Microeconomic Theory: TA Session

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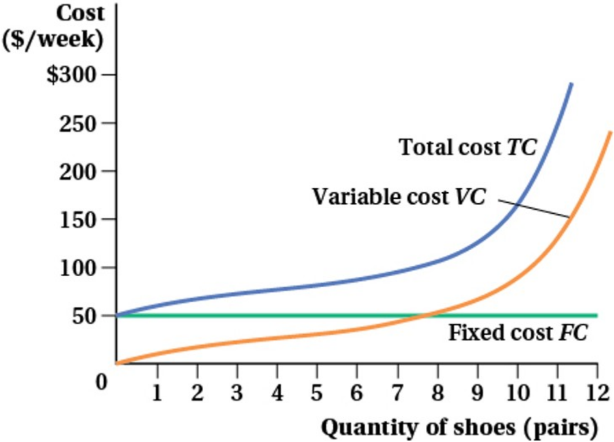
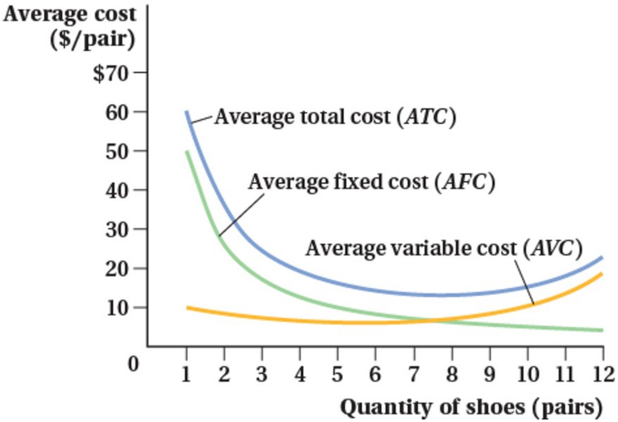
Reminder

No TA Section Next Friday, Oct 17th due to fall break

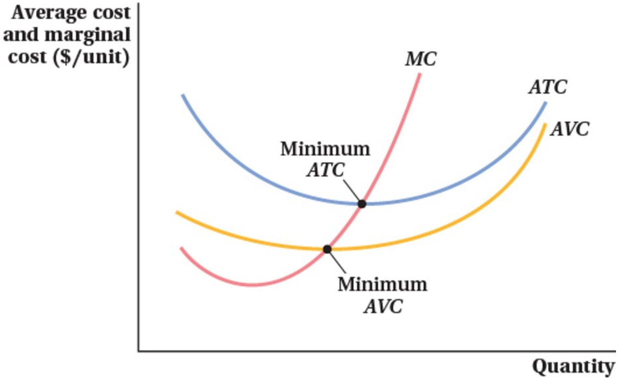
Fixed cost, variable cost, and total cost



AFC, AVC and ATC



Marginal cost



- ATC is minimized when MC=ATC
- AVC is minimized when MC=AVC

Cost - exercise

1. Suppose a firm's total cost function is $TC(Q)$. Show algebraically that ATC is minimized where $MC = ATC$.
2. A firm's total cost function is $TC(Q) = 100 + 10Q + Q^2$.
   - Derive MC, FC, AVC, and ATC.
   - Find the output level where ATC is minimized
3. A firm's production function is $Q = 5L^{0.5}$, and the wage rate is $w = 20$. Derive VC, AVC, MC.

Cost - exercise

Answer:

1. $ATC(Q) = \frac{TC(Q)}{Q}$, ATC is minimized when its derivative equals 0: $ATC'(Q) = \frac{TC'(Q)Q - TC(Q)}{Q^2} = 0 \;\Rightarrow\; TC'(Q)Q - TC(Q) = 0 \;\Rightarrow\; TC'(Q) = \frac{TC(Q)}{Q}$. The left hand side $TC'(Q)$ is MC, and the right hand side is ATC, so we get $MC = ATC$.
2. $MC = 10 + 2Q,\; FC = 100,\; VC = 10Q + Q^2,\; AVC = \frac{VC}{Q} = 10 + Q,\; ATC = \frac{TC}{Q} = \frac{100}{Q} + 10 + Q$. ATC is minimized where $MC = ATC$: $10 + 2Q = \frac{100}{Q} + 10 + Q \;\Rightarrow\; Q = 10$.
3. $Q = 5L^{0.5}$, so $L = \frac{Q^2}{25}$, variable cost $VC = wL = \frac{4Q^2}{5}$, $AVC = \frac{VC}{Q} = \frac{4Q}{5}$, $MC = VC' = \frac{8Q}{5}$.

Perfect competition

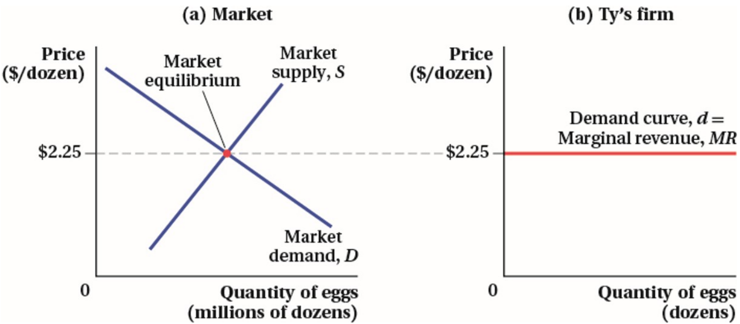
In a perfectly competitive market, buyers and sellers are price takers

Three characteristics of a perfectly competitive market:

- The market has many buyers and sellers
- The goods offered by sellers are identical
- Firms can freely enter or exit the market

Perfect competition

For a firm in a perfectly competitive market, P=MR



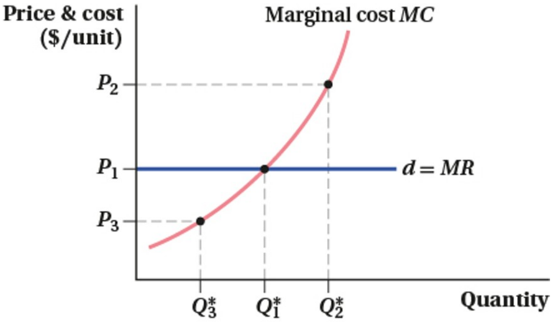
Profit maximization under perfect competition

The profit of a firm:

$$\pi = TR - TC$$

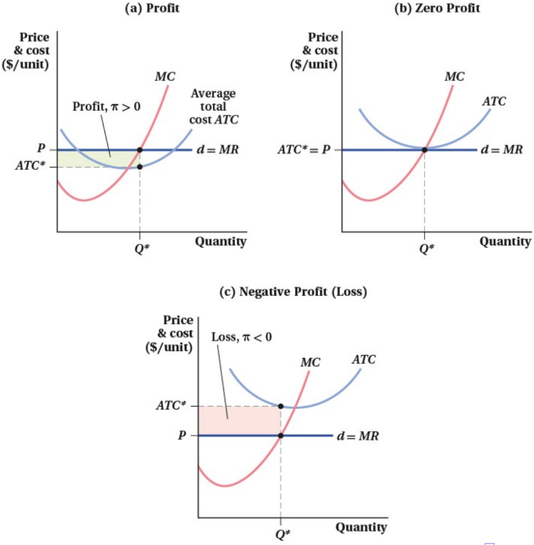
To maximize profit, take the derivative:

$$\pi' = MR - MC = 0$$
$$P = MR = MC$$



Profit

$$\pi = TR - TC = (P - ATC) \times Q$$



Short-run 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 still pays fixed costs, but pays no variable cost and earns no revenue

A firm chooses to shut down if:

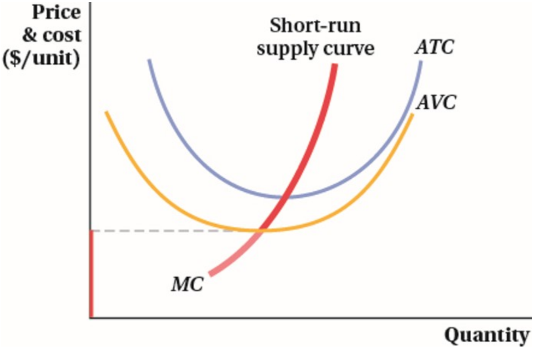
$$\begin{aligned} TR &< VC \\ \implies TR/Q &< VC/Q \\ \implies P &< AVC \end{aligned}$$

Short-run supply curve

Recall that firms will produce where P=MC, so the supply curve overlaps with MC curve

But the firm will shut down if $P < AVC$

The short-run supply curve is the part of the MC curve above AVC



The long-run decision to exit or enter

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:

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

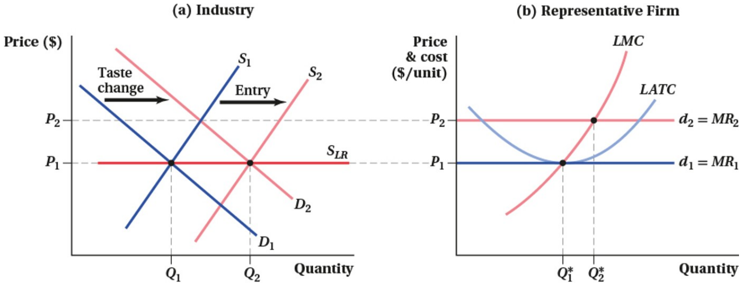
On the contrary, a firm chooses to enter the market if:

$$P > ATC$$

- 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 in the long run:** $P = ATC$

The effect of a change in demand in the long run

Suppose a change in taste increases demand from D_1 to D_2
$\Rightarrow$ Short-run price increases from P_1 to P_2
$\Rightarrow$ Existing firms make a profit, new firms enter the market
$\Rightarrow$ The entry of new firms increases supply (from S_1 to S_2) until all firms make zero profit
$\Rightarrow$ The new equilibrium is characterized by D_2 and S_2, quantity increases from Q_1 to Q_2, price remain unchanged at P_1, which is also the representative firm's lowest ATC



Perfect competition - exercise

In a perfectly competitive market, the market demand is $Q = 400 - 5P$. Firms in the market are identical; each firm's cost function is $C(q) = q^2 - 4q + 36$. Calculate the number of firms in this market in the long run.

Answer: Suppose there are n firms in the long run, each producing q units. According to the demand curve, $nq = 400 - 5P \;\Rightarrow\; P = 80 - \frac{nq}{5}$. Each individual firm's optimal production is achieved where $P = MC$: $80 - \frac{nq}{5} = 2q - 4$. In the long run, firms earn zero profit, so $P = ATC$: $80 - \frac{nq}{5} = q - 4 + \frac{36}{q}$. Putting the two equations together, we have $MC = ATC \;\Rightarrow\; 2q - 4 = q - 4 + \frac{36}{q} \;\Rightarrow\; q = 6$. Plugging this into the $P = MC$ equation: $80 - \frac{6n}{5} = 8 \;\Rightarrow\; n = 60$.