Cost Curve Slides

Econ 360

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Learning Outcomes/Goals

1. Identify fixed and variable costs using verbal descriptions or equations.

2. Derive average and marginal costs from a given total cost curve (described verbally or with equations).

3. Describe the relationship between any two cost curves.

Where We Are

- We can find a firm's optimal amount of production (either using profit maximization or cost minimization).
- We know how much a firm should pay its inputs (generally capital and labor) at the optimum.
- But we **don't** yet know if a firm's optimal output means it is making money in the short run or in the long run, and therefore if the firm should even be in the market or not!
  - We will need some tools in order to answer these questions.
  - Those tools are cost curves.

Fixed Costs and Variable Costs

- Suppose Bill wants to open a lemonade store in town.
- There are some costs Bill has to pay up-front that he can't change and don't depend on how much lemonade Bill produces. Some examples include:
  - Business license.
  - Rent for a building.
  - Renting machines in order to make the lemonade.
  - We call these **Fixed Costs** because they do not vary with output (or lemonades), they are fixed.
- Other costs Bill has to pay will depend on, or vary, with how much lemonade Bill produces.
  - Wages for employees.
  - Supplies like cups, lemons, sugar, and water.
  - Electricity, cleaning supplies.
  - We call these **Variable Costs** because these costs vary with output.

Total Cost

- We can add Bill's **Fixed Costs** and **Variable Costs** together, which gives us Bill's **Total Cost**.

- In mathematical notation, we would say:

$$TC = FC + VC$$

- If we denote the amount of lemonade Bill produces as l, we could say that

$$TC(l) = FC + VC(l).$$

- Remember FC, or Fixed Cost, does not depend on l.

Average Costs

- When Bill starts producing lemonade, Bill might want to know how much, on average, it costs to produce one lemonade.

- To find **Average** Total Cost, **Average** Fixed Cost, and **Average** Variable Cost, we can simply divide each cost by l, or the quantity of lemonades.

$$ATC(l) = \frac{TC(l)}{l} = \frac{FC}{l} + \frac{VC(l)}{l} = AFC + AVC(l).$$

Marginal Costs

- When we did Profit Maximization, often we set marginal revenue=Marginal Cost.
- Marginal cost is the additional cost when we produce one extra unit.
- This is just the derivative of Total Cost.

$$MC(I) = \frac{\partial TC(I)}{\partial I} = \frac{\partial FC}{\partial I} + \frac{\partial VC(I)}{I} = 0 + \frac{\partial VC(I)}{I}.$$

- Again, FC does not depend on I, so Marginal cost is just the derivative of Variable Cost.

Example

Suppose Bill's total cost function to produce quantity q of pencils is $TC = 1000 - 2q + 14q^2$.

- Question: Find FC, VC, ATC, AFC, AVC, and MC.

Example–Solution

Suppose Bill's total cost function to produce quantity q of pencils is $TC = 1000 - 2q + 14q^2$.

- Question: Find FC, VC, ATC, AFC, AVC, and MC.
  - $FC = 1000$.
  - $VC(q) = -2q + 14q^2$.
  - $ATC(q) = \frac{1000}{q} - 2 + 14q$.
  - $AFC(q) = \frac{1000}{q}$.
  - $AVC(q) = -2 + 14q$.
  - $MC(q) = -2 + 28q$.

Example–Graphed

GRAPH HERE

Where Do These Cost Functions Come From?

- Suppose Bill has 2 inputs, labor and capital.
- Capital here is the building and lemonade machines, both of which he rents and has to sign year-long leases each year for the building and the number of machines he wants.
- Labor is simply Bill's workers, and suppose Bill can hire and fire workers within a single day.
- How do these things tell us the Total Cost function we have been working with?

Where Do These Cost Functions Come From?

$$\text{Profit Maximization/Cost Minimization} \implies L^*, K^* \iff q^*.$$
$$TC(L^*, K^*) = TC(K^*(q), L^*(q)) = TC(q).$$

- Bill's profit maximization or cost minimization problem will tell Bill how many machines/labor to hire, which at the same time will tell him his optimal quantity to produce.

- If Bill wants to change his q, the Total Cost function is a shortcut way that includes the changes in the amount of labor/capital Bill needs to hire to produce q at the maximum profit/lowest cost possible.

Short Run vs Long Run Cost Functions

- This is all well and good, but if Bill wants to change q and can only change his capital every year, his capital is fixed in the short-run, say at $\bar{K}$.
- Then his **Short Run** Total Cost curve becomes $TC(q) = TC(\bar{K}, L(q))$.
- In the **Long Run**, Bill can change both capital and labor, and so $TC = TC(K(q), L(q))$.

Questions for Class

- How might a short run total cost curve look compared to a long run total cost curve?
- What is the relationship between average variable cost and marginal cost?
- What can these cost curves tell us about the profit of a firm?