Elements of Microeconomics: TA Session

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Reminder

Assignment 4 is due this coming Sunday, Nov 10, at 11:59pm

There is no TA session next Friday, Nov 15, due to the exam

Assignment 3, Q2

Labor	Total Product (TP)	Average Product of Labor	Marginal Product of Labor
0	0		
1	40	40	40
2	160	80	120
3	351	117	191
4	600	150	249
5	875	175	275

In this question, the production function is "discrete". At Labor=0, APL and MPL are undefined. They should be left blank instead of 0.

Assignment 3, Q2

Alternatively, consider the following question:

- A firm's production function is $Q = 5L$, where Q is total product and L is labor input. What is the firm's average product of labor and marginal product of labor at $L = 0$?

Answer:

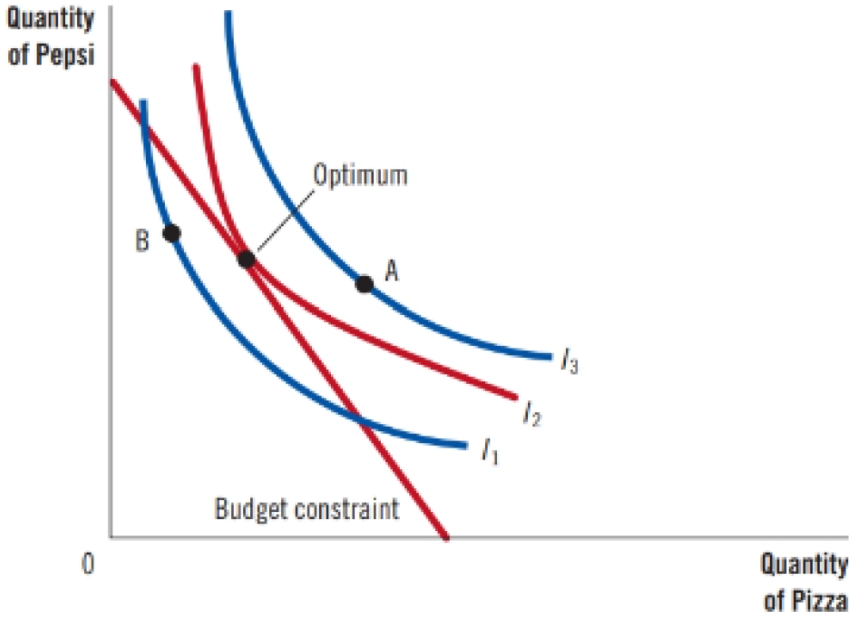
- Average product of labor: $APL = \frac{TotalProduct}{Labor} = \frac{0}{0}$ is still undefined
- But marginal product of labor is 5. This is because the production function is "continuous". With a linear production function with a slope of 5, we have $MPL = 5$ at every point on the line. (In mathematical jargon: the derivative of the production function at $L = 0$ is 5.)

Assignment 3, Q4

Explain the equi-marginal principle of optimization in your own words.

Answer:

- In words: at optimum, consumers will distribute their income on the available goods such that the marginal utility derived from the last dollar spent on each good is equal
- In maths: $MU_A/P_A = MU_B/P_B$



The decision to shut down

- **Shutdown:** a short-run decision not to produce anything during a specific period due to current market conditions
- **Exit:** a long-run decision to permanently leave the market

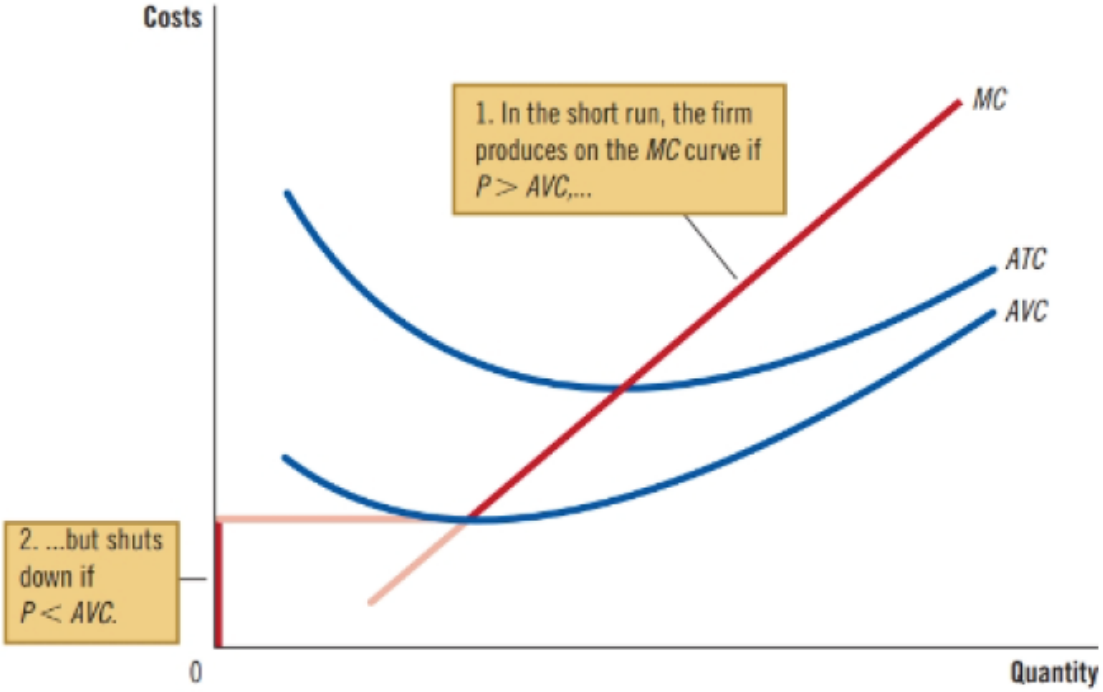
When a firm shuts down, it pays no variable cost and earns no revenue

A firm chooses to shut down if:

$$\begin{aligned} TR &< VC \\ \implies TR/Q &< VC/Q \\ \implies P &< AVC \end{aligned}$$

The decision to shut down

A firm shuts down if $P < AVC$



Recall that MC and AVC curves cross where AVC is lowest

- The firm chooses to shut down if price is lower than the firm's minimal AVC
- The firm's short-run supply curve is the part of MC curve that lies above the AVC curve

The decision to exit

In the short run, a firm's fixed cost is a **sunk cost**: a cost that has already been committed and cannot be recovered

But in the long run, the decision to exit the market will save the fixed costs as well

A firm chooses to exit if:

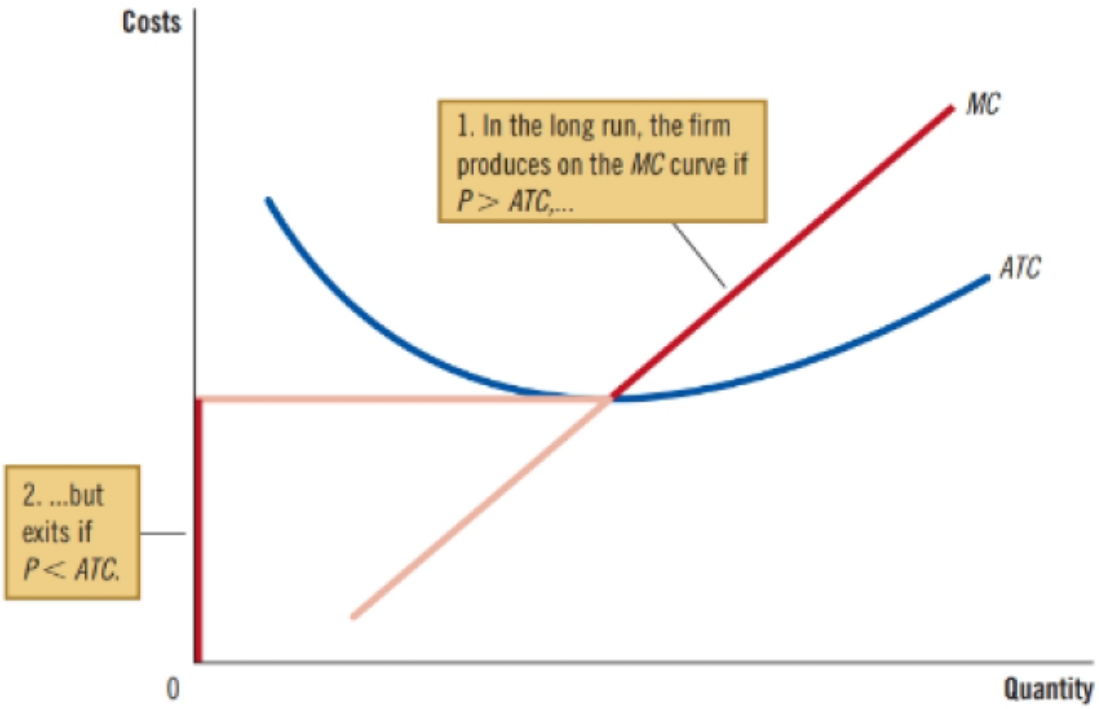
$$\begin{aligned} TR &< TC \\ \implies TR/Q &< TC/Q \\ \implies P &< ATC \end{aligned}$$

On the contrary, a firm chooses to enter if:

$$P > ATC$$

Long-run supply curve

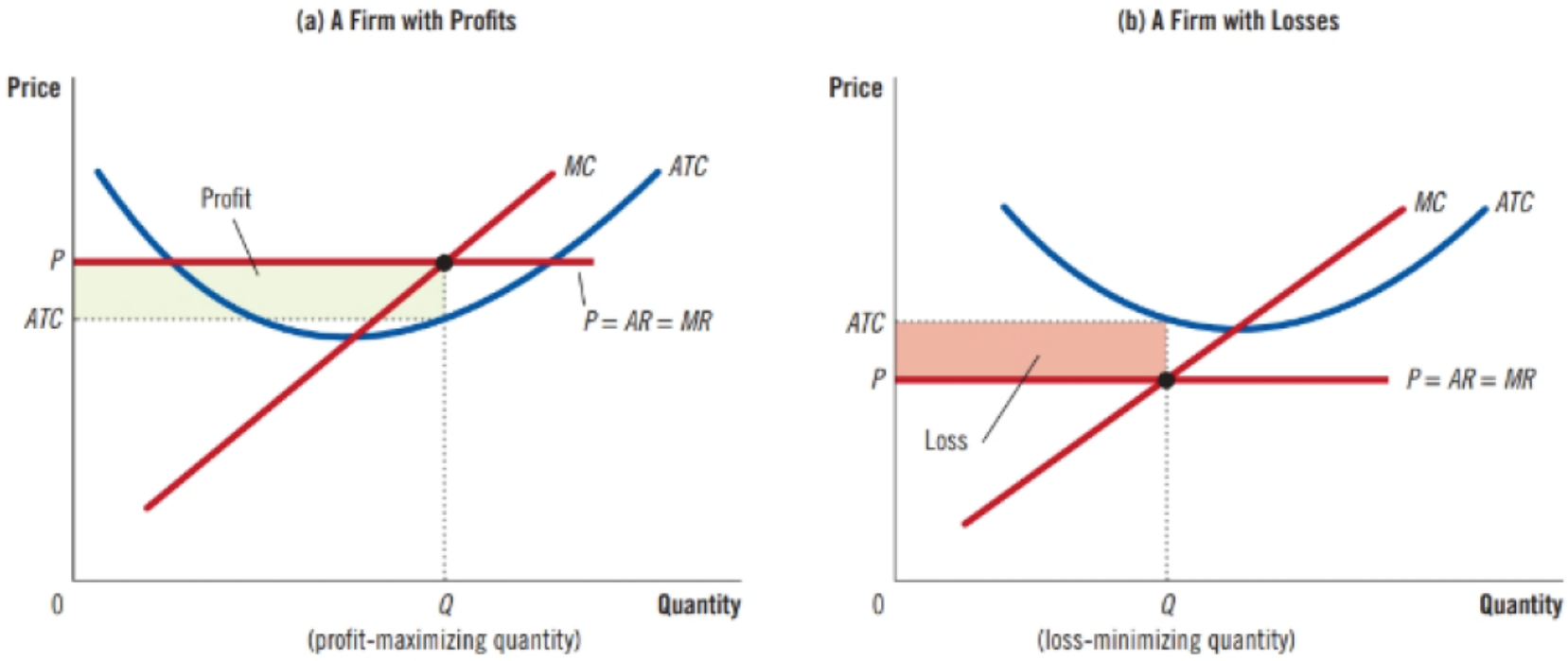
A competitive firm's long-run supply curve:



The firm's long-run supply curve is the part of the MC curve that lies above the ATC curve

Profits and losses

$$\text{Profit} = (P - ATC) \times Q$$



Competitive market's short-run supply curve

Suppose all firms in the market are identical

In the short run, the number of firms is fixed. To derive the entire market's supply curve, just multiply Q by the number of firms

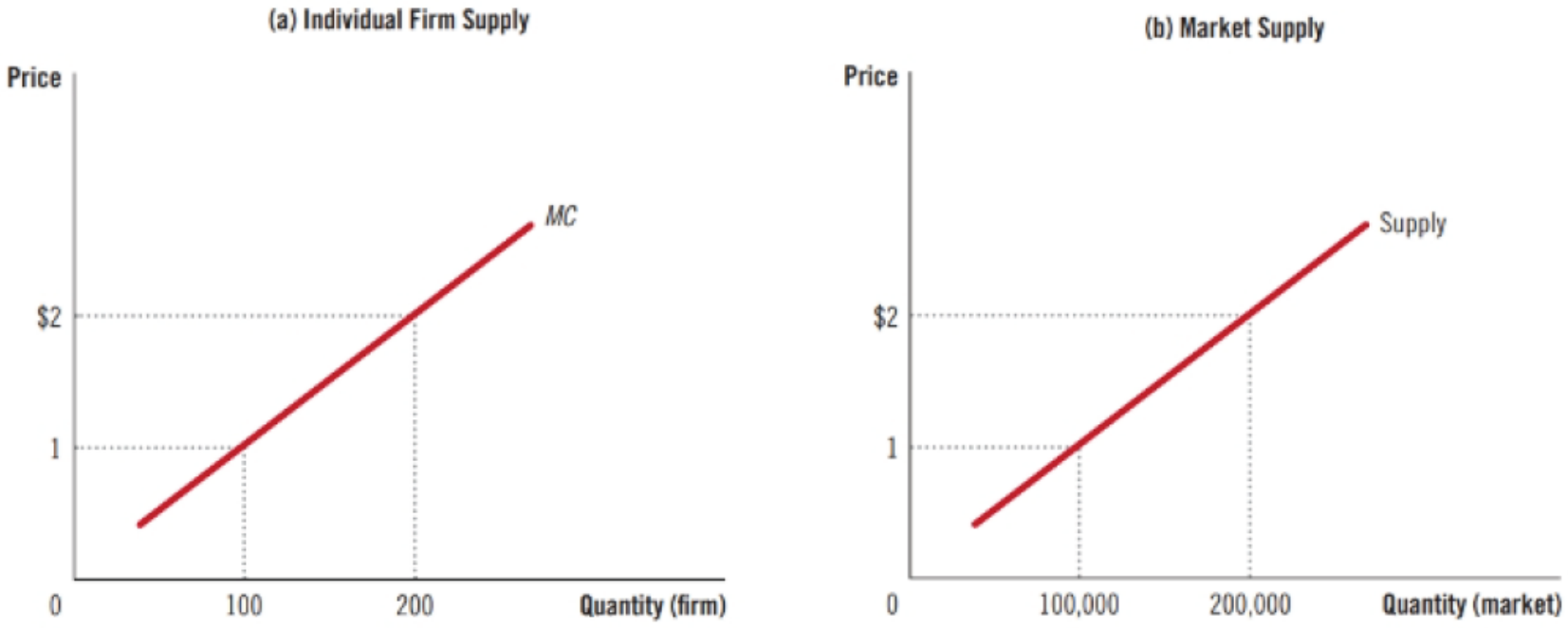
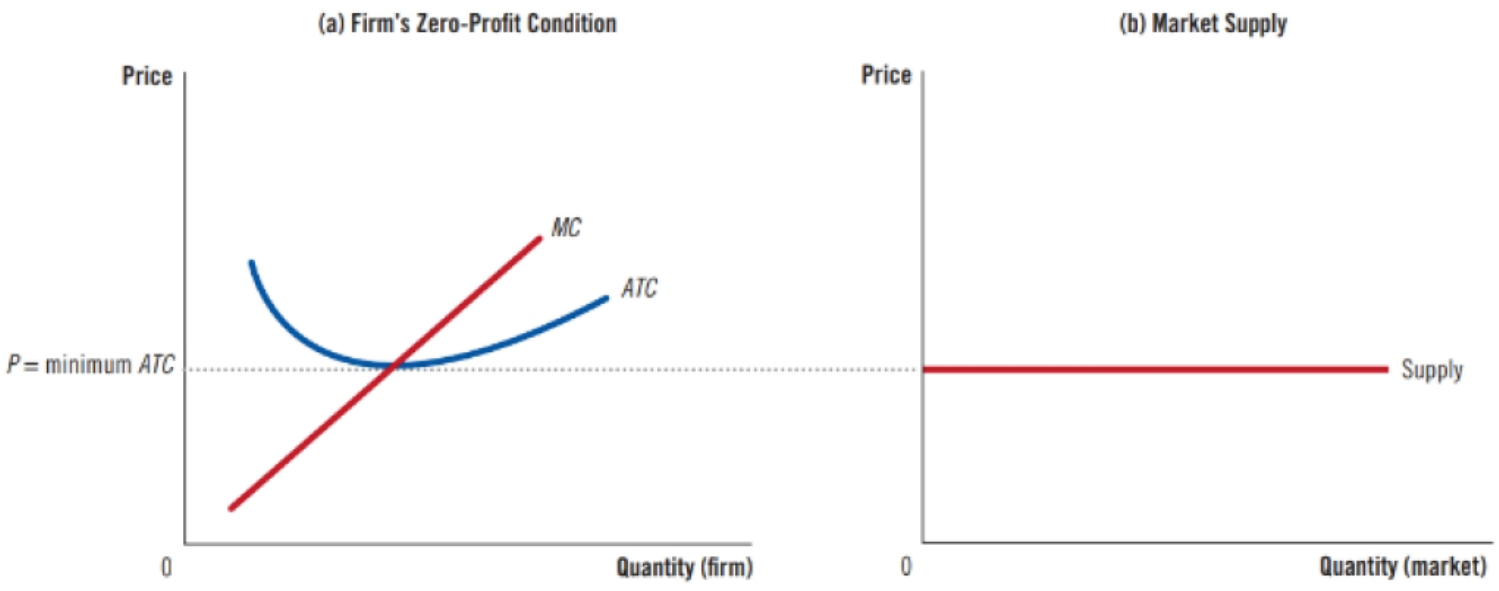


Figure: Market with 1,000 firms

Competitive market's long-run supply curve

In the long run, firms can freely enter or exit the market

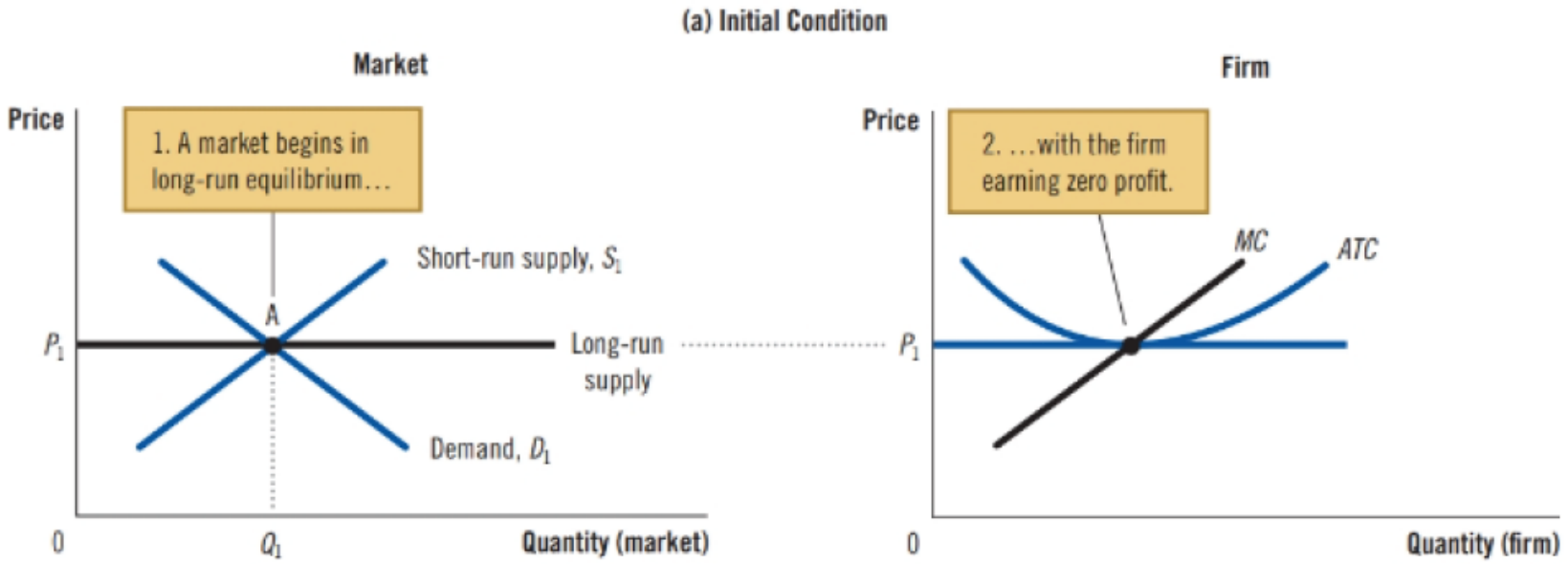
- If profits are positive, more firms will enter the market; if profits are negative, existing firms will exit the market
- **In equilibrium, all firms make zero profit!**
  - This is economic profit rather than accounting profit; economic profit takes opportunity cost into account



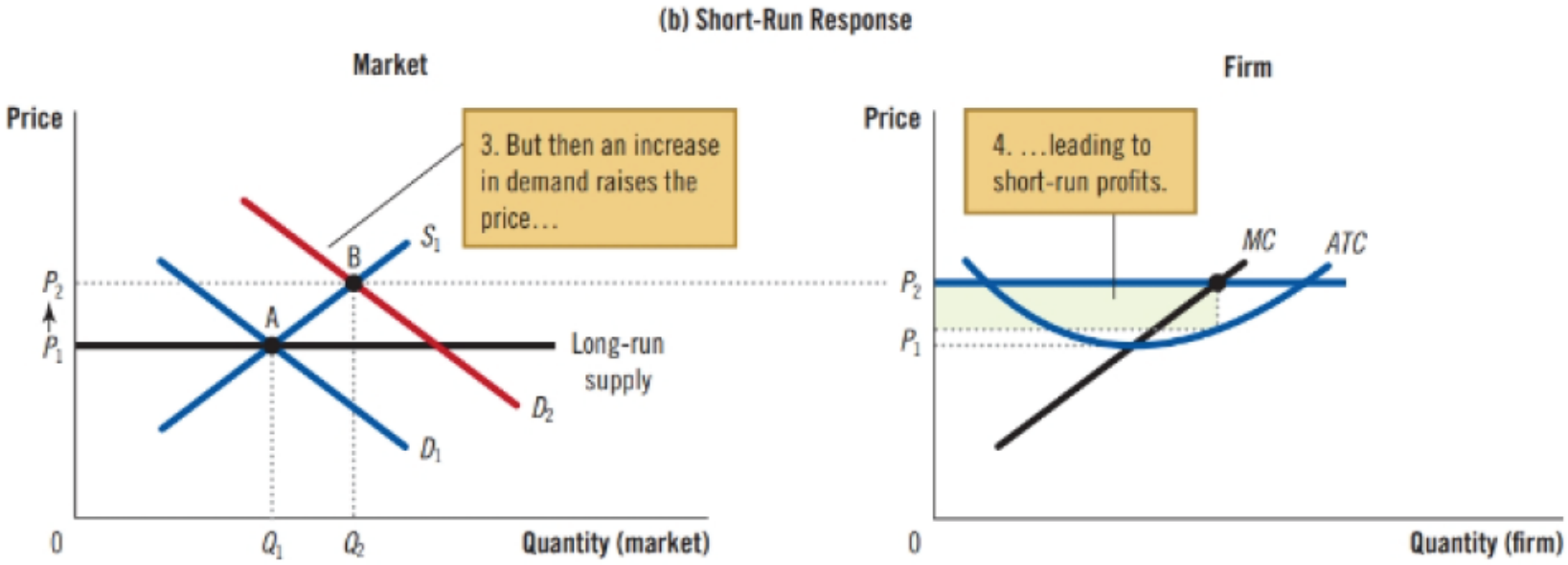
In the long run, $P = MC =$ minimum ATC, and supply curve is flat

A shift in demand: initial condition

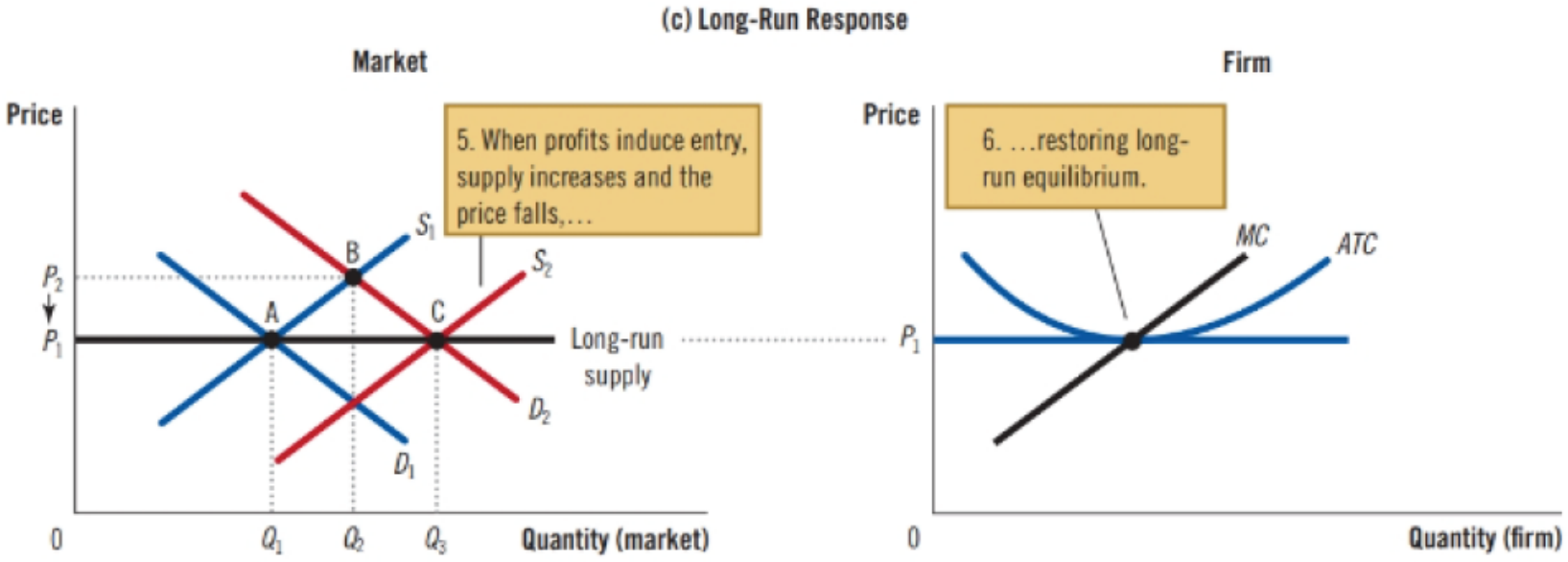
In the following, we consider how firms and the market respond to an increase in demand



A shift in demand: short-run response



A shift in demand: long-run response



Why long-run supply curve might slope upward

In the above, we derived a flat long-run supply curve. This is based on a lot of simplifying assumptions, such as identical firms

In practice, there are many reasons why the long-run supply curve might slope upwards

1. **Limited resources for production:** In the market for farm products, the quantity of available land is limited. As more people become farmers, they bid up land prices and increasing the cost of all farmers in the market
2. **Heterogeneous firms:** E.g. each firm may have different costs. If more firms enter the market, price must rise for entry to be profitable for them.

Nevertheless, one key observation remains the same:

- Because firms can enter and exit more easily in the long run than in the short run, the long-run supply curve is typically **more elastic** than the short-run supply curve

Competitive market - exercise

Consider a perfectly competitive market for apple pies. The market demand curve is $Q = 400 - 5P$. Each firm's short-term supply curve is $q = 2 + \frac{P}{2}$. Each firm's AVC and FC is given below.

Quantity	AVC	FC
5	1	36
6	2	36
7	3	36
8	4	36
9	5	36

1. Suppose there are 60 firms in the market.
   (a) What is the market's short-term supply curve?
   (b) What is the market's shot-term equilibrium price and quantity?
   (c) What is each firm's profit?
   (d) In the long run, how will the number of firms change?

Competitive market - exercise

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2. Last week, we found the long-run, zero-profit equilibrium using the guess-and-verify approach. Can you directly calculate the equilibrium number of firms without guessing and verifying? (Hint: $AVC = q - 4$)

Competitive market exercise - explained

1. Market's short-term supply curve: $Q = 60 \times (2 + \frac{P}{2}) = 120 + 30P$

   Short-term market equilibrium:
   $Q = 120 + 30P = 400 - 5P \implies P^* = 8, Q^* = 360, q^* = 6$

   Each firm's profit $= P^* q^* - AVC \cdot q^* - FC = 8 \times 6 - 2 \times 6 - 36 = 0$

   Profit is zero, this is the long-run equilibrium, and firm number will not change.

Competitive market exercise - explained

2. Suppose the equilibrium number of firm is n.

   The short-run market supply curve: $Q = n(2 + \frac{P}{2}) = 2n + \frac{nP}{2}$

   Short-run equilibrium: $Q = 400 - 5P = 2n + \frac{nP}{2}$

   $\Longrightarrow P^* = \frac{800-4n}{10+n}$, $q^* = 2 + \frac{P^*}{2} = \frac{420}{10+n}$, $AVC^* = q^* - 4 = \frac{380-4n}{10+n}$

   In long-run equilibrium, each firm earns zero profit:

$$
\begin{aligned}
\text{Profit} &= P^* q^* - AVC \cdot q^* - FC \\
&= \frac{(800-4n)420}{(10+n)^2} - \frac{(380-4n)420}{(10+n)^2} - 36 \\
&= \frac{[(800-4n)-(380-4n)]\,420}{(10+n)^2} - 36 \\
&= \frac{420^2}{(10+n)^2} - 36 = 0
\end{aligned}
$$

   Solving, we get $\frac{420}{10+n} = 6 \implies n = 60$