1.3 — Perfect Competition I

ECON 326 • Industrial Organization • Spring 2023

Ryan Safner

Associate Professor of Economics

safner@hood.edu

ryansafner/ioS23

ioS23.classes.ryansafner.com

Outline

Recall: The Firm's Two Problems

1^{st} Stage: firm's profit maximization problem:

1. **Choose:** < output >

2. **In order to maximize:** < profits >

2^{nd} Stage: firm's cost minimization problem:

1. **Choose:** < inputs >

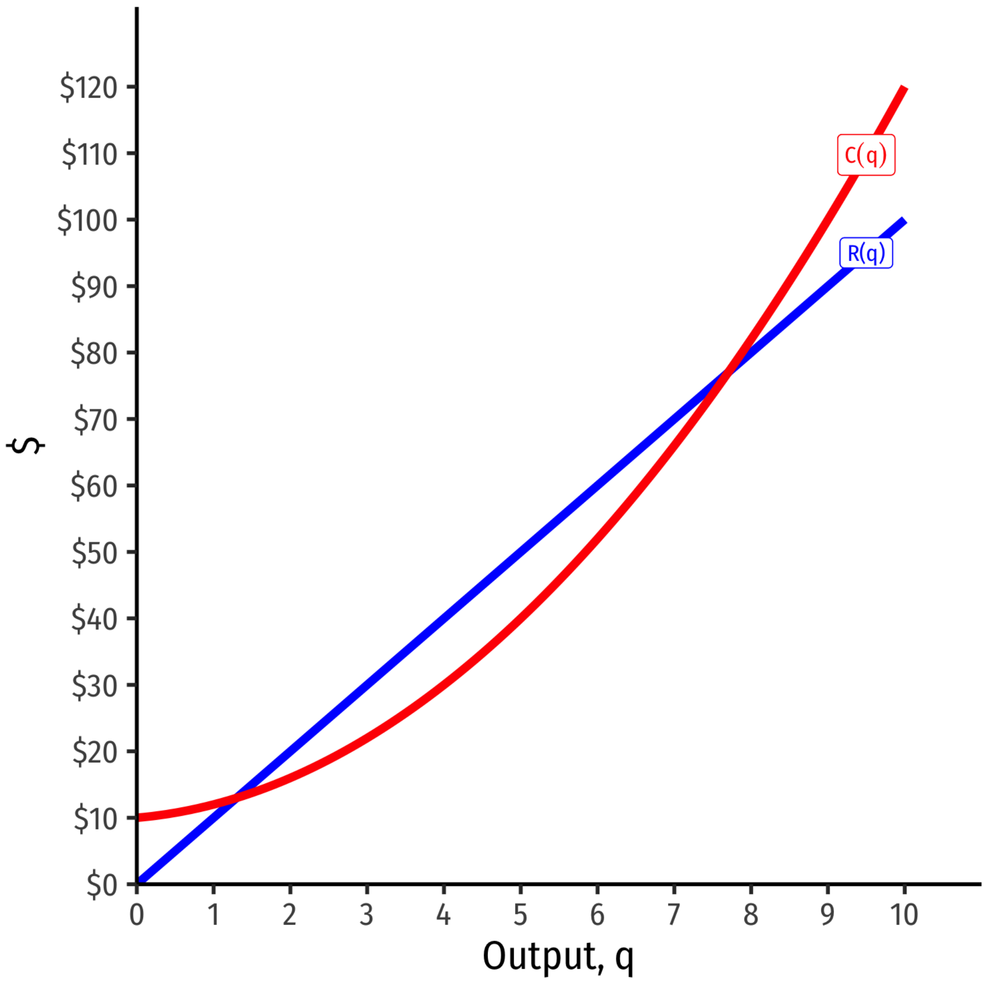
2. **In order to *minimize*:** < cost >

3. **Subject to:** < producing the optimal output >

- Minimizing costs $\iff$ maximizing profits

Visualizing Total Profit As $R(q) - C(q)$

- $\pi(q) = R(q) - C(q)$



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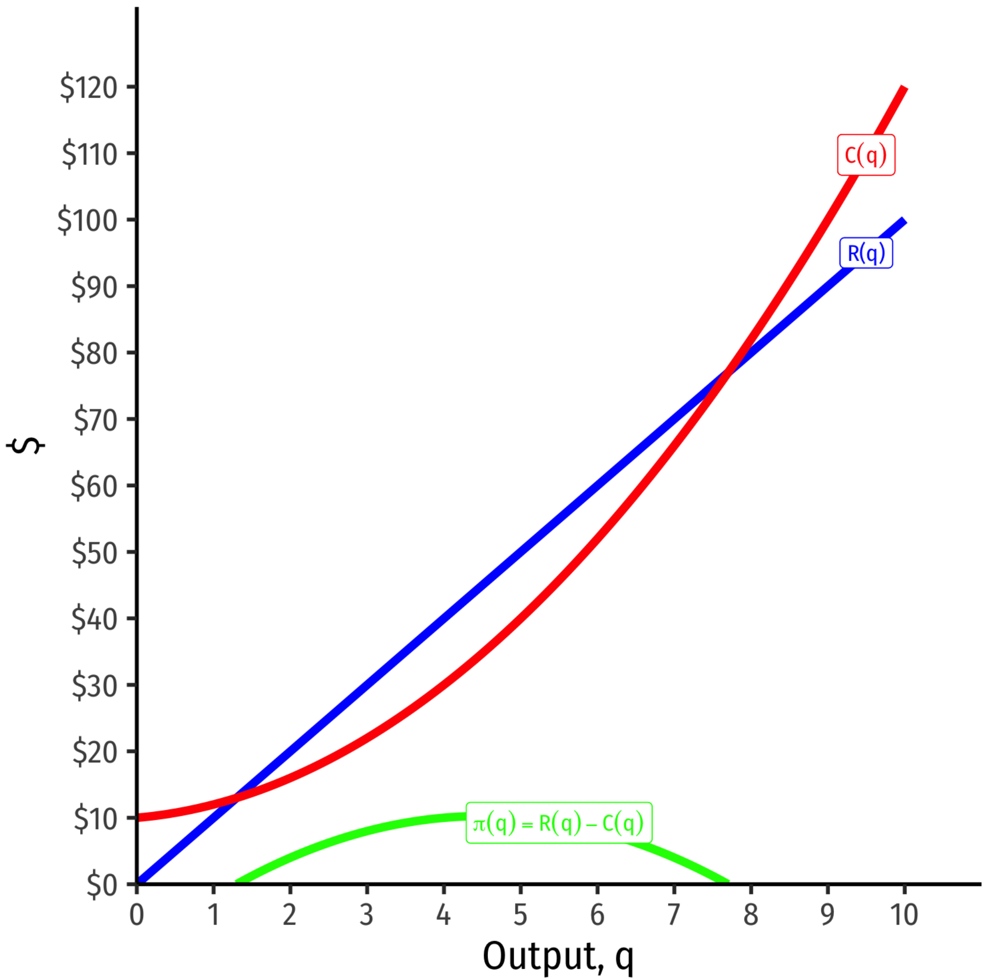
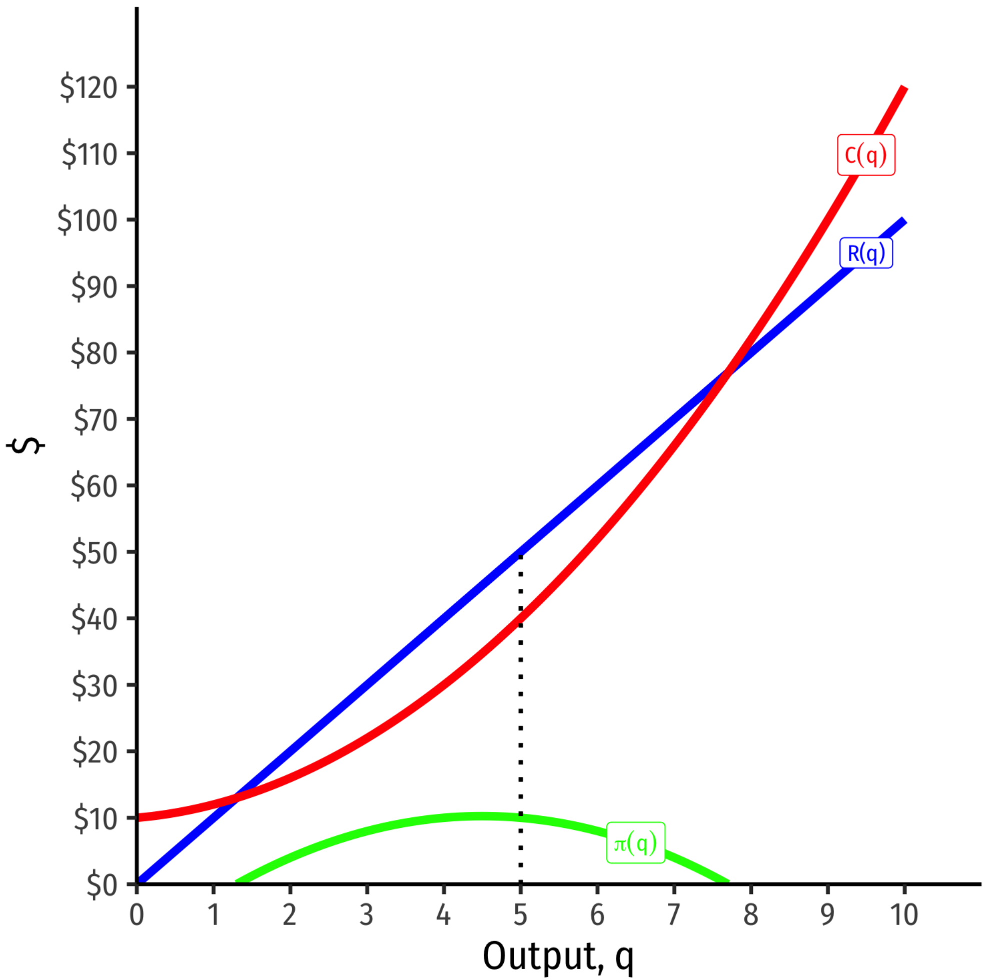


Visualizing Total Profit As $R(q) - C(q)$

- $\pi(q) = R(q) - C(q)$
- Graph: find q^* to max $\pi \implies q^*$ where max distance between $R(q)$ and $C(q)$



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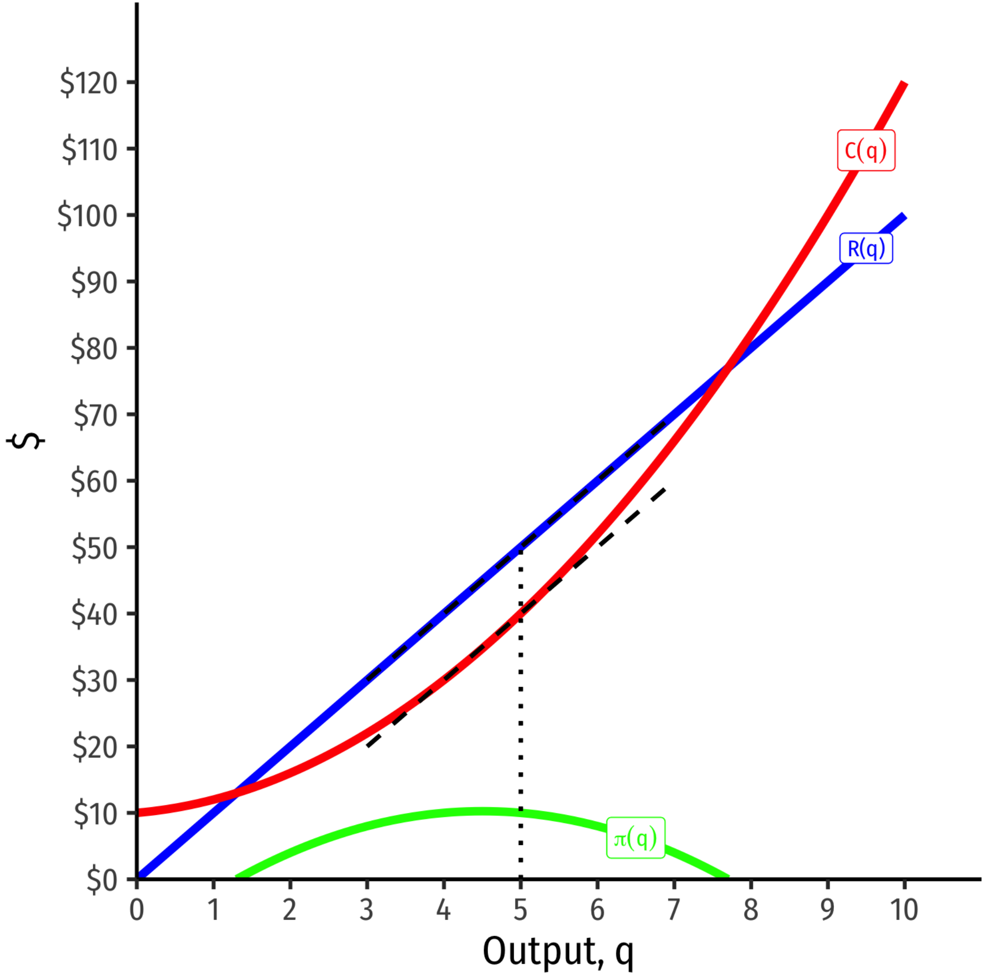
- Slopes must be equal:

$$MR(q) = MC(q)$$



Visualizing Total Profit As $R(q) - C(q)$

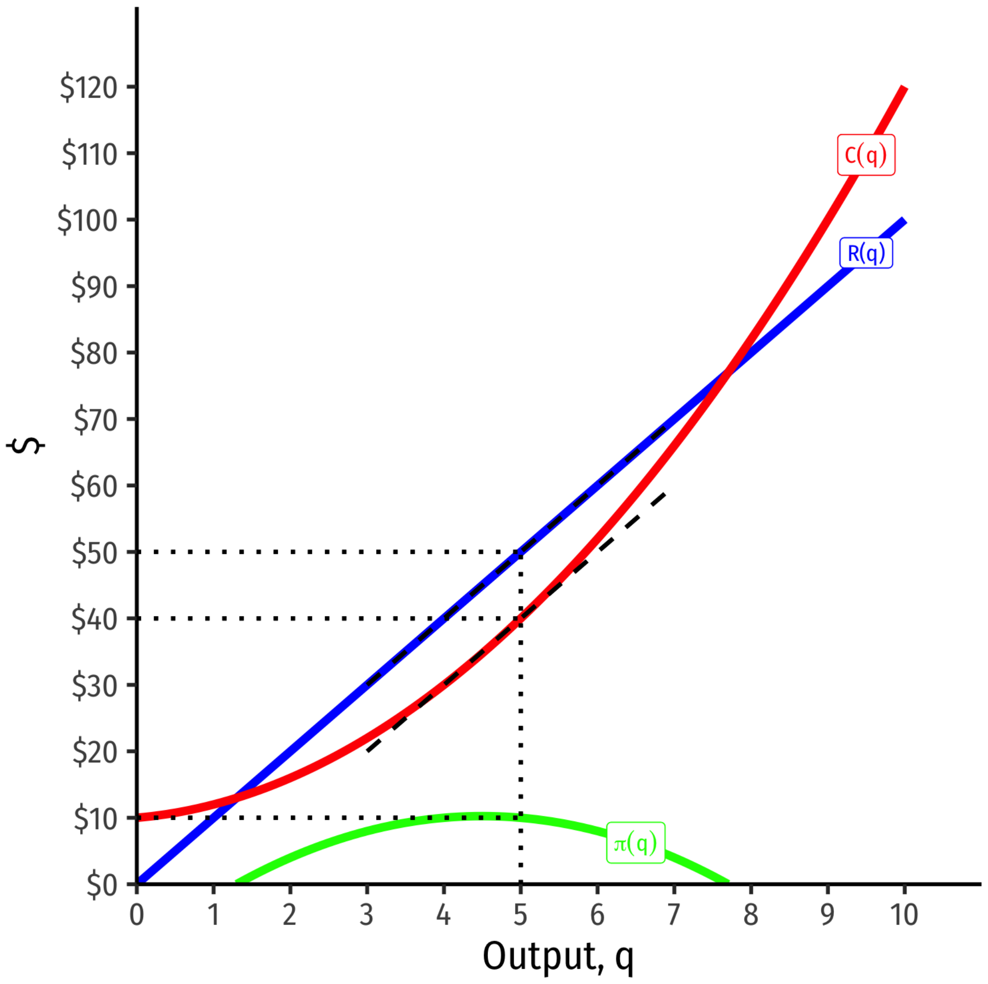
- $\pi(q) = R(q) - C(q)$

- Graph: find q^* to max $\pi \implies q^*$ where max distance between $R(q)$ and $C(q)$

- Slopes must be equal:

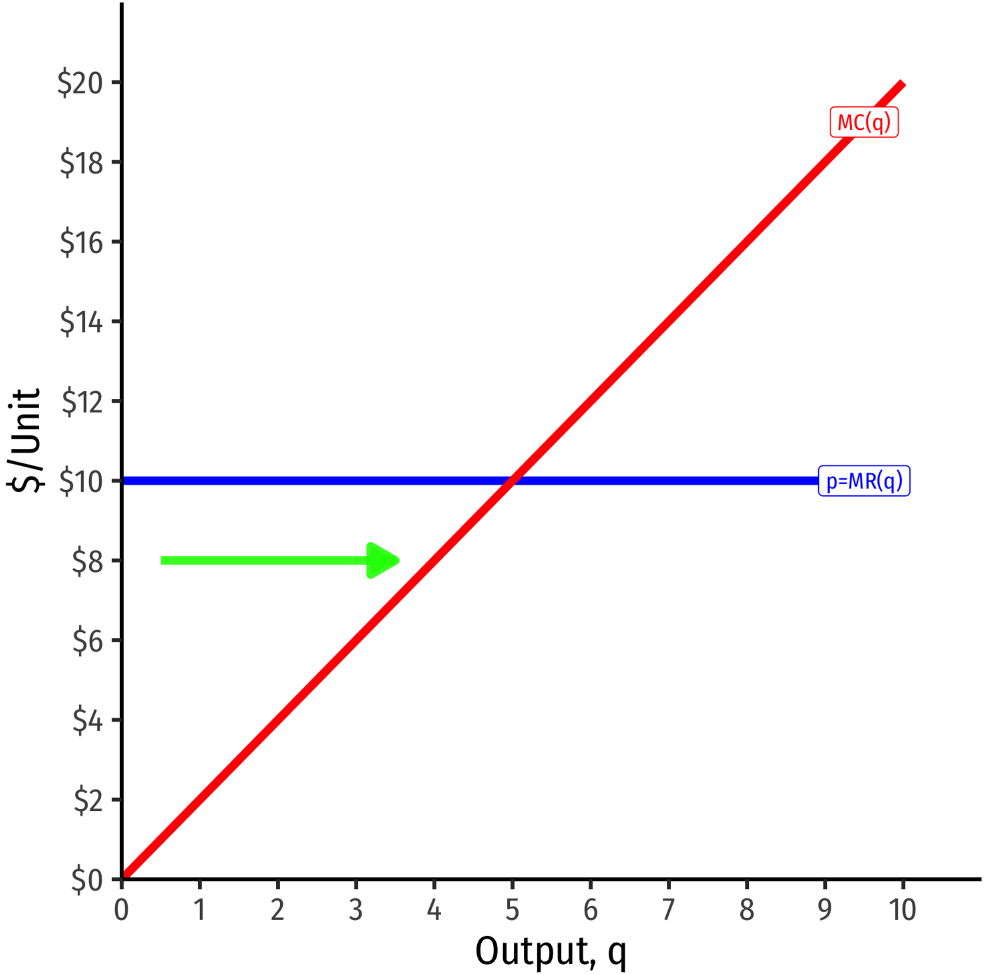
$$MR(q) = MC(q)$$

- At $q^* = 5$:
  - $R(q) = 50$
  - $C(q) = 40$
  - $\pi(q) = 10$



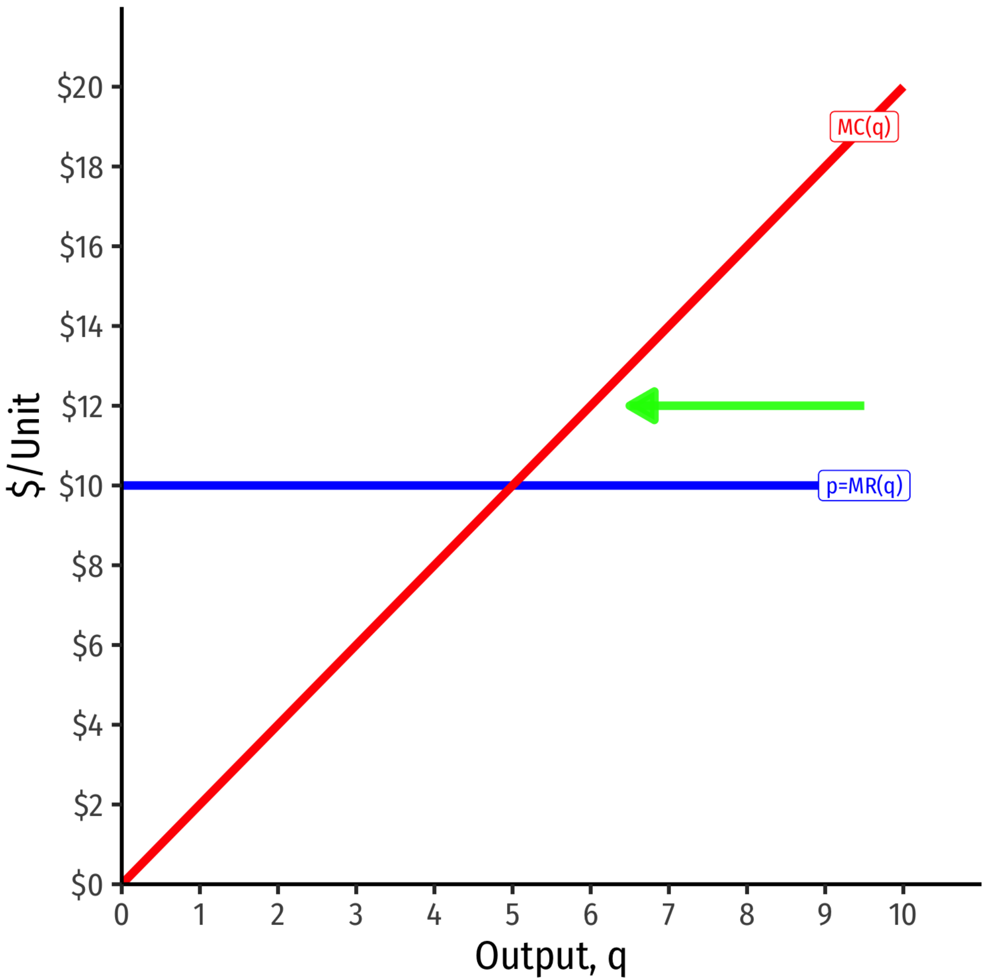
Visualizing Profit Per Unit As $MR(q)$ and $MC(q)$

- At low output $q < q^*$, can increase π by producing *more*: $MR(q) > MC(q)$



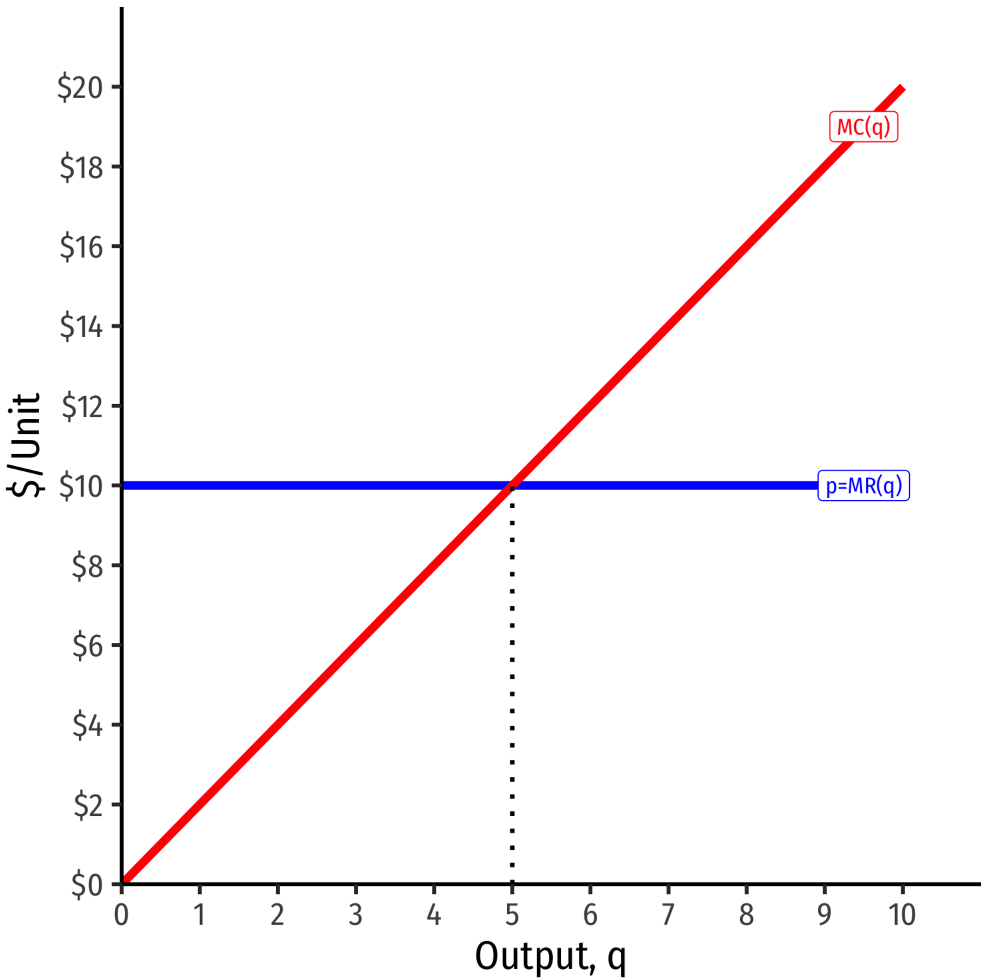
Visualizing Profit Per Unit As $MR(q)$ and $MC(q)$

- At high output $q > q^*$, can increase π by producing *less*: $MR(q) < MC(q)$



Visualizing Profit Per Unit As $MR(q)$ and $MC(q)$

- π is *maximized* where
  $\color{blue}{MR(q)} = \color{red}{MC(q)}$

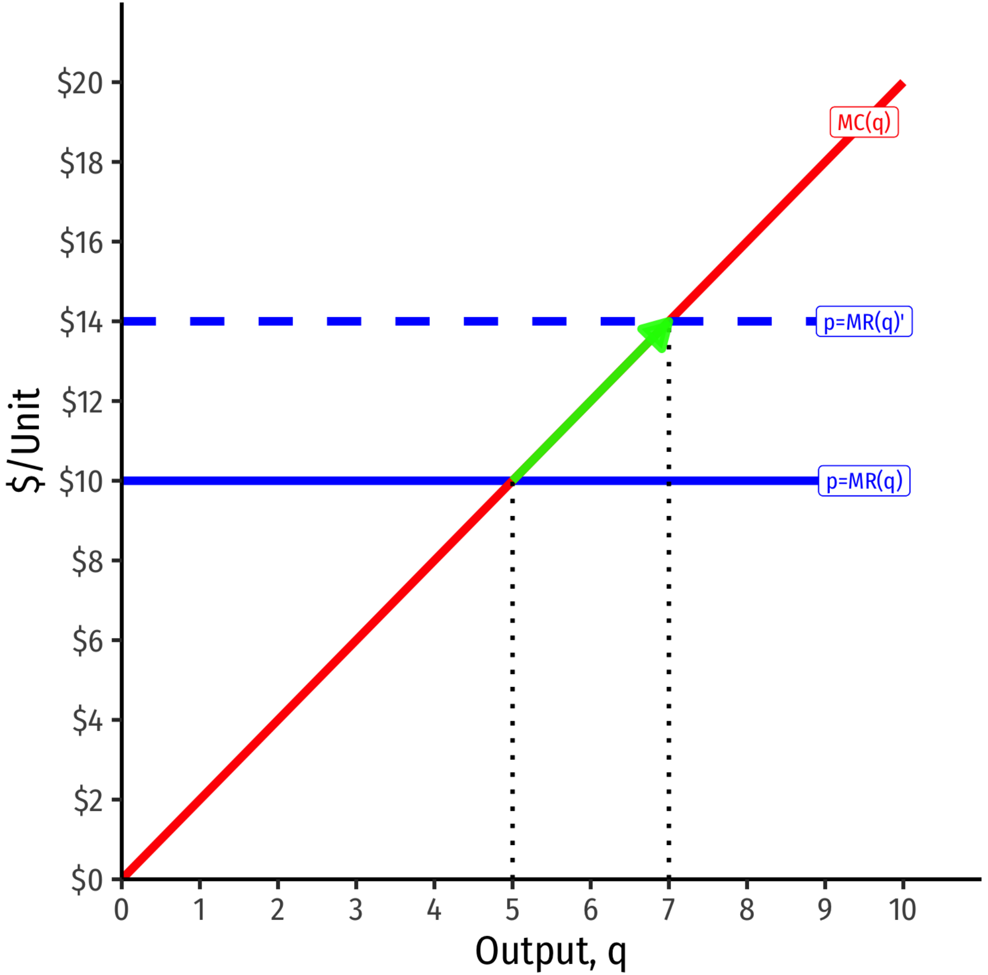


Comparative Statics

If Market Price Changes I

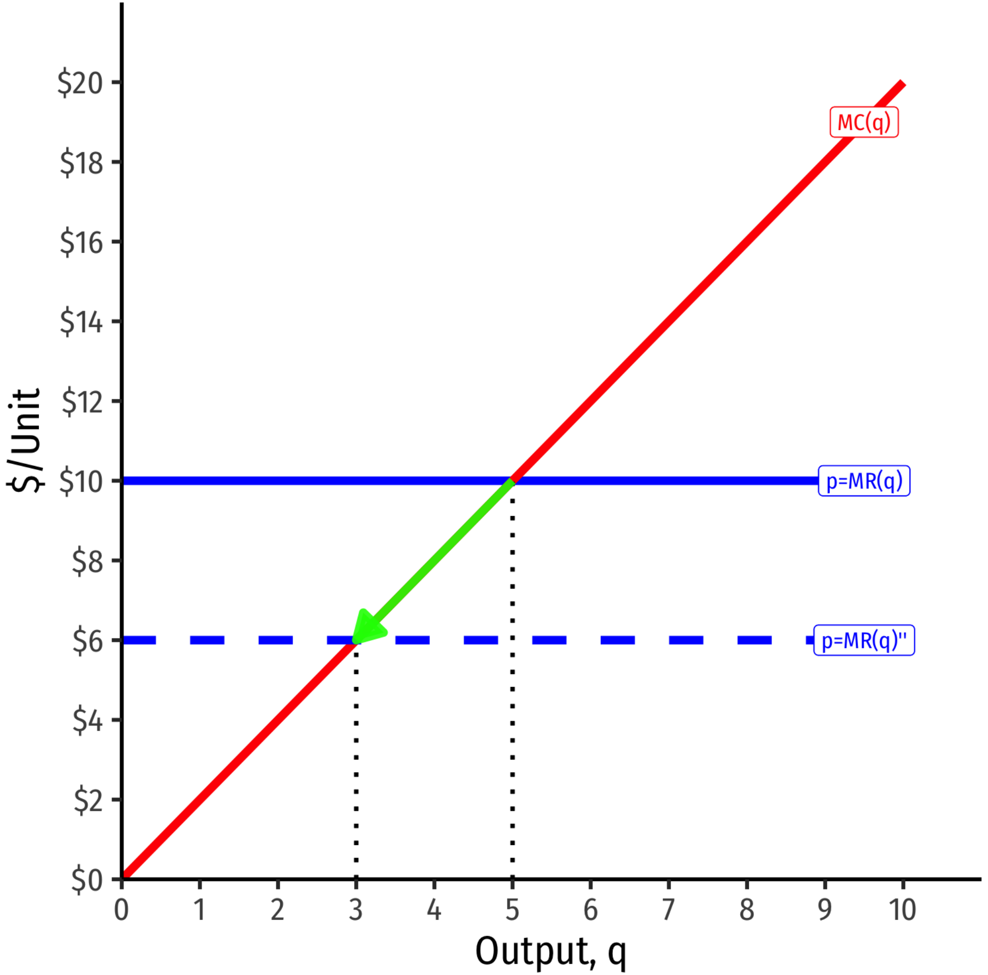
- Suppose the market price **increases**

- Firm (always setting MR=MC) will respond by **producing more**



If Market Price Changes II

- Suppose the market price **decreases**
- Firm (always setting MR=MC) will respond by **producing less**

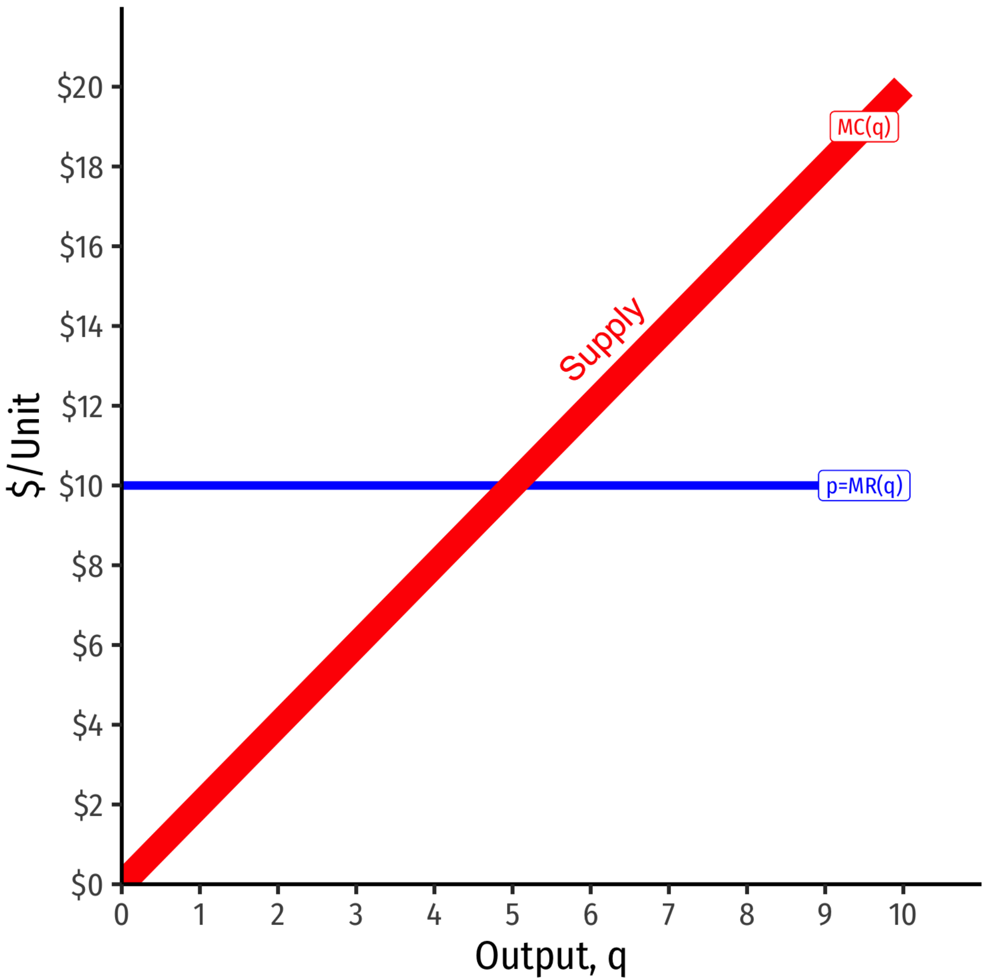


The Firm's Supply Curve

- **The firm's marginal cost curve is its supply curve**‡

$$p = MC(q)$$

  - How it will supply the optimal amount of output in response to the market price
  - **Firm always sets its price equal to its marginal cost**



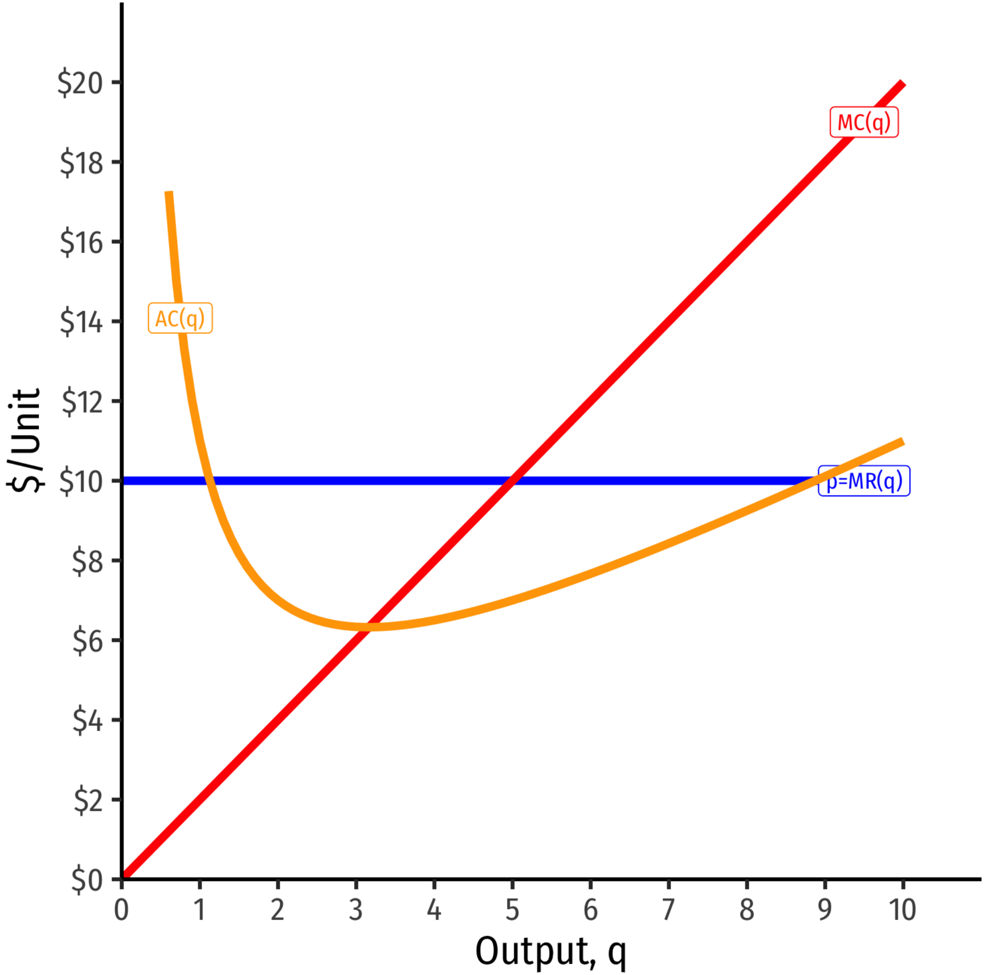
‡ Mostly...there is an important **exception** we will see shortly!

Calculating Profit

Calculating (Average) Profit as AR(q)-AC(q)

- Profit is

$$\pi(q) = R(q) - C(q)$$



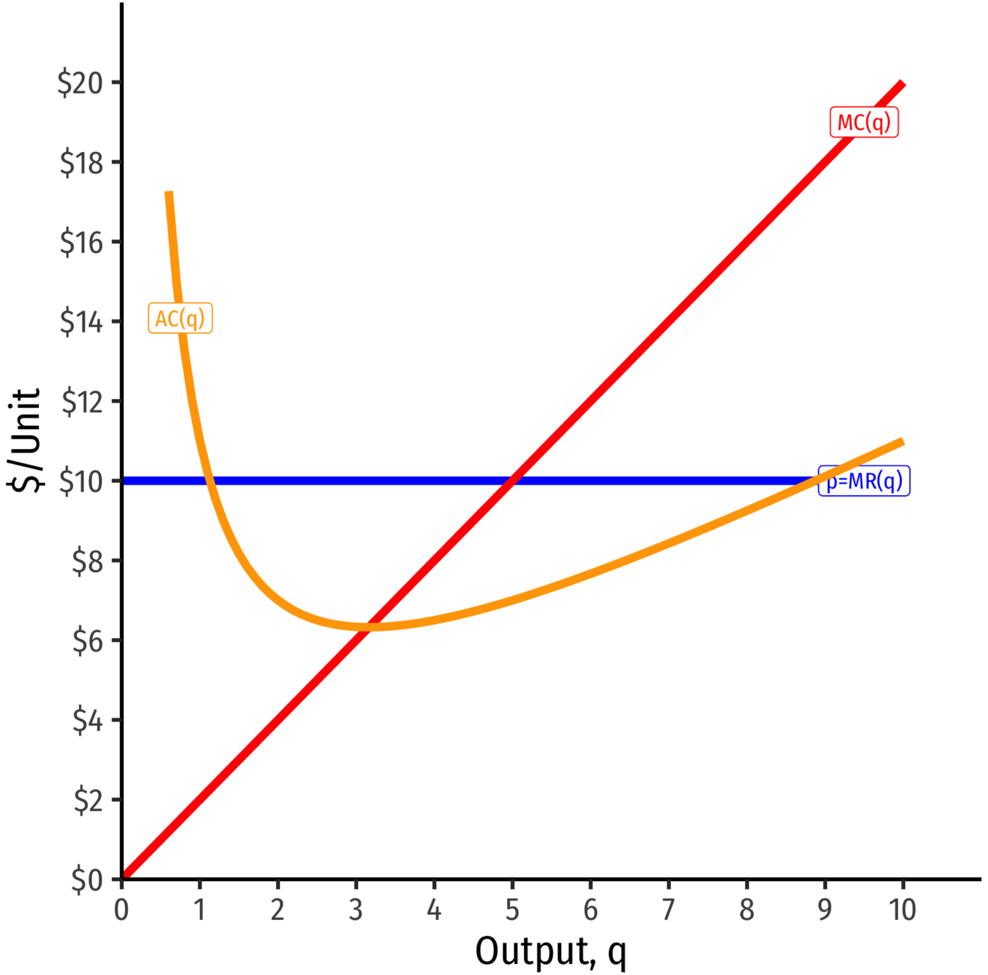
Calculating (Average) Profit as AR(q)-AC(q)

- Profit is

$$\pi(q) = R(q) - C(q)$$

- Profit per unit can be calculated as:

$$\begin{aligned}\frac{\pi(q)}{q} &= {\color{blue}AR(q)} - {\color{orange}AC(q)}\\ &= {\color{blue}p} - {\color{orange}AC(q)}\end{aligned}$$



Calculating (Average) Profit as AR(q)-AC(q)

- Profit is

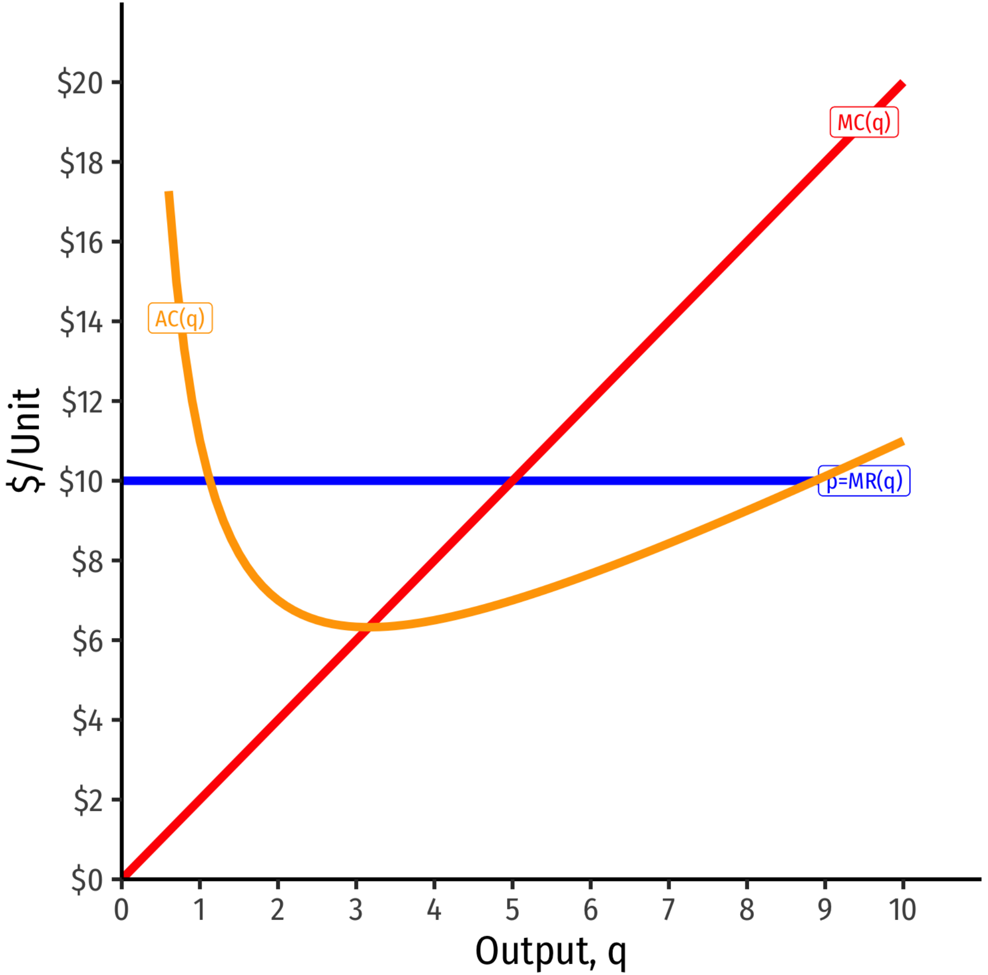
$$\pi(q) = R(q) - C(q)$$

- Profit per unit can be calculated as:

$$\begin{aligned}\frac{\pi(q)}{q} &= AR(q) - AC(q)\\ &= p - AC(q)\end{aligned}$$

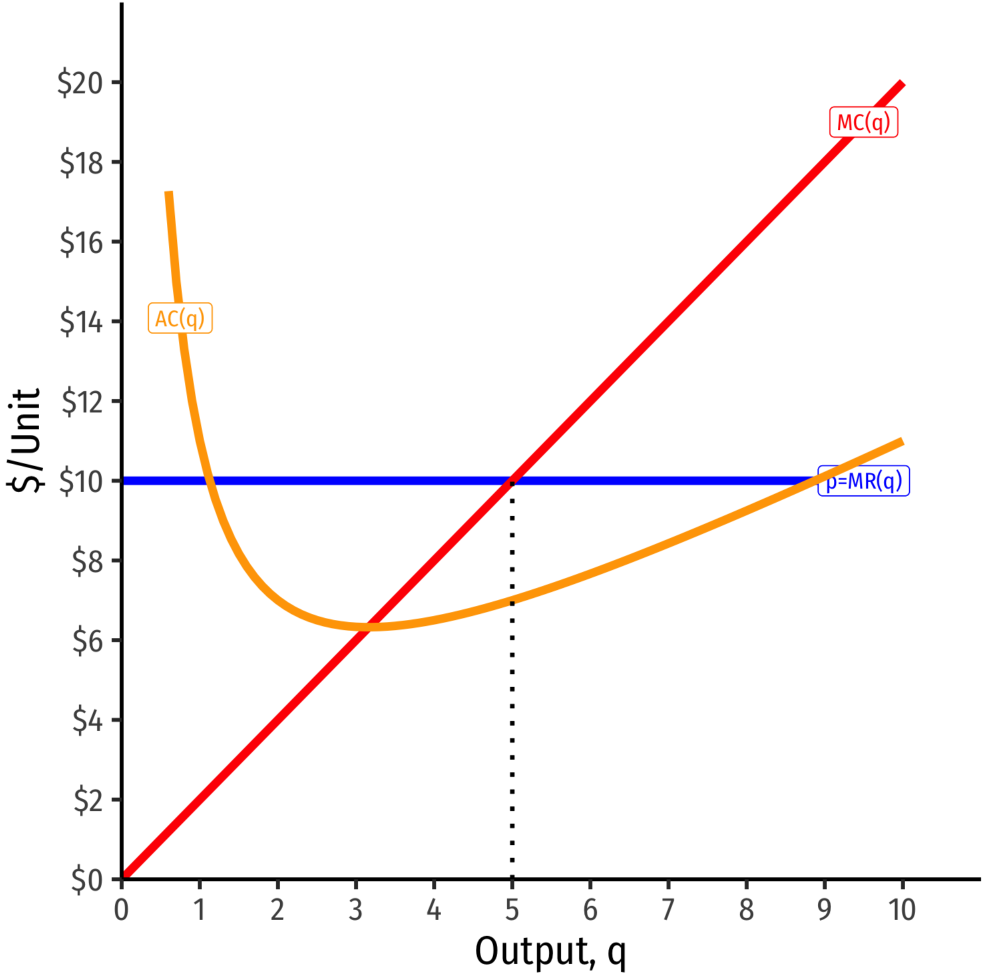
- Multiply by q to get total profit:

$$\pi(q) = q\left[p - AC(q)\right]$$



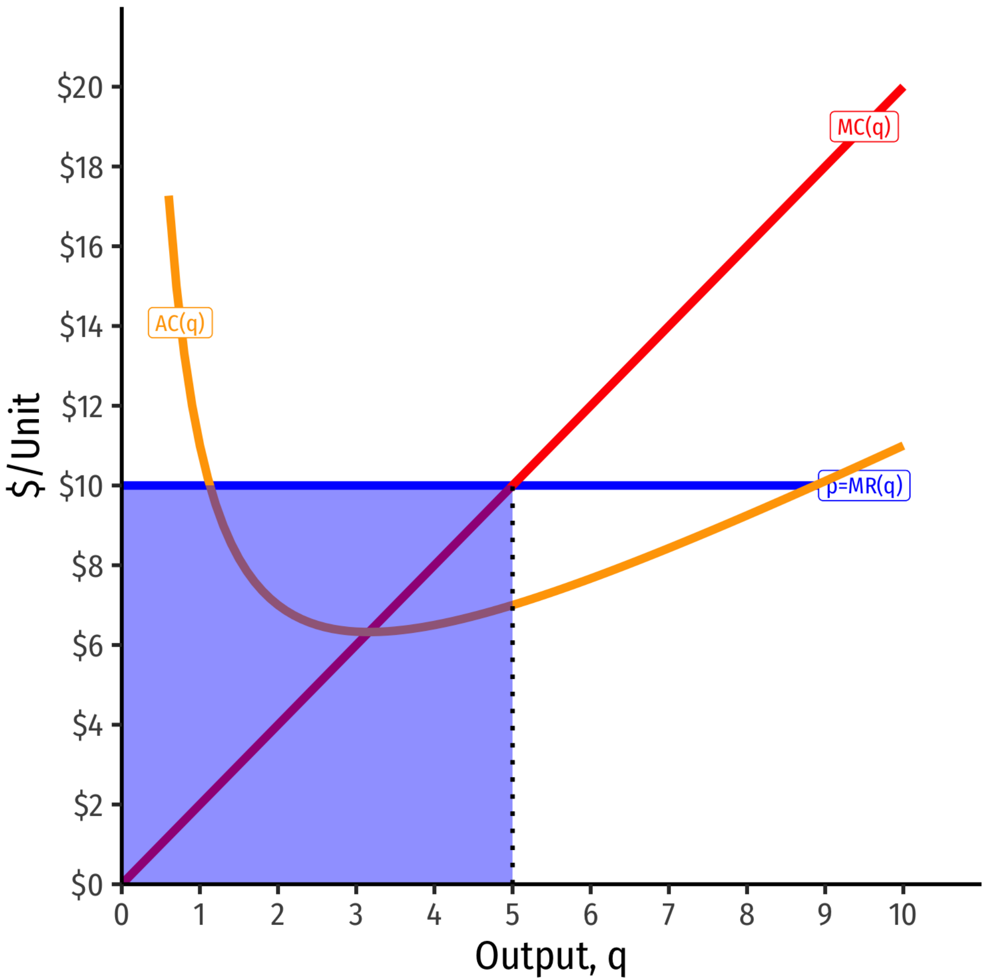
Calculating (Average) Profit as AR(q)-AC(q)

- At market price of $p^* = \$10$
- At $q^* = 5$ (per unit):
- At $q^* = 5$ (totals):



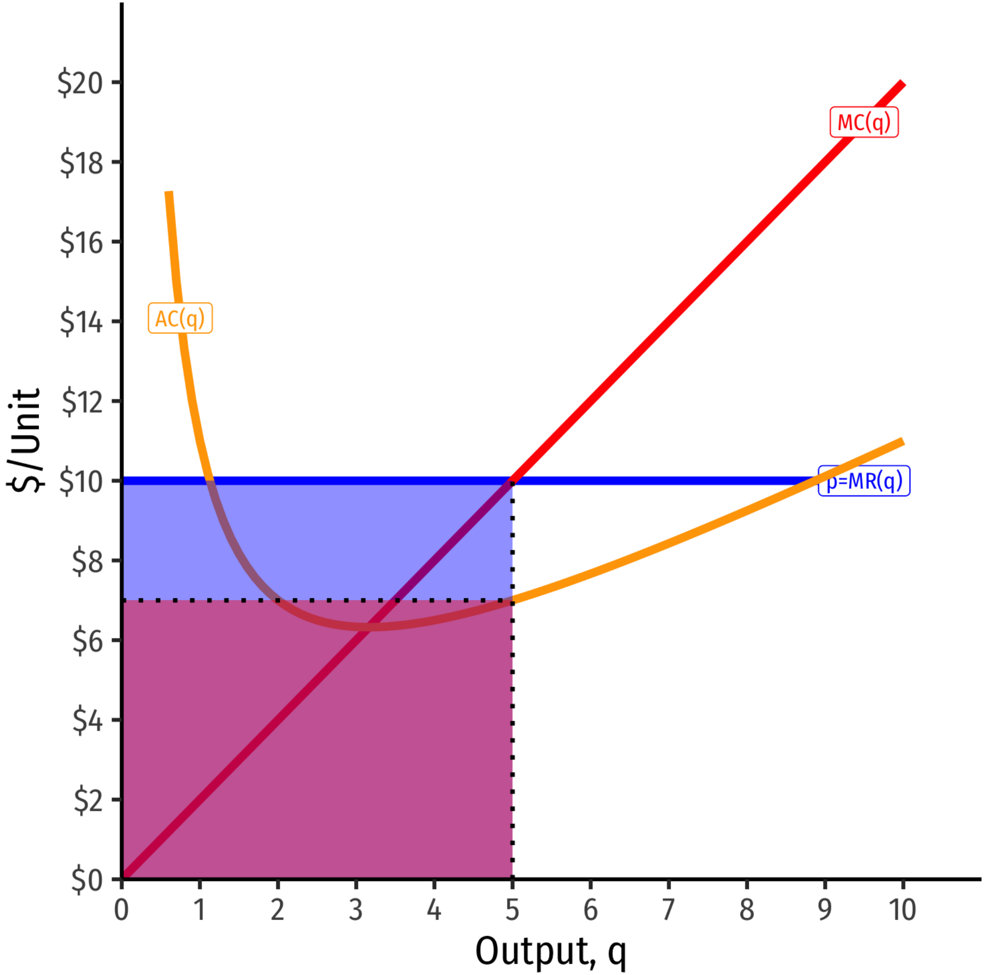
Calculating (Average) Profit as AR(q)-AC(q)

- At market price of $p^* = \$10$
- At $q^* = 5$ (per unit):
  - $AR(5) = \$10/\text{unit}$
- At $q^* = 5$ (totals):
  - $R(5) = \$50$



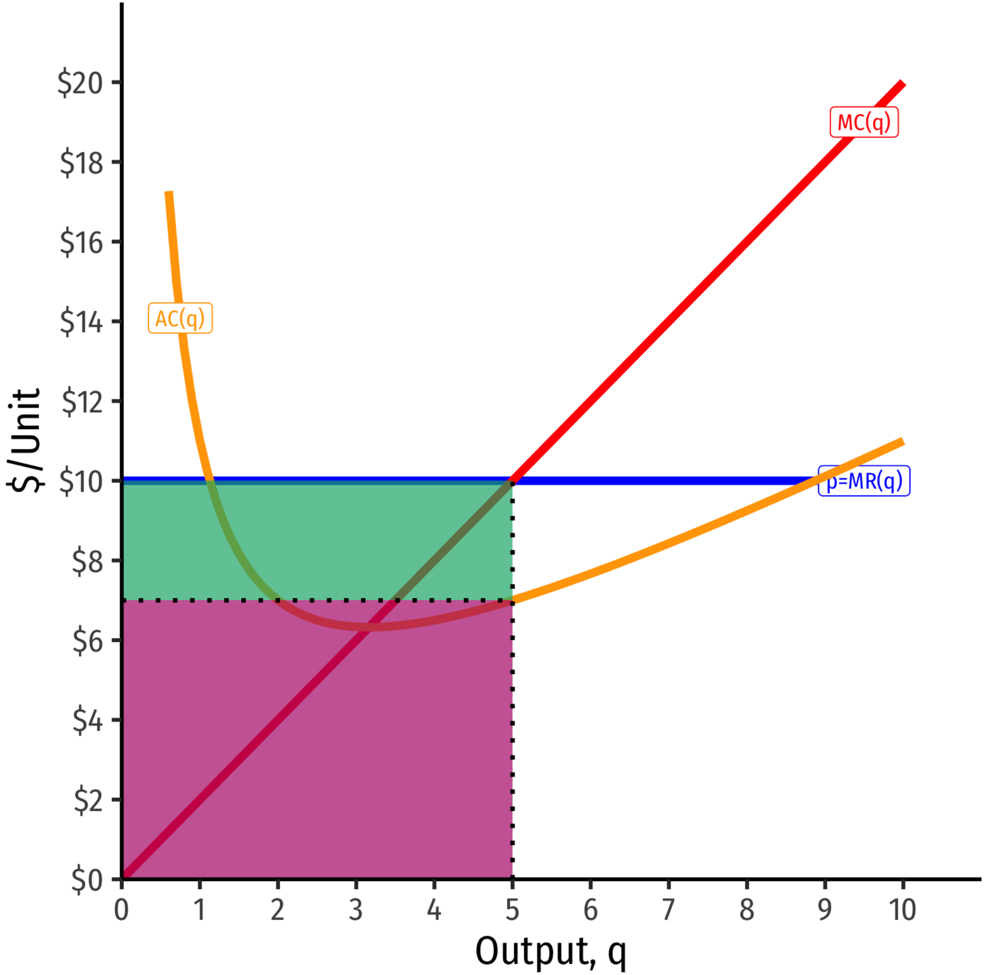
Calculating (Average) Profit as AR(q)-AC(q)

- At market price of $p^* = \$10$
- At $q^* = 5$ (per unit):
  - $AR(5) = \$10/\text{unit}$
  - $AC(5) = \$7/\text{unit}$
- At $q^* = 5$ (totals):
  - $R(5) = \$50$
  - $C(5) = \$35$



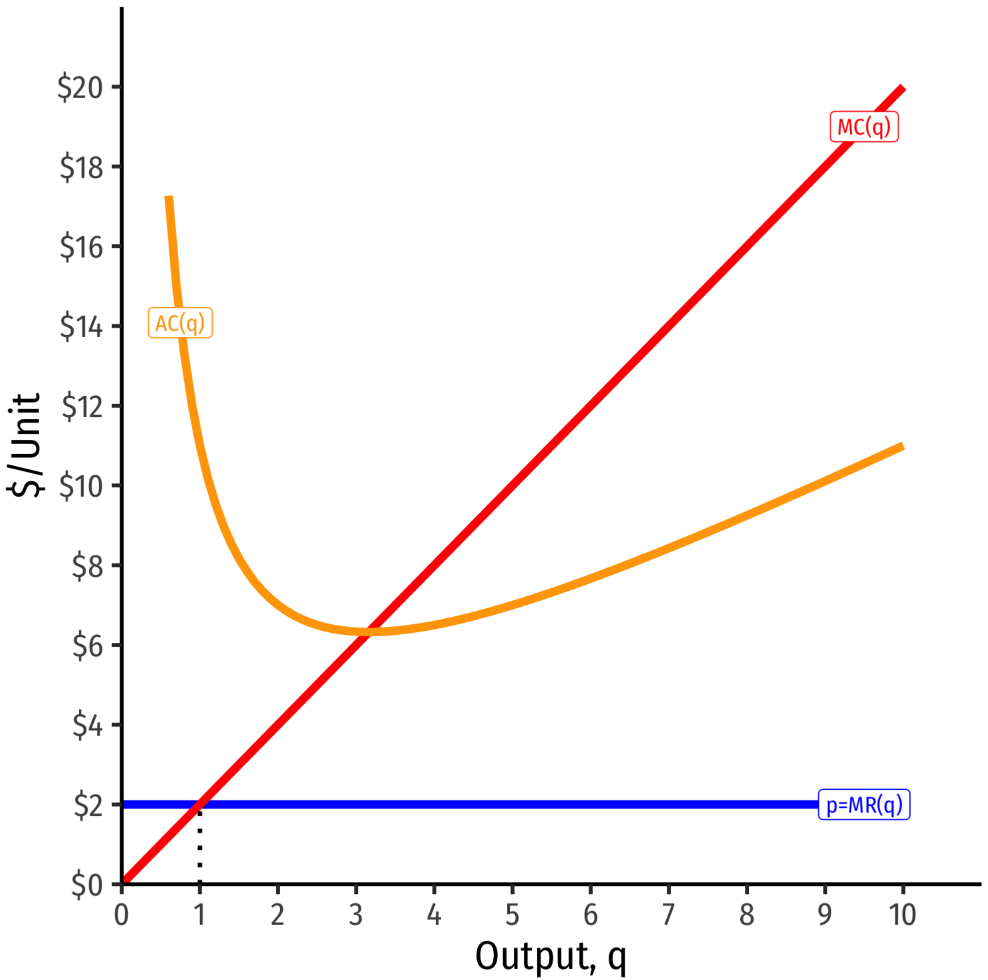
Calculating (Average) Profit as AR(q)-AC(q)

- At market price of $p^* = \$10$
- At $q^* = 5$ (per unit):
  - $AR(5) = \$10/\text{unit}$
  - $AC(5) = \$7/\text{unit}$
  - $A\pi(5) = \$3/\text{unit}$
- At $q^* = 5$ (totals):
  - $R(5) = \$50$
  - $C(5) = \$35$
  - $\pi = \$15$



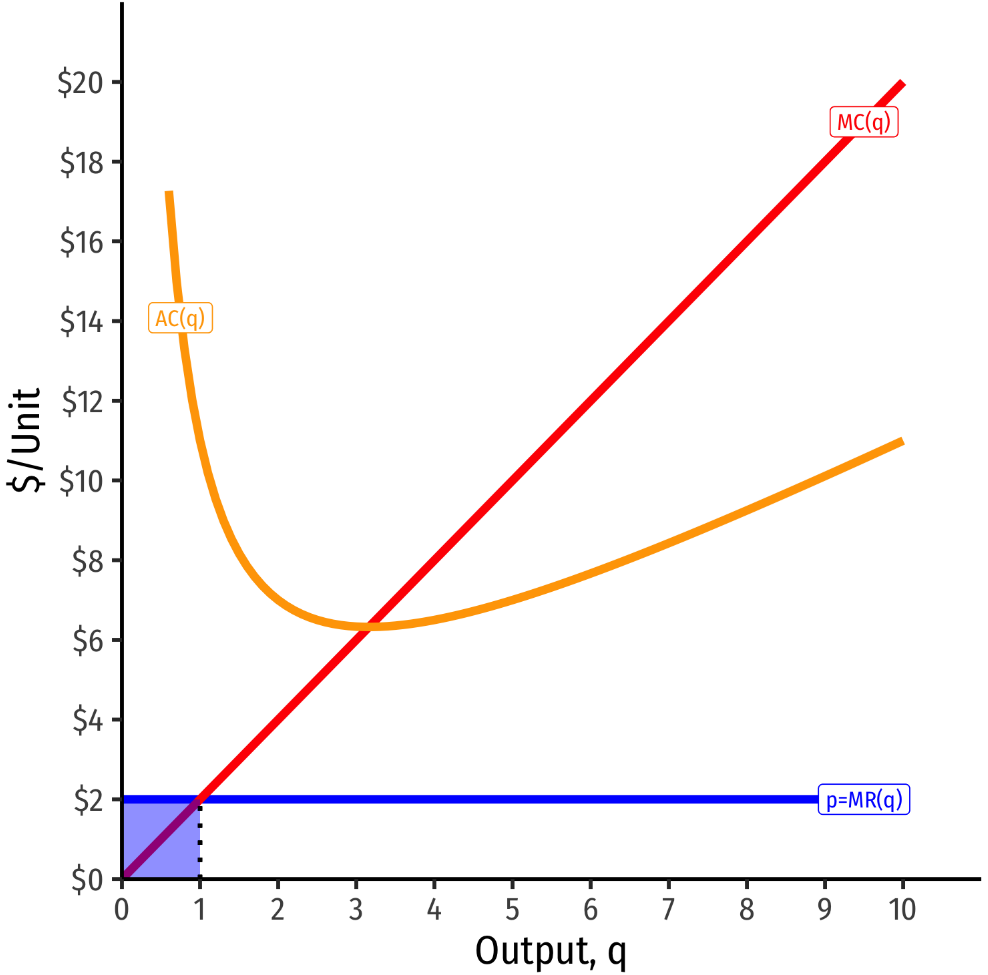
Calculating (Average) Profit as AR(q)-AC(q)

- At market price of $p^* = \$2$
- At $q^* = 1$ (per unit):
- At $q^* = 1$ (totals):



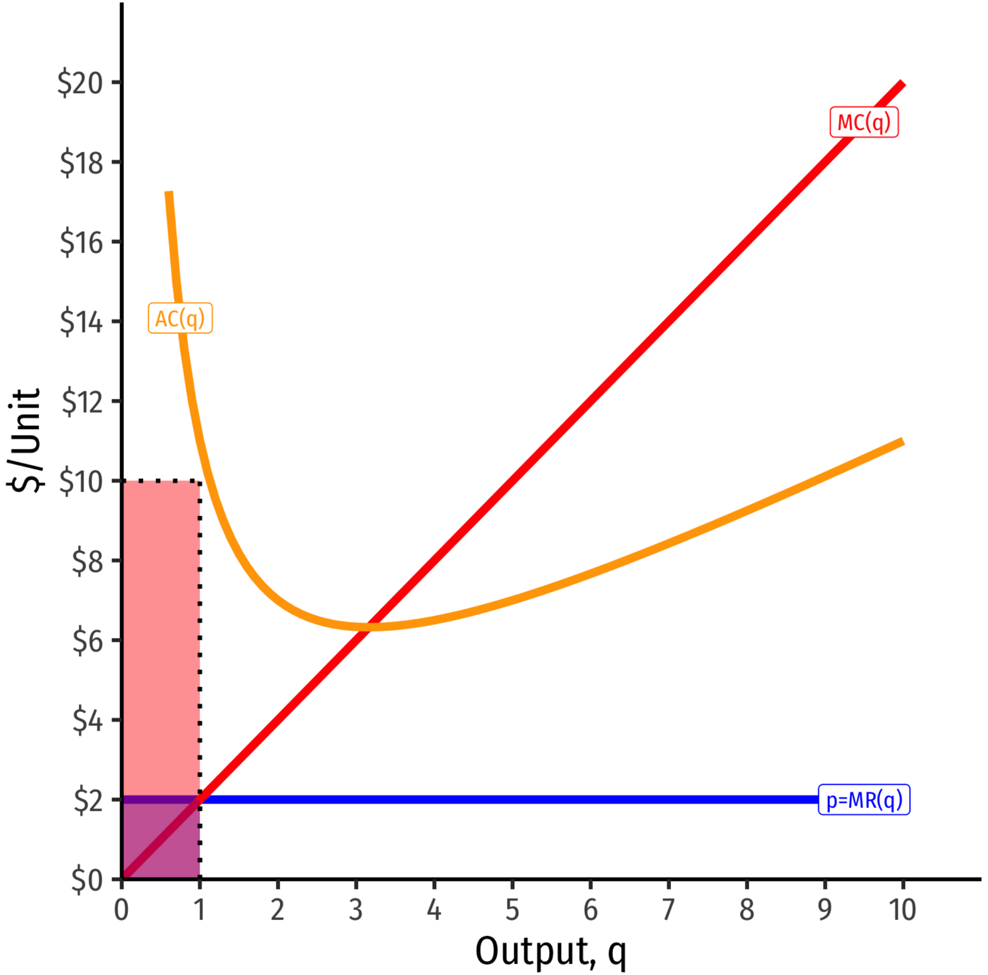
Calculating (Average) Profit as AR(q)-AC(q)

- At market price of $p^* = \$2$
- At $q^* = 1$ (per unit):
  - $AR(1) = \$2/\text{unit}$
- At $q^* = 1$ (totals):
  - $R(1) = \$2$



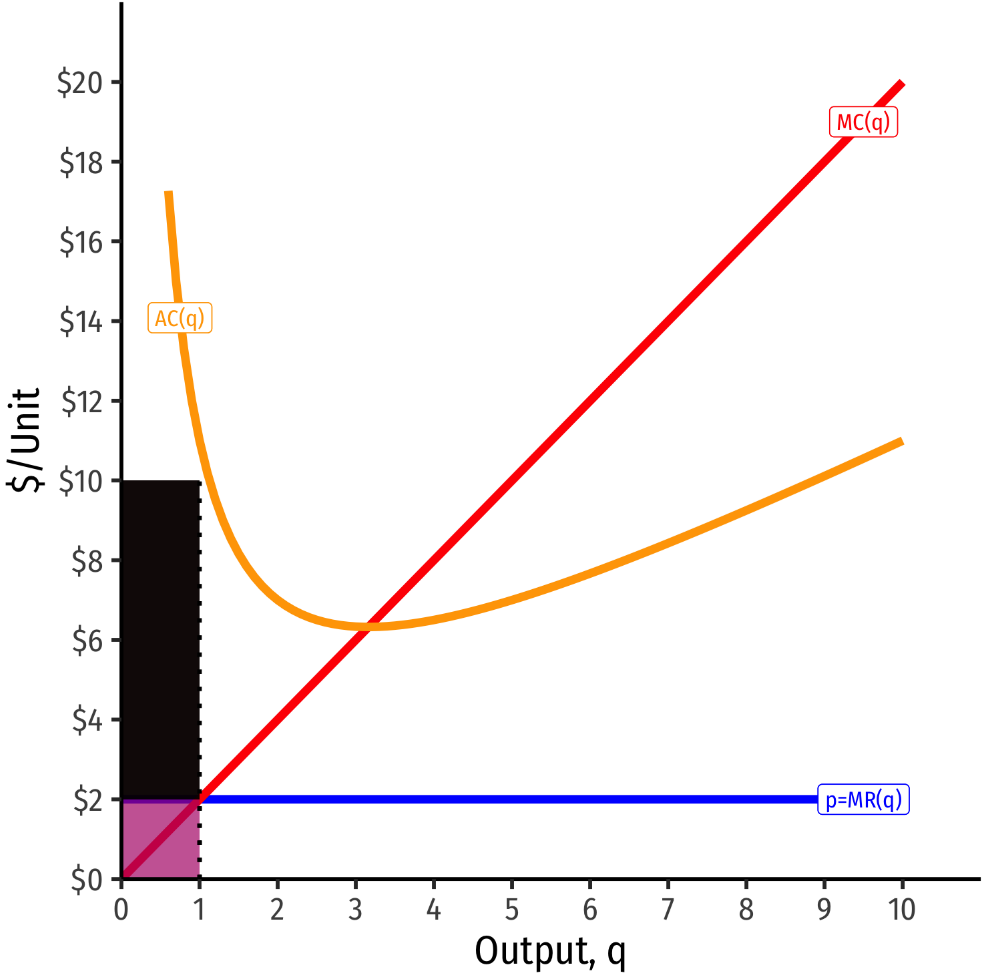
Calculating (Average) Profit as AR(q)-AC(q)

- At market price of $p^* = \$2$
- At $q^* = 1$ (per unit):
  - AR(1) = \$2/unit
  - AC(1) = \$10/unit
- At $q^* = 1$ (totals):
  - R(1) = \$2
  - C(1) = \$10



Calculating (Average) Profit as AR(q)-AC(q)

- At market price of p* = $2
- At q* = 1 (per unit):
  - AR(1) = $2/unit
  - AC(1) = $10/unit
  - Aπ(1) = -$8/unit
- At q* = 1 (totals):
  - R(1) = $2
  - C(1) = $10
  - π(1) = -$8



Short-Run Shut-Down Decisions

Short-Run Shut-Down Decisions

- What if a firm's profits at q^* are **negative** (i.e. it earns **losses**)?

- **Should it produce at all?**

Short-Run Shut-Down Decisions

- Suppose firm chooses to produce **nothing** $(q = 0)$:

- If it has **fixed costs** $(f > 0)$, its profits are:

$$\pi(q) = pq - C(q)$$

Short-Run Shut-Down Decisions

- Suppose firm chooses to produce **nothing** $(q = 0)$:

- If it has **fixed costs** $(f > 0)$, its profits are:

$$\pi(q) = pq - C(q)$$
$$\pi(q) = pq - f - VC(q)$$

Short-Run Shut-Down Decisions

- Suppose firm chooses to produce **nothing** $(q=0)$:

- If it has **fixed costs** $(f>0)$, its profits are:

$$\begin{aligned}
\pi(q) &= pq - C(q)\\
\pi(q) &= pq - f - VC(q)\\
\pi(0) &= -f
\end{aligned}$$

i.e. it (still) pays its fixed costs

Short-Run Shut-Down Decisions

- A firm should choose to produce **no output** $(q = 0)$ only when:

$$\pi \text{ from producing} < \pi \text{ from not producing}$$

Short-Run Shut-Down Decisions

- A firm should choose to produce **no output** $(q = 0)$ only when:

$$\pi \text{ from producing} < \pi \text{ from not producing}$$
$$\pi(q) < -f$$

Short-Run Shut-Down Decisions

- A firm should choose to produce **no output** $(q = 0)$ only when:

$$\begin{aligned} \pi \text{ from producing} &< \pi \text{ from not producing} \\ \pi(q) &< -f \\ pq - VC(q) - f &< -f \end{aligned}$$

Short-Run Shut-Down Decisions

- A firm should choose to produce **no output** $(q = 0)$ only when:

$$
\begin{aligned}
\pi \text{ from producing} &< \pi \text{ from not producing} \\
\pi(q) &< -f \\
pq - VC(q) - f &< -f \\
pq - VC(q) &< 0
\end{aligned}
$$

Short-Run Shut-Down Decisions

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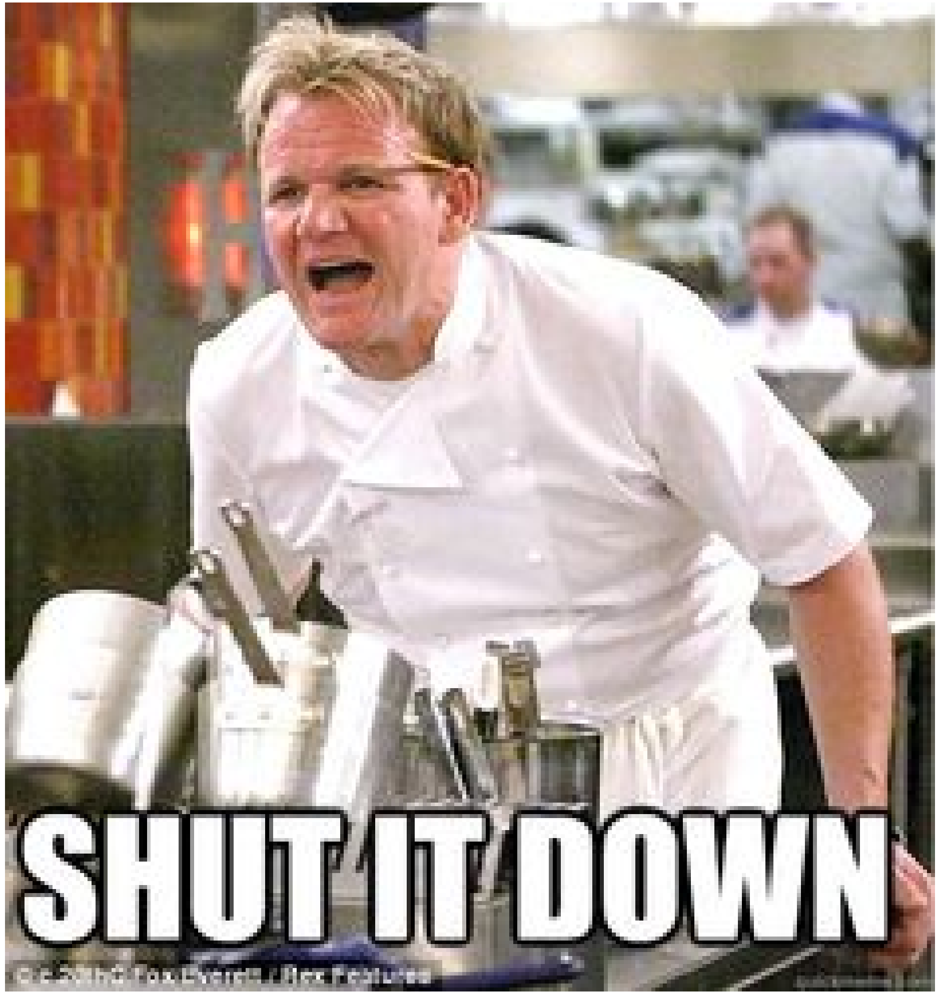
$$

Short-Run Shut-Down Decisions

- A firm should choose to produce **no output** $(q=0)$ only when:

$$\begin{aligned}\pi \text{ from producing} &< \pi \text{ from not producing}\\ \pi(q) &< -f\\ pq - VC(q) - f &< -f\\ pq - VC(q) &< 0\\ pq &< VC(q)\\ \color{red}{p} &\color{red}{< AVC(q)}\end{aligned}$$

- **Shut down price**: firm will shut down production *in the short run* when $p < AVC(q)$



The Firm's Short Run Supply Decision

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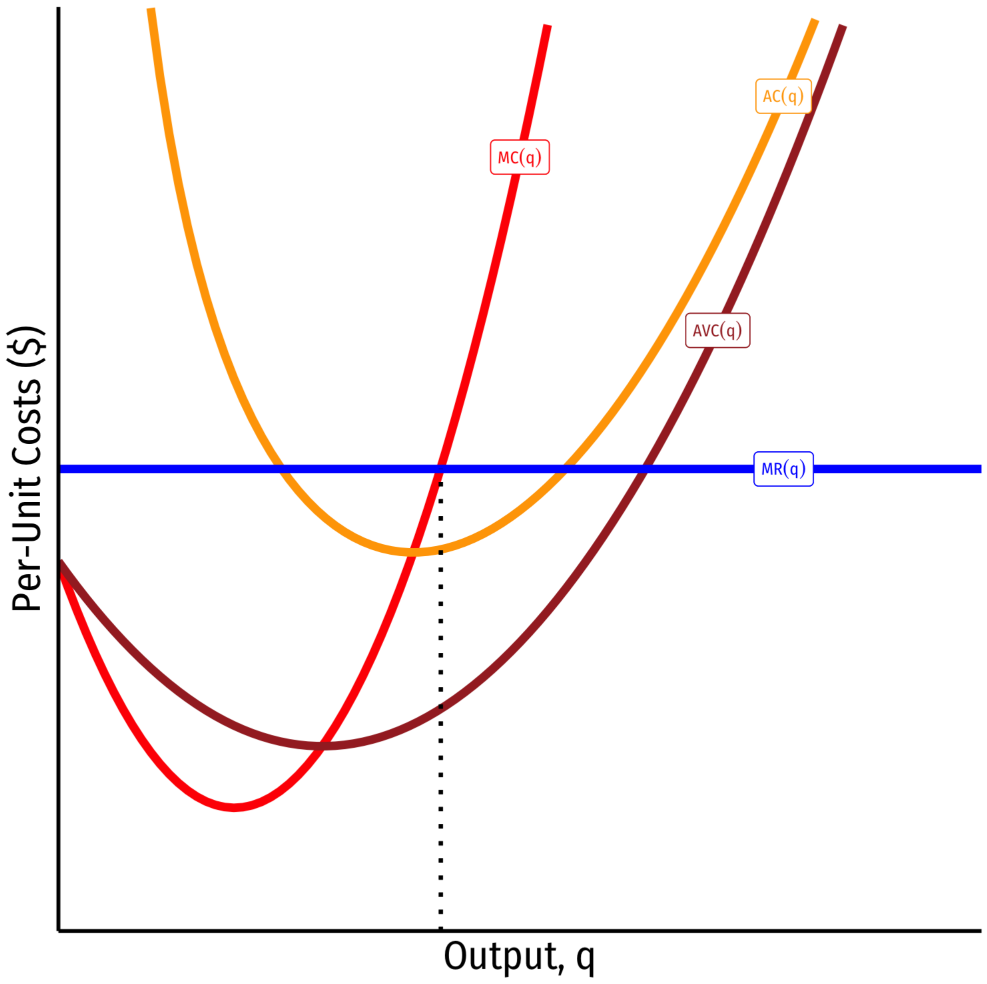

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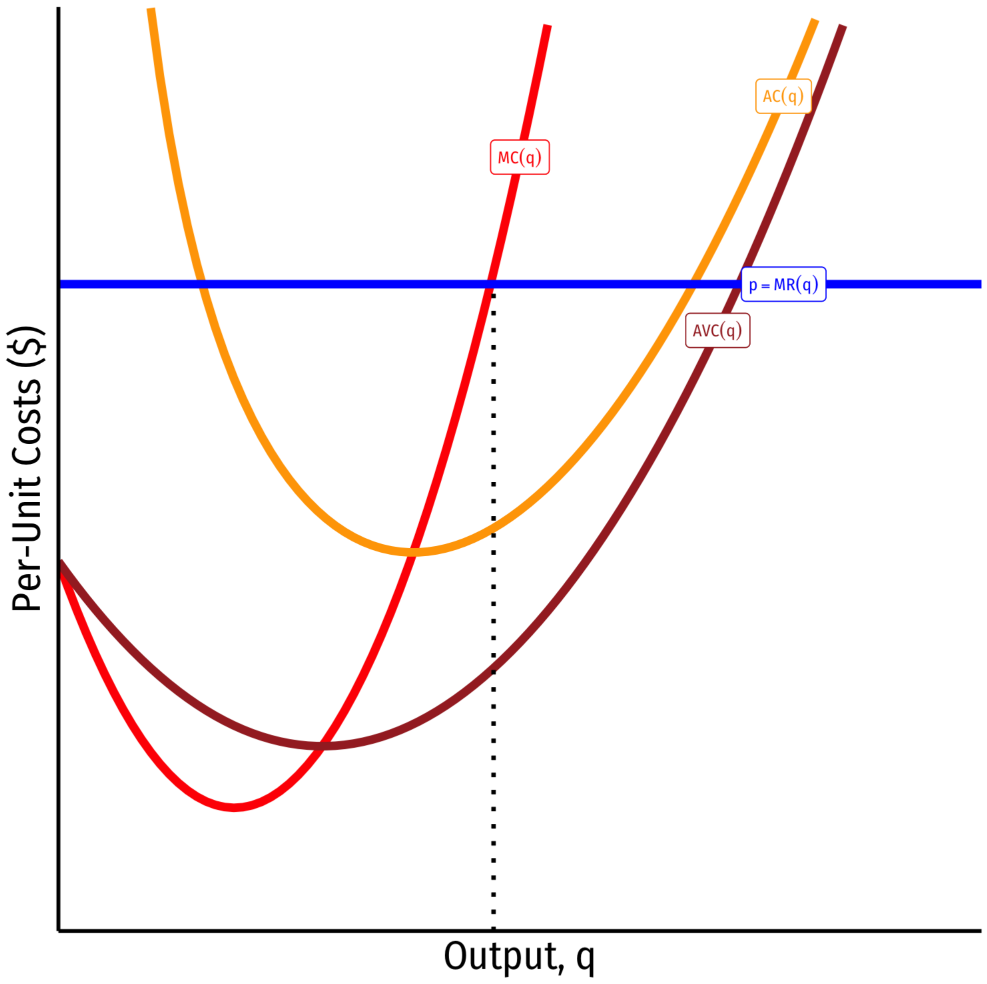

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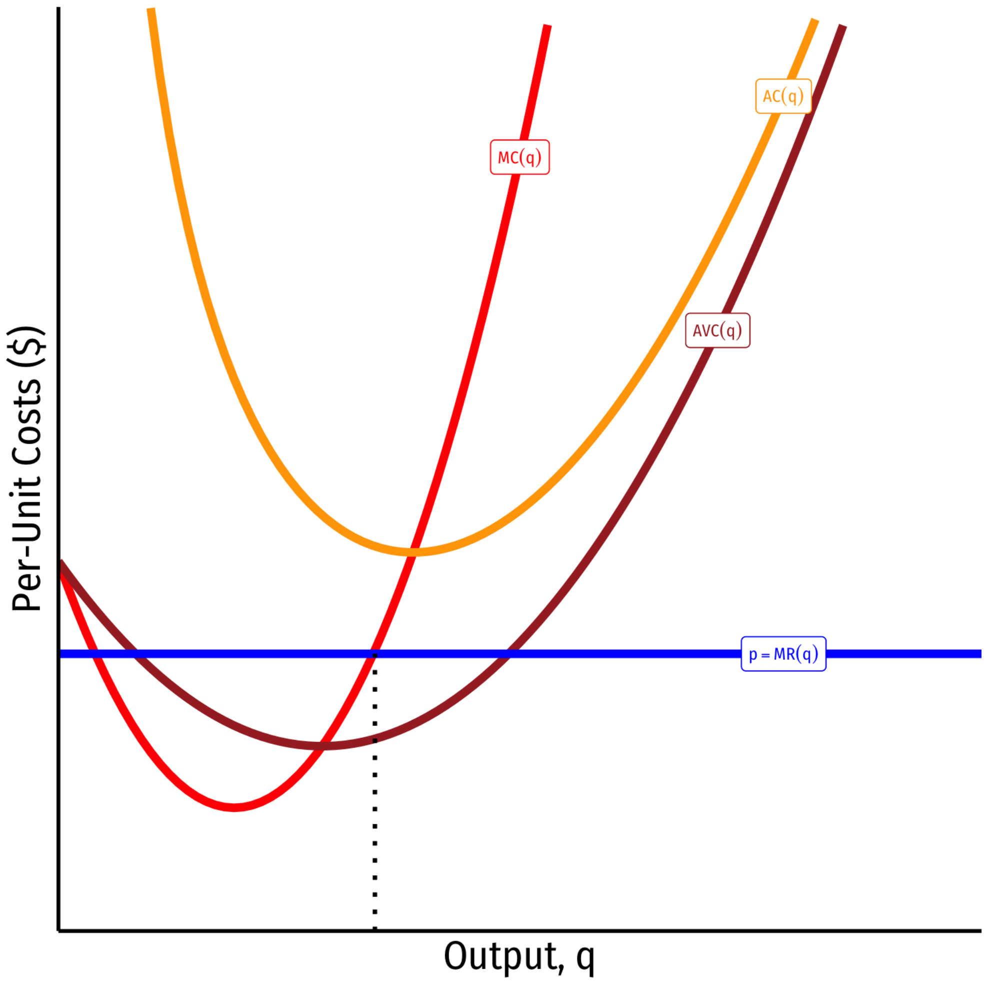

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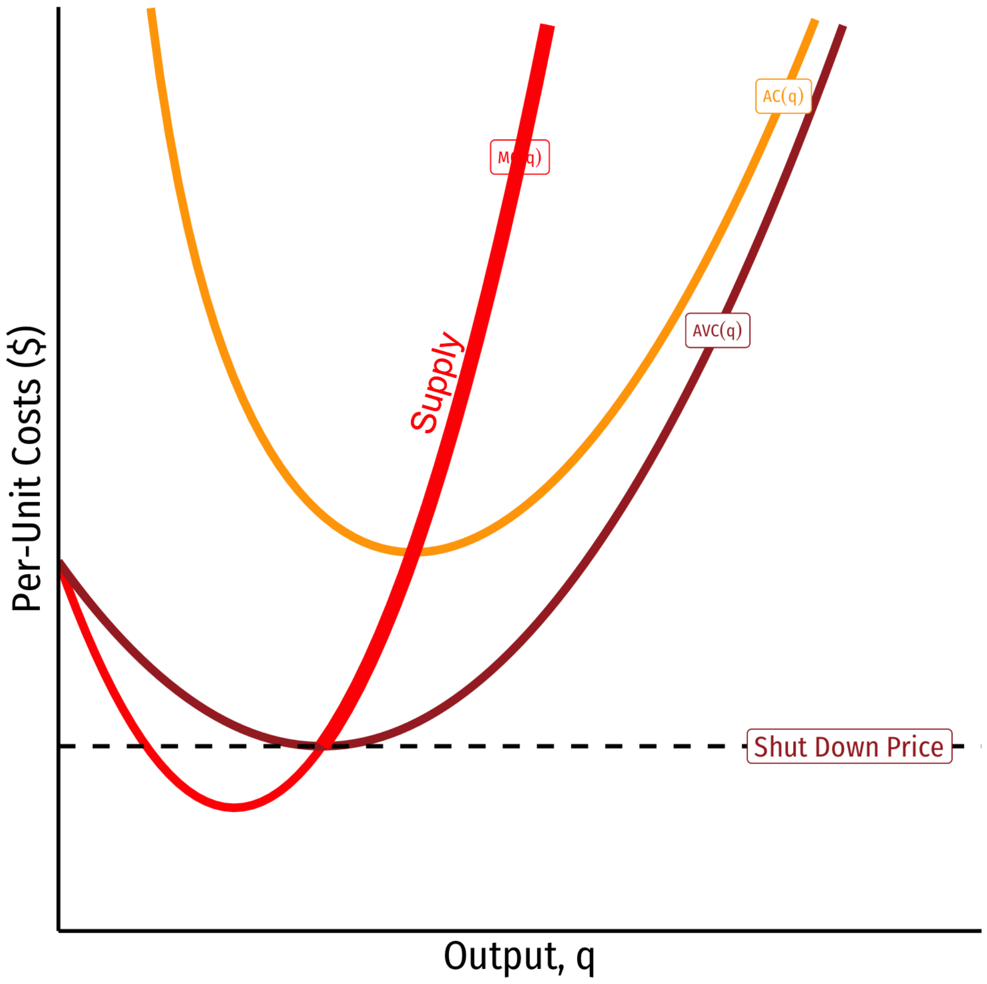

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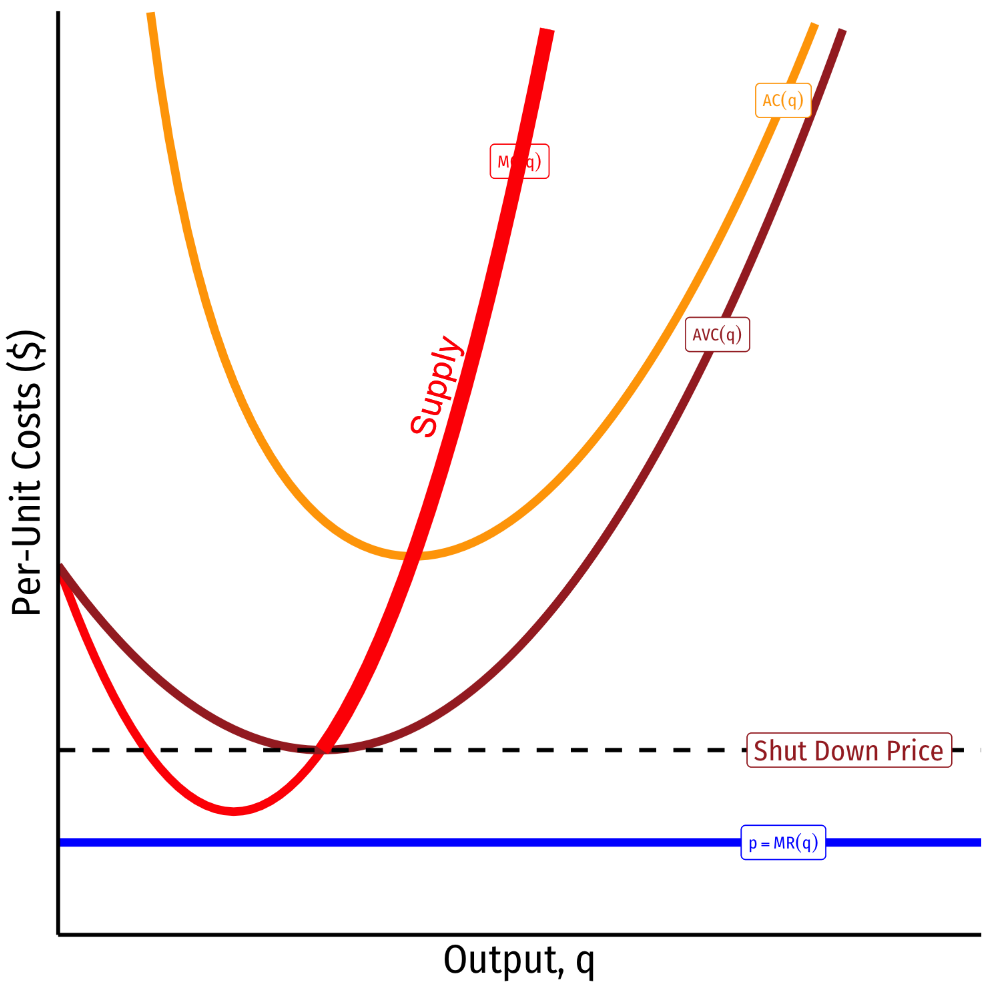
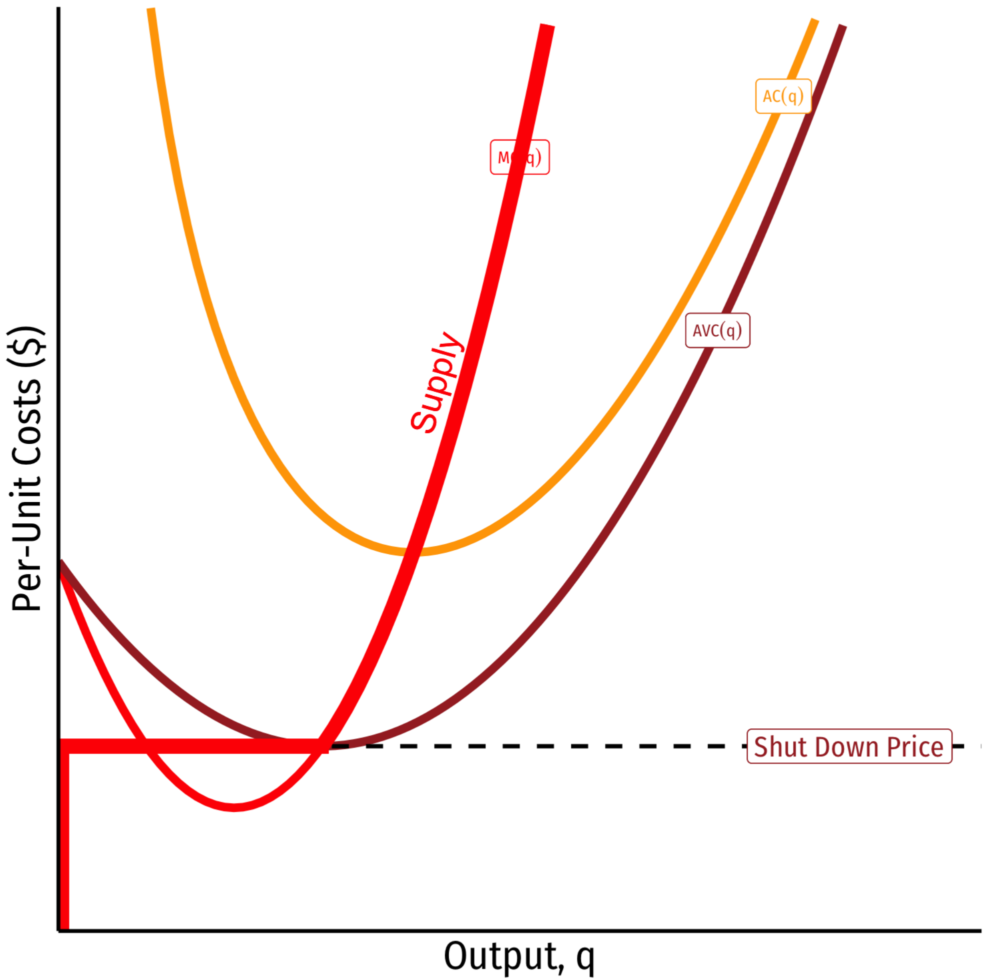


The Firm's Short Run Supply Decision



Firm's short run supply curve:

$$\begin{cases} p = MC(q) & \text{if } p \geq AVC \\ q = 0 & \text{If } p < AVC \end{cases}$$

The Firm's Short Run Supply Decision

Firm's short run supply curve:

$$\begin{cases} p = MC(q) & \text{if } p \geq AVC \\ q = 0 & \text{If } p < AVC \end{cases}$$

Summary:

1. **Choose q^* such that $MR(q) = MC(q)$**

2. **Profit $\pi = q[p - AC(q)]$**

3. **Shut down if $p < AVC(q)$**

Firm's short run (inverse) supply:

$$\begin{cases} p = MC(q) & \text{if } p \geq AVC \\ q = 0 & \text{If } p < AVC \end{cases}$$