

Lecture 10: Costs

October 28, 2025

Course Administration

- ① Problem Set 9 posted
- ② Achieve for Chapters 6 and 7 (may be buggy) posted; optional
- ③ Midterm: Come see me if grade < 62
 - See syllabus page on website
 - Search for “scheduler”

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- ④ Final exam
 - Confirmed for Dec. 16: **3 to 5**, or 5:20 to 7:20
 - Come to time of your choice
 - If you need a DSS exam, request it now!

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- ⑤ Today: Second of four supply lectures
- ⑥ Any questions?

Next Week: Ripped from the Headlines

Send article by Wednesday midnight.

Afternoon

Finder	Presenter
Dylan Q.	Aykut
George	Harini

Evening

Finder	Presenter
Eric	Daija
Paula	Elizabeth

This Week: Ripped from the Headlines

Afternoon

Finder	Presenter
Aykut	Olivia

Evening

Finder	Presenter
n/a	Raghan moved to 11/11

Costs

- 1 Total and marginal output
- 2 Why policymakers should care about costs
- 3 Accounting and opportunity costs
- 4 Sunk costs
- 5 Fixed and variable costs
- 6 Average and marginal costs
- 7 Short and long run costs
- 8 Economies of scale, returns to scale, returns to scope

Total Output versus Marginal Product

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First, remember

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Total versus Marginal Output

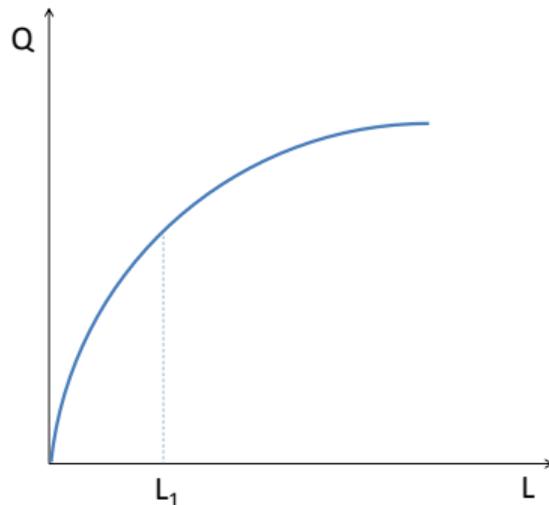
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Answer holds if we replace “capital” with “labor”

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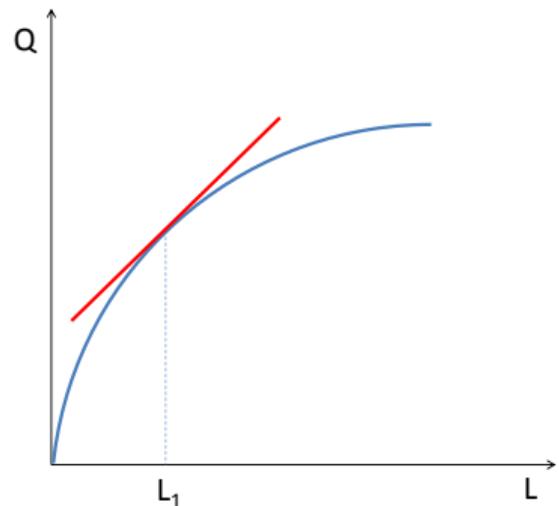
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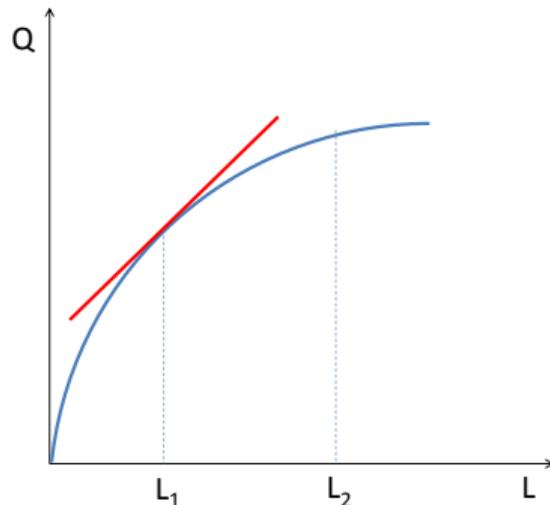
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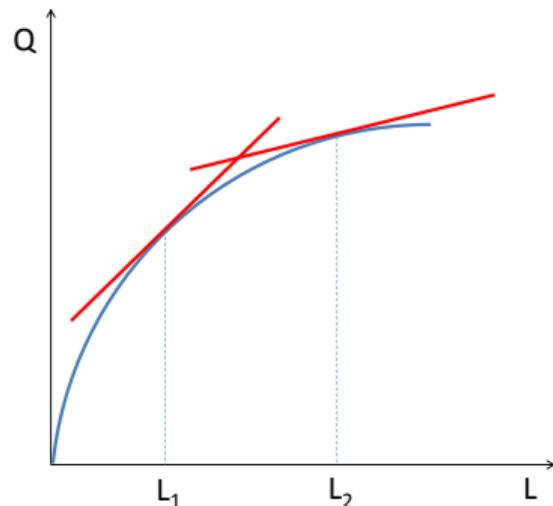
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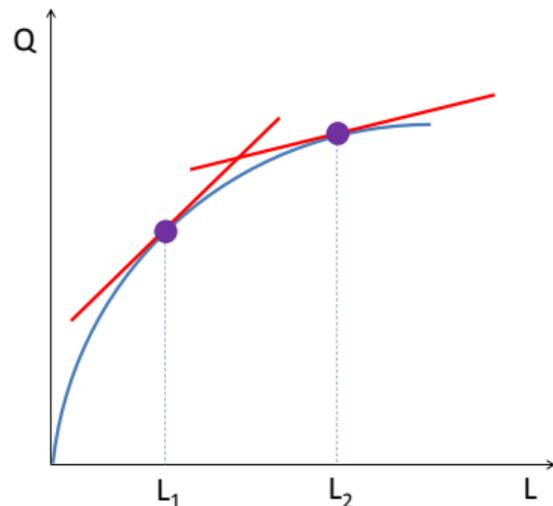
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Costs and Policymakers

Why Should Policymakers Care About Firm Costs?

- Shape of supply cost function determine economies of scale

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- Government is frequently a producer itself
 - what's the right mix of labor and capital to provide SNAP food assistance?

Economic Costs vs. Accounting Costs

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- Opportunity cost \equiv cost of what you give up by using an input
 - Perhaps most easily thought of as next best opportunity for funds
 - What's the opportunity cost of pursuing a MPP?

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Economic cost \equiv accounting cost + opportunity cost

Opportunity Costs in Government

Newsletters

The Atlantic

IDEAS

Buses Shouldn't Be Free

The push for fareless transit is downstream of a larger failure: American urban elected officials have struggled to improve government services, especially infrastructure development.

By Jerusalem Demsas



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- Argues that transit riders care more about service than cost
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→ Take opportunity costs into account in decisionmaking

Sunk Costs

Defining Sunk Costs

- Firm has some fixed costs
- If the firm went bankrupt, some of those costs could be recovered
- The non-recoverable part of the fixed costs are sunk costs
- Examples?

Now that the Costs are Sunk

- When costs are sunk, they should not enter into future business decisions
- Making decisions based on sunk costs is known as the “sunk cost fallacy”
- Decisions should be forward-looking: sunk costs are gone

Waterworld and Sunk Costs

Or Iraq/Afghanistan Invasion and Sunk Costs, If You Prefer

Mo.	Ex. Rev.	Costs			Ex. Profit	
		Total	Sunk	Add'l	Continue	No Prod.
June	150	-100	-16	-84	50	-16



^aTwo good listens on this topics are a Freakonomics [podcast](#) and a Planet Money [transcript/podcast](#).

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→ **Do not take sunk costs into account in decisionmaking**

Fixed and Variable Costs

Types of Cost

- Fixed costs \equiv costs that do not depend on how much output the firm produces
- Variable costs \equiv costs that do vary with the firm's output

What Determines Whether the Cost is Fixed or Variable?

Time Horizon

- Many things are fixed in the short run
- Nothing is fixed in the long run

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Other Factors

- Active rental markets can turn fixed costs into variable costs
- Long-run labor contracts can make labor a fixed, rather than variable cost

3 Key Cost Curves

By definition,

total cost = fixed cost + variable cost

or

$$TC = FC + VC$$

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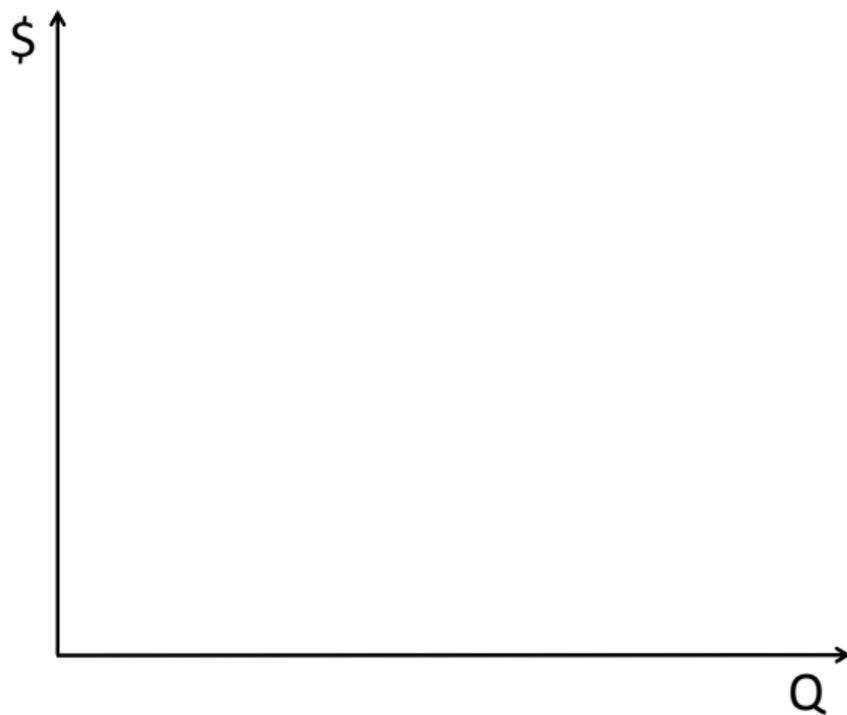
$$TC = FC + VC$$

How does each of these change with Q ?

- Total cost
- Fixed cost
- Variable cost

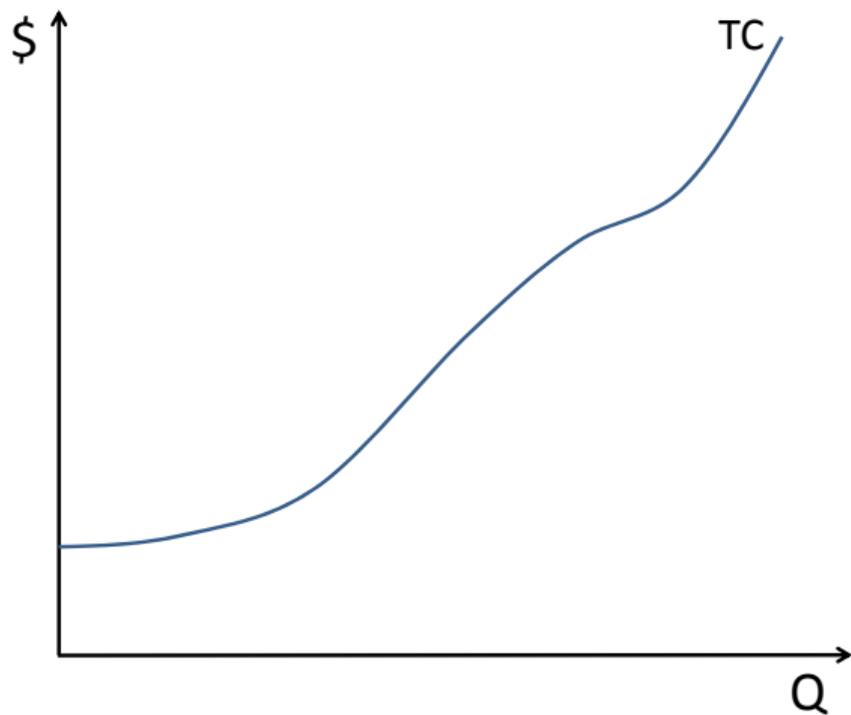
Drawing TC, FC and VC

What Does the Total Cost Curve Look Like?



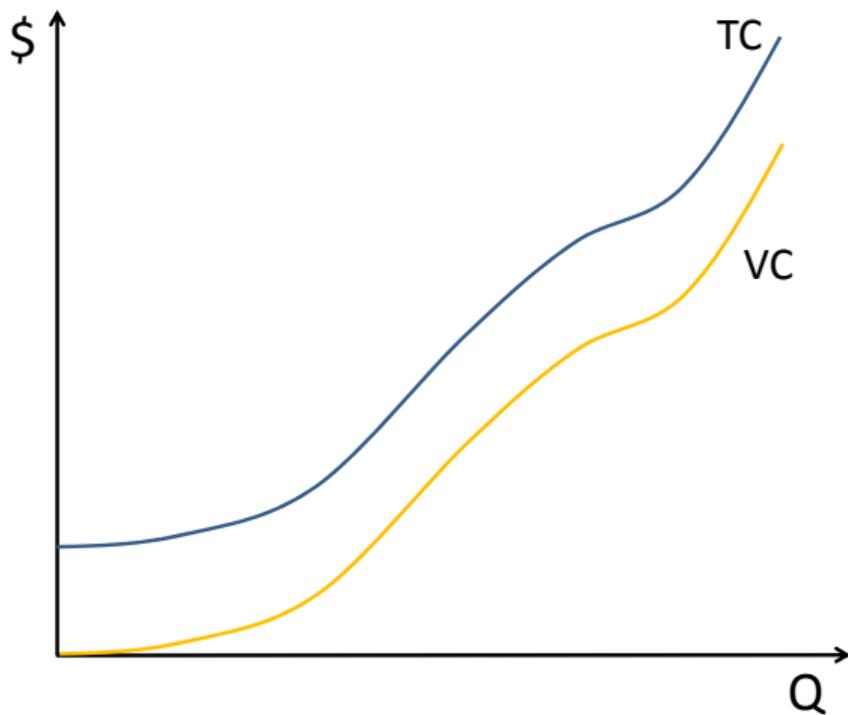
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What About the Variable Cost Curve?



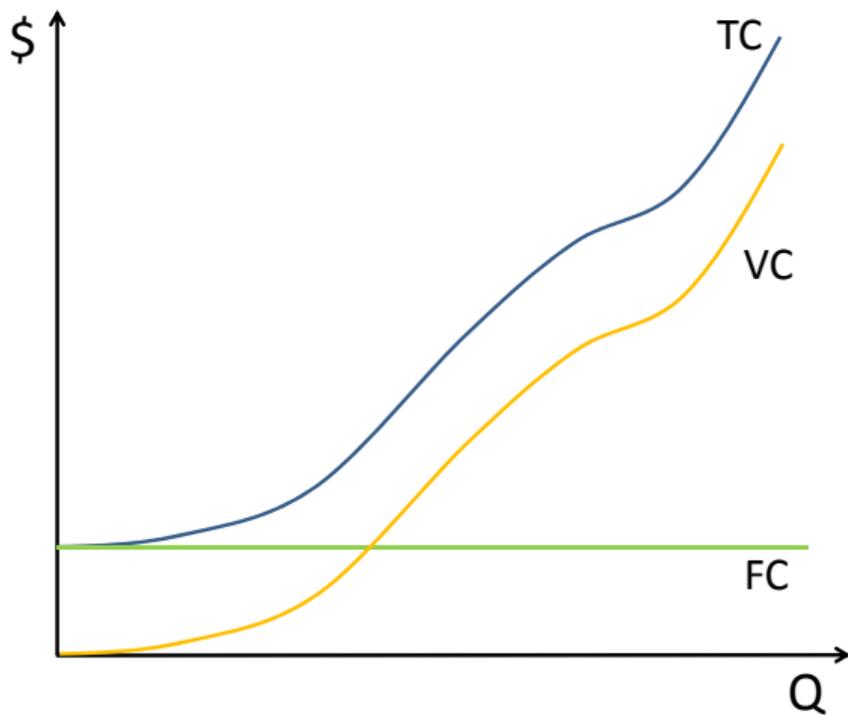
Drawing TC, FC and VC

And the Fixed Cost Curve?



Drawing TC, FC and VC

Everyone, Together



Average and Marginal Costs

Going from Total to Average

Remember

$$TC = FC + VC$$

Going from Total to Average

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If the firm produces Q , how do we find average total cost?

Going from Total to Average

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If the firm produces Q , how do we find average total cost?

$$ATC = \frac{TC}{Q}$$

Going from Total to Average

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Therefore

$$ATC = \frac{TC}{Q} = \frac{FC + VC}{Q}$$

Going from Total to Average

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Therefore

$$ATC = \frac{TC}{Q} = \frac{FC + VC}{Q}$$

- Average total costs: $ATC = \frac{TC}{Q}$
- Average fixed costs: $AFC = \frac{FC}{Q}$
- Average variable costs: $AVC = \frac{VC}{Q}$

Average Costs

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What about the shapes?

- *AFC*

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- AFC
- AVC – remember the law of diminishing returns
- ATC

Note that because there are fixed costs, this must be the short run.

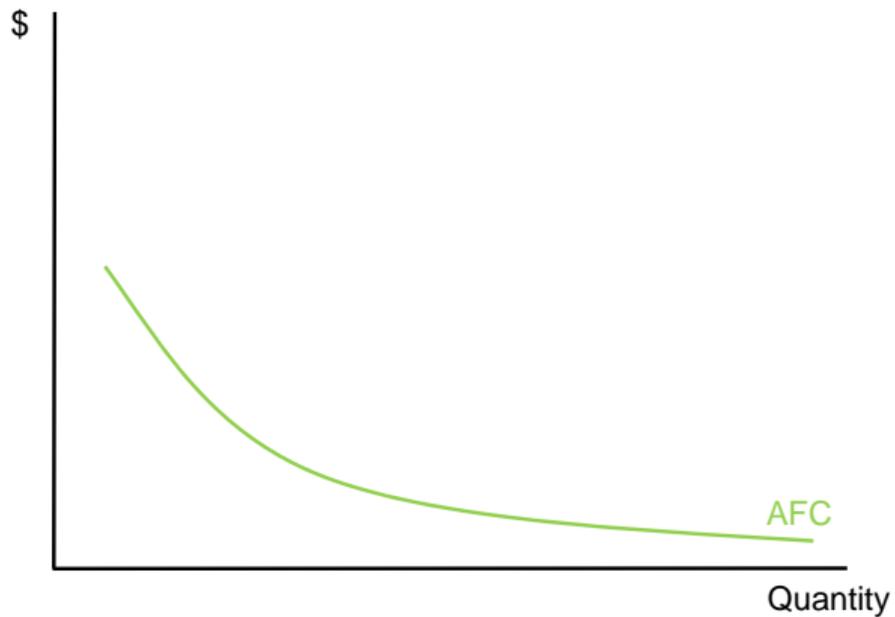
Average Costs in Pictures

What Does Average Fixed Cost Look Like?



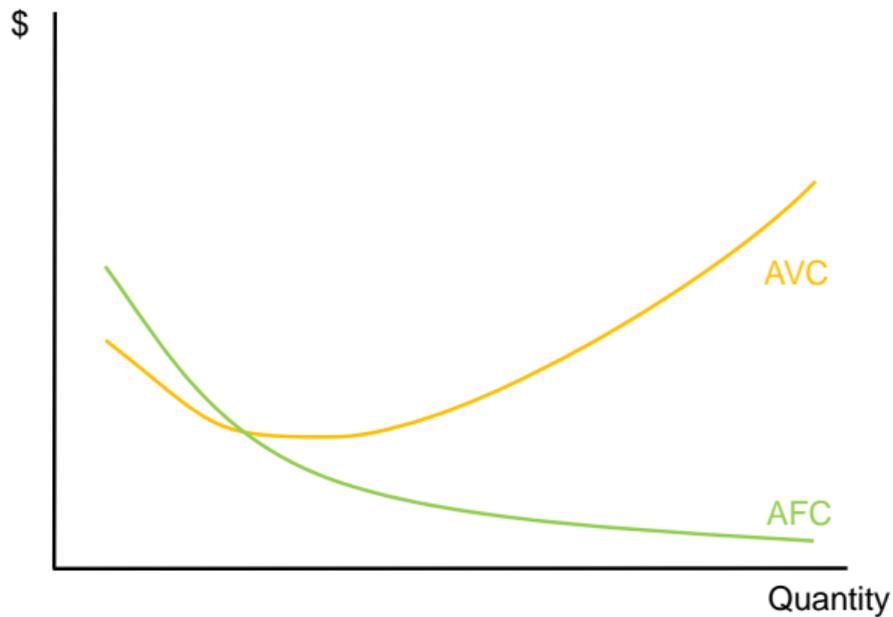
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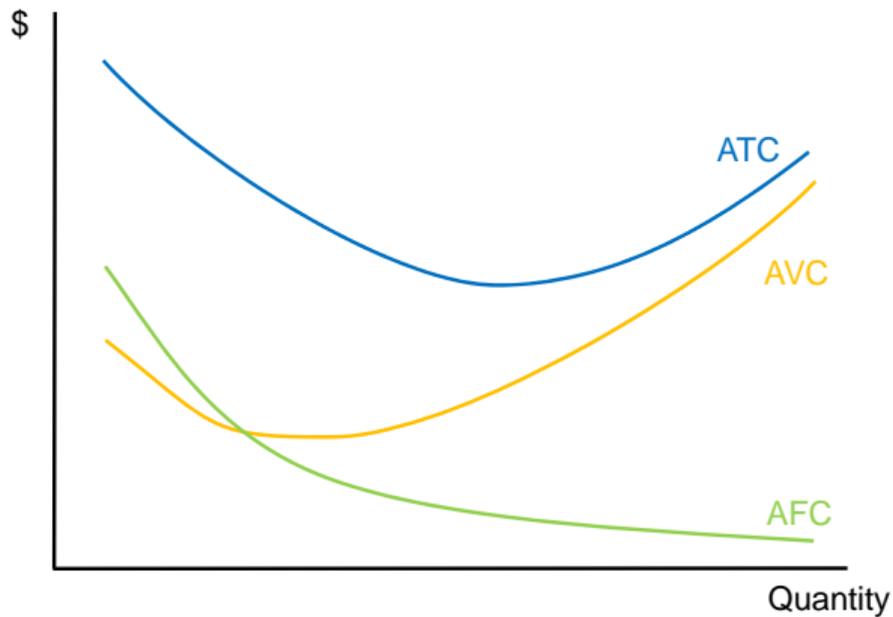
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And Average Total Cost?



Average Costs in Pictures

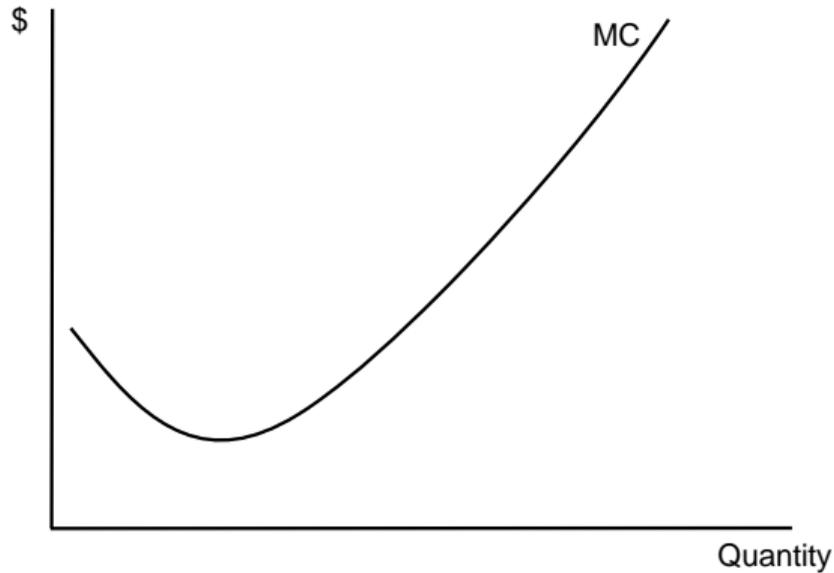
Everyone, Together



Marginal Cost

- Marginal cost \equiv additional cost to produce an additional unit of output
- Without calculus, $MC = \frac{\Delta C}{\Delta Q}$, or the slope of the total cost curve
- With calculus, $MC = \frac{\partial C}{\partial Q}$
- What is its shape?

Drawing Marginal Cost



→ Marginal cost is the only cost that matters for many firm decisions

Average vs. Marginal Cost

$$ATC = \frac{TC}{Q}, \quad MC = \frac{\Delta C}{\Delta Q} = \left(\frac{\partial C}{\partial Q} \right)$$

- Both come from total cost
- When $MC < ATC$, what happens to average cost as Q increases?

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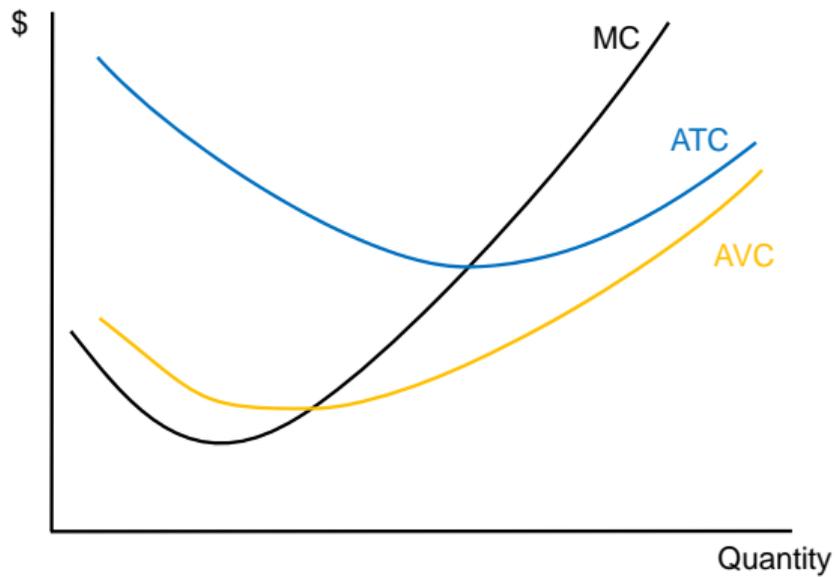
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- $\rightarrow MC = AC \rightarrow AC$ must be at a minimum

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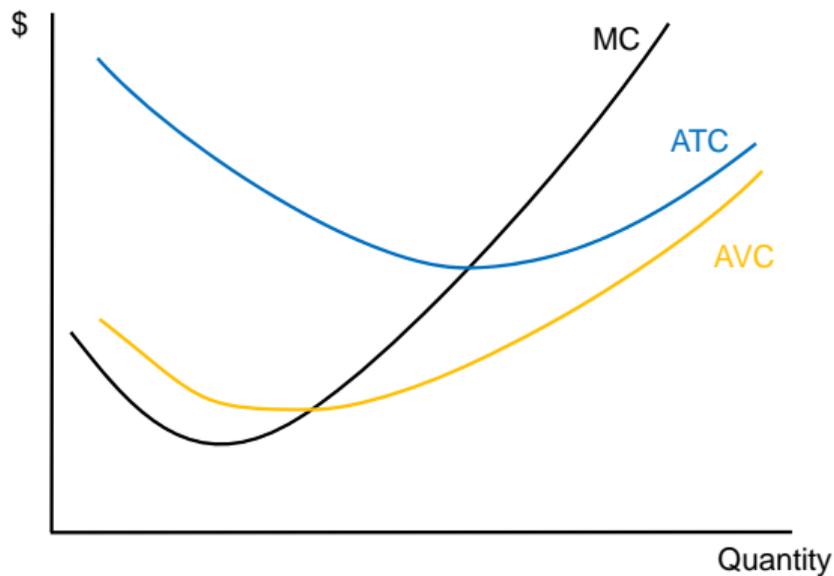
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- $\rightarrow MC = AC \rightarrow AC$ must be at a minimum
- $\rightarrow MC$ curve intersects AC curve at minimum

Average and Marginal Costs



Average and Marginal Costs



Marginal cost curve intersects average cost curve at its minimum

Relationship Between Costs

Use the logic of costs to figure out what's missing.

Q	TC	FC	VC	MC
0		5		
1			10	
2				8
3	28			

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Q	TC	FC	VC	MC
0	5	5	0	0
1	15	5	10	10
2	23	5	18	8
3	28	5	23	5

Short Run & Long Run Costs

In the long run, nothing is fixed.

Implications of No Fixed Costs in Long Run

- Long run costs are never higher than short run costs
- Long run average cost curve intersected by marginal cost curve at the same place as the short-run average cost curve (where's that?)

Implications of No Fixed Costs in Long Run

- Long run costs are never higher than short run costs
- Long run average cost curve intersected by marginal cost curve at the same place as the short-run average cost curve (where's that?)
 - the minimum of the average cost curve
- But all costs in the long run are variable

An In-Class Problem: Costs

Suppose a firm's total cost curve is $TC = 10Q^2 + 6Q + 60$, and the marginal cost curve is $MC = 20Q + 6$.

- 1 Find an expressions for the firm's
 - 1 fixed cost
 - 2 variable cost
 - 3 average total cost
 - 4 average variable cost
- 2 Find the output level that minimizes average total cost.
- 3 Find the output level that minimizes average variable cost.
- 4 If $MC = 20Q + 6$ were the firm's long run marginal cost, could $MC_{SR} = 15Q + 6$ be the firm's short-run marginal cost?

In-Class Problem Answer

- Expressions for
 - Fixed cost: The part of output not a function of price – or costs when output is zero
 $\rightarrow FC = 60$
 - Variable cost: Recall that $TC = FC + VC \rightarrow 10Q^2 + 6Q + 60 = 60 + VC$, or
 $VC = 10Q^2 + 6Q$
 - Average total cost: $ATC = C/Q = 10Q + 6 + 60/Q$
 - Average variable cost: $AVC = VC/Q = 10Q^2 + 6Q = 10Q + 6$.
- Output level that minimizes average total cost: Recall that ATC is at a minimum where $ATC = MC \rightarrow 10Q + 6 + 60/Q = 20Q + 6$, or
 $10Q + 60/Q = 20Q \rightarrow 10Q = 60/Q \rightarrow 10Q^2 = 60 \rightarrow Q^2 = 6 \rightarrow Q = \sqrt{6}$
- Output level that minimizes AVC is where
 $AVC = MC \rightarrow 10Q + 6 = 20Q + 6 \rightarrow 10Q = 0 \rightarrow Q = 0$. Remember that AVC increases with production.
- We know that $MC_{SR} \geq MC_{LR}$, $15Q + 6 \leq 20Q + 6$, so, no.

Recap of Today

- Opportunity Costs
- Sunk Costs
- Cost Curves: $\text{Total Cost} = \text{Fixed Cost} + \text{Variable Cost}$
- Average Cost and Marginal Cost
- Short Run and Long Run Costs
- Economies of Scale (and maybe Scope)

Next Class

- Do Problem Set 9, and do Achieve problems as you see fit
- Read GLS Chapter 8
- Skip 8.5