1 Costs

Explicit Costs Direct monetary costs for inputs into production. These are essentially accounting costs.

Implicit Costs Foregone opportunities that could have been taken. These are often *opportunity costs*, which are the next best use for a resource. Economists also care about implicit costs.

Sunk Costs Costs that have already been spent and cannot be recovered. These should never factor into production decisions.

2 Short-Run Costs

Short Run Cost Costs in which labor can change but capital is fixed.

Fixed Costs F A cost that does not change as you vary the amount of output produced. This cannot be adjusted in the short-run.

Variable Costs VC Costs that change depending on the quantity of output. These can be adjusted in the short-run.

Total Cost C The sum of variable and fixed costs.

Marginal Cost How much the firm's cost changes when you produce one more unit of output. This is equal to the derivative of the cost function, and in the short-run is equal to the derivative of the variable costs.

$$MC = \frac{dC(q)}{dq} = \frac{dVC(q)}{dq}$$

If there are diminishing marginal returns, then the marginal cost will be increasing as quantity increases.

Average Fixed Cost AFC The fixed cost divided by the quantity produced.

Average Variable Cost AVC The variable cost divided by the quantity produced.

Average Cost AC The total cost divided by the quantity produced.

If the marginal cost is less than the average cost, then producing one more unit will decrease the average (variable) cost. If the marginal cost is greater than the average (variable) cost, then producing one more unit will increase the average (variable) cost.

$\Rightarrow$ The marginal cost is equal to the average (variable) cost at the minimum value of average cost. Thus the marginal cost curve always intersects the average (variable) cost curve at the minimum of the average (variable) cost curve.

3 Long-Run Costs

In the long-run, all costs are variable so there are no fixed costs. Thus our total costs are just equal to our variable costs.

$$F = 0 \Rightarrow C = VC$$

4 Economies of Scale

Economies of Scale Property of a cost function such that average cost falls as the quantity produced increases.

$\Rightarrow MC < AC$

Diseconomies of Scale Property of a cost function such that average cost rises as the quantity produced increases.

$\Rightarrow MC > AC$

5 Profit Maximization

There are two decisions a firm must make when maximizing their profits.

1. **Output decision**: If a firm produces, what level of output q^* maximizes their profits?
2. **Shutdown decision**: Would the firm be better off producing q^* or not producing anything at all and avoiding fixed costs that are *not* sunk?

5.1 Output Decision

In order to maximize profits, we set the derivative of the profit equation equal to zero.

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

$$\pi'(q) = 0 \Rightarrow R'(q) - C'(q) = 0 \Rightarrow R'(q) = C'(q) \Rightarrow MR = MC$$

Thus the quantity of output that maximizes profits is the one such that marginal revenue equals marginal cost.

Perfect Competition A type of market where all buyers and sellers are price takers. This means that no individual firm can affect the price level on their own.

$\Rightarrow MR = R'(q) = p$

5.2 Shutdown Decision

A firm must also decide if it is better off shutting down and not producing anything. If revenue is less than avoidable cost, then the firm is better off shutting down.

$$pq < VC(q) \Leftrightarrow p < \frac{VC(q)}{q} \Leftrightarrow p < AVC$$

6 Supply Curves

6.1 Short-Run

In the short-run, firms determine the optimal quantity q^*, and then compare their profit under q^* to their profit if they don't produce anything.

1. Find q^* such that $MC(q^*) = p$.
2. Compare $AVC(q^*)$ to price.
   (a) If $p \geq AVC(q^*)$ then produce q^*.
   (b) If $p < AVC(q^*)$ then shut down and produce nothing.

6.2 Long-Run

In the long-run, firms determine the optimal quantity q^*, then determine if their profits make it worth entering the market.

1. Find q^* such that $MC(q^*) = p$.
2. Compare $AC(q^*)$ to price.
   (a) If $p \geq AC(q^*)$ then the firm would have nonnegative profits and should enter.
   (b) If $p < AC(q^*)$ then the firm would lose money and should not enter.

The shutdown-point occurs at the minimum of the LRAC curve, because for all quantities below this point the marginal cost (and therefore the price) is below the long-run average cost.

6.3 Long-Run Entry and Exit

In the long-run, firms enter if they make positive profits, and exit if they don't.

Firms enter if:

$$\pi > 0 \Rightarrow R > C \Rightarrow pq^* > TC(q^*) \Rightarrow p > LRAC(q^*) \Rightarrow MC(q^*) > LRAC(q^*)$$

Firms exit if:

$$\pi < 0 \Rightarrow R < C \Rightarrow pq^* < TC(q^*) \Rightarrow p < LRAC(q^*) \Rightarrow MC(q^*) < LRAC(q^*)$$

If no firms are entering or exiting, then the market is in a long-run equilibrium. If this is true, it must be that:

$$p = MC(q^*) = LRAC(q^*)$$

This occurs at the minimum of the long-run average cost curve.

7 Exercises

1. Due to Xavier's recent win over University of Cincinnati in the Crosstown Shootout, Darwin wants to sell t-shirts to celebrate the victory. The cost of producing q t-shirts is given by $C(q) = 3q^2 + 8q + 432$. Darwin has *already* paid \$432 to a graphic designer to make the design for the t-shirts.

   (a) Darwin has talked to Xavier students and they have agreed to pay \$44 for each t-shirt (they *really* want the t-shirts). What quantity of t-shirts should Darwin produce?

   (b) What are Darwin's profits? Should he produce any t-shirts at all, or just shut down and celebrate without a t-shirt?

   (c) Given that Xavier blew Cincinnati out in last year's Crosstown shootout, it looks like there will be a market for t-shirts every single year. Myles has the same cost function as Darwin and is thinking of also making t-shirts. Does he have an incentive to do so?

   (d) What is Darwin's supply curve?

(e) In the long run how many t-shirts should Darwin produce?

(f) What will the price of t-shirts be in the long-run?