Run Industry Supply Curve when firms differ in productivity

- Suppose some firms are more productive than others
- Example: oil production with better/worse wells
- In the long-run, supply is such that:
  - All producing firms produce up to P=mc
  - Least productive firm (marginal firm) makes zero profits
  - Other firms make positive profits
  - Supply curve is upward sloping (more firms enter when P higher)

Quiz:

Question: Consider a competitive industry where firms have different fixed costs but they all have the same marginal costs of production. In the equilibrium:

- A. All firms make zero profits
- B. Only the marginal firm make zero profits
- C. All firms make positive profits
- D. Either A, B, C could be true, it depends.

The Invisible Hand

- In a market economy, profits provide signals that move resources across industries to where they are most valued.
- These movements occur without any centralized planning or direction.
- A corollary: In a well-functioning market economy, there are always some industries that are expanding and some that are contracting.
- This helps explain economists generally dislike ***barriers to entry***

Summing it all up

- A profit-maximizing firm produces up to p = mc
- Comparing p to atc tells whether profits are positive, zero, or negative
- If firms are making positive profits, entry of new firms drives price down and so drives profits down
- If firms are making negative profit, exit of firms drives price up and so drives profit up
- In the long-run, profit is zero for the marginal firm: p = atc = mc (profit zero for all firms if all identical)

References

- CORE-The Economy, Unit 7.
- Principles of Economics, Chapter 5.