Lecture 7: Costs

October 13, 2015
Overview

Course Administration

Why Policymakers Should Care About Costs

Accounting vs. Opportunity Costs

Sunk Costs

Cost Curves

Average and Marginal Costs

Short-Run and Long-Run Costs

Economies of Scale and Maybe Scope
Course Administration

1. Problem Sets
   - Return problem set 5
   - Collect problem set 6
   - Problem set 7 posted

2. Midterm is next class
   - Bring a non-programmable calculator (not your cell phone!)
   - A pen or pencil
   - And nothing else

3. Final exam
   - Just requested room for December 15, 5:20 to 7:20

4. Any questions?
Ripped from the Headlines

As a reminder, in two weeks, after the midterm

Afternoon
Finder | Presenter
--- | ---
David Walrath | Sharon Alvarez

Evening
Finder | Presenter
--- | ---
Erika Solem | Elizabeth Krevsky
Anna Chuhkno | Kevin Schoenberger
Why Should Policymakers Care About Firm Costs?

- Supply costs determine economies of scale
- Input costs drive firm behavior
- Government policy can modify input costs
- Government is frequently a producer itself
  - how many fighter aircraft do we need to provide defense?
  - to sign up clients for the Affordable Care Act, which is better: an improved website, or more personal help?
  - are the fixed costs of a new data tracking system worthwhile?
Economic Costs vs. Accounting Costs

- **Accounting cost** ≡ direct cost
- **Opportunity cost** ≡ cost of what you give up by using an input
  - Perhaps most easily thought of as next best opportunity for funds
  - Give an opportunity cost example!
  - What’s the opportunity cost of holding cash?
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 is called “sunk” – or 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”
# Waterworld and Sunk Costs

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

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- June: Ex. Profit > 0, clearly should go ahead.
- Sept.: Ex. Profit still > 0.
- Dec.: Ex. Profit < 0. Halt production? No, because alternative is loss of 140.

Sunk cost fallacy would compare profit of -25 to 0.

Two good listens on this topics are a Freakonomics podcast and a Planet Money transcript/podcast.
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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
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

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

- Total cost – recall the expansion path!
- Fixed cost
- Variable cost

We know that $TC = FC + VC$. 
3 Key Cost Curves

- Total cost – recall the expansion path!
- Fixed cost
- Variable cost

We know that \( TC = FC + VC \).
Sketch them on the paper in front of you, starting with \( FC \) and \( VC \).
Drawing TC, FC and VC

What Does the Total Cost Curve Look Like?
Drawing TC, FC and VC

What About the Variable Cost Curve?
Drawing TC, FC and VC
And the Fixed Cost Curve?
Drawing TC, FC and VC

Everyone, Together
Average Costs

Definitions

- Average total costs: $AC = \frac{C}{Q}$
- Average fixed costs: $AFC = \frac{FC}{Q}$
- Average variable costs: $AVC = \frac{VC}{Q}$
Average Costs

Definitions

- Average total costs: \( AC = \frac{C}{Q} \)
- Average fixed costs: \( AFC = \frac{FC}{Q} \)
- Average variable costs: \( AVC = \frac{VC}{Q} \)

What about the shapes?

- \( AFC \)
Average Costs

Definitions

- Average total costs: \( AC = \frac{C}{Q} \)
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What about the shapes?

- \( AFC \)
- \( AVC \) – remember the law of diminishing returns
Average Costs

Definitions

- Average total costs: \( AC = \frac{C}{Q} \)
- Average fixed costs: \( AFC = \frac{FC}{Q} \)
- Average variable costs: \( AVC = \frac{VC}{Q} \)

What about the shapes?

- \( AFC \)
- \( AVC \) – 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?

Quantity

$
Average Costs in Pictures
What About Average Variable Costs?

$\begin{align*}
\text{Quantity} \\
\text{AFC}
\end{align*}$
Average Costs in Pictures
And Average Total Cost?

$\begin{array}{|c|c|}
\hline
\text{Quantity} & \text{AVC} \\
\hline
\text{AFC} & \\
\hline
\end{array}$
Average Costs in Pictures

Everyone, Together
Marginal Cost

- Marginal cost ≡ additional cost of producing 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

\[ MC \]

$ vs. Quantity
Average vs. Marginal Cost

\[ AC = \frac{C}{Q} \]

\[ MC = \frac{\Delta C}{\Delta Q} = \left( \frac{\partial C}{\partial Q} \right) \]

- Both come from total cost
- When \( MC > AC \), what happens to average cost as \( Q \) increases?
Average vs. Marginal Cost

\[ AC = \frac{C}{Q} \]

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- Both come from total cost
- When \( MC > AC \), what happens to average cost as \( Q \) increases? increases
- When \( MC < AC \), what happens to average cost as \( Q \) increases?
Average vs. Marginal Cost

\[ AC = \frac{C}{Q} \]

\[ MC = \frac{\Delta C}{\Delta Q} = \left( \frac{\partial C}{\partial Q} \right) \]

- Both come from total cost
- When \( MC > AC \), what happens to average cost as \( Q \) increases? increases
- When \( MC < AC \), what happens to average cost as \( Q \) increases? decreases
- \( \rightarrow MC = AC \rightarrow AC \) must be at a minimum
- \( \rightarrow MC \) curve intersects \( AC \) curve at minimum
Average and Marginal Costs

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Three Types of Costs

Compare the long and short run for

- Total Costs
- Average Costs
- Marginal Costs
Short Run and Long Run Expansion Paths

- Goal is to consider long-run expansion path
- Then short run expansion path
- Which factor – $K$ or $L$ – is generally fixed in the short run?
- What must be true about the cost of the optimal mix of $K$ and $L$ in the short run relative to the long run?
Short Run and Long Run Expansion Paths

- Goal is to consider long-run expansion path
- Then short run expansion path
- Which factor – $K$ or $L$ – is generally fixed in the short run?
- What must be true about the cost of the optimal mix of $K$ and $L$ in the short run relative to the long run?
  - Never less than in the long run.
Optimal Input Choices in the Short and Long Run

Firm’s Isoquants. What \((K, L)\) Does It Use to Produce?

\[
\begin{align*}
K & \quad Q = a \\
& \quad Q = b \\
& \quad Q = c \\
L & 
\end{align*}
\]
Optimal Input Choices in the Short and Long Run

With Isocost Curves
Optimal Input Choices in the Short and Long Run

Long-Run Optimal Choices and an Expansion Path. What’s Fixed in the Short Run?

\[ Q = a \]
\[ Q = b \]
\[ Q = c \]
Optimal Input Choices in the Short and Long Run

*K* Fixed. What are the optimal \((K, L)\)?

\[ K \text{ is fixed} \]
Optimal Input Choices in the Short and Long Run

SR Optimal Bundles: Where are Isocosts?

K is fixed
Short run expansion path
Optimal Input Choices in the Short and Long Run

Total Costs Higher in Short Run

K is fixed
Short run expansion path
Optimal Input Choices in the Short and Long Run

Compare Long and Short Run Expansion Paths

K not fixed
Long run expansion path

K is fixed
Short run expansion path

L

K

K is fixed
Short run expansion path

K not fixed
Long run expansion path
Two Cost Curves: Which One is the Short-Run Curve?

What Do You Think?
Two Cost Curves: Which One is the Short-Run Curve?

Short Run Costs Are Always $\geq$ Long Run Costs
Short-Run vs Long-Run Average Total Costs

- Repeat the exercise we just did for a variety of levels of initial fixed costs
- What will always be true about the short-run total cost curve relative to the long-run total cost curve?
- The short run cost curve is always $\geq$ the long-run curve
- Recall – what is the shape of the average cost curve?
Drawing Short- and Long-Run Average Total Cost Curves

LR Average Cost Curve. What About SR AC at $K = a$?
Drawing Short- and Long-Run Average Total Cost Curves

At Another $K$?
Drawing Short- and Long-Run Average Total Cost Curves

And Another $K$?
Drawing Short- and Long-Run Average Total Cost Curves

SR Cost Curves in Envelope of LR Curve
Short Run vs. Long Run Marginal Costs

- Where does the long-run marginal cost curve intersect the average cost curve?
Short Run vs. Long Run Marginal Costs

- Where does the long-run marginal cost curve intersect the average cost curve?
- This holds true for the short-run curves, too
Drawing Short-Run Marginal Cost Curves

Where is SR MC, \( K = a \)?
Drawing Short-Run Marginal Cost Curves

Where is SR MC, $K = b$?
Drawing Short-Run Marginal Cost Curves

Where is SR MC, $K = c$?
Drawing Short-Run Marginal Cost Curves

Everyone, Together
Suppose a firm’s total cost curve is \( TC = 10Q^2 + 6Q + 60 \), and \( MC = 20Q + 6 \).

1. Find an expressions for the firm’s
   1.1 fixed cost
   1.2 variable cost
   1.3 average total cost
   1.4 average variable cost

2. Find the output level that minimizes average total cost.

3. Find the output level that minimizes average variable cost.

4. Is it possible for \( MC_{SR} = 15Q + 6 \) to be short-run marginal costs?
Economies of Scale

Three types

• **Economies of scale** $\equiv$ output increases more rapidly than total cost

• **Diseconomies of scale** $\equiv$ output increases more slowly than total cost

• **Constant economies of scale** $\equiv$ total cost and output increase as same rate
Economies of scale vs. returns to scale

- Economies of scale are about total inputs and total outputs
- Returns to scale are about inputs
- Increasing returns to scale $\Rightarrow$ economies of scale
- Economies of scale $\not\Rightarrow$ returns to scale
Economies of Scope

- Economies of scope $\equiv$ firm produces multiple outputs more cheaply together than it would each individual output
- Diseconomies of scope $\equiv$ firm produces multiple outputs at a higher cost than it would if it produced each output individually
- Where do they come from?
Economies of Scope

- Economies of scope \(\equiv\) firm produces multiple outputs more cheaply together than it would each individual output
- Diseconomies of scope \(\equiv\) firm produces multiple outputs at a higher cost than it would if it produced each output individually
- Where do they come from?
- From sharing common inputs or knowledge
Recap of Today

- Opportunity Costs
- Sunk Costs
- Cost Curves: Total Cost = Fixed Cost + Variable Cost
- Average Cost and Marginal Cost
- Short Run and Long Run Costs
- Economies of Scale (and maybe Scope)
Next Class

- Turn in Problem Set 7
- Midterm