Introduction to Economics

Analysis of Costs

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- Costs affect input choices, investment decisions, and even the decision of whether to stay in business.
- Is it cheaper to hire a new worker or to pay overtime?
- To open a new factory or expand an old one?
- To invest in new machinery domestically or to outsource production abroad?
- Businesses want to choose those methods of production that are most efficient and produce output at the lowest cost.

- **Total cost** represents the lowest total dollar expense needed to produce each level of output q.
- TC rises as q rises.
- **Fixed cost** represents the total dollar expense that is paid out even when no output is produced; fixed cost is unaffected by any variation in the quantity of output. "overhead" or "sunk costs"
- **Variable cost** represents expenses that vary with the level of output—such as raw materials, wages, and fuel—and includes all costs that are not fixed.
- Always, by definition,

$$TC = TFC + TVC$$

(1) Quantity q	(2) Fixed cost FC ($)	(3) Variable cost VC ($)	(4) Total cost TC ($)
0	55	0	55
1	55	30	85
2	55	55	110
3	55	75	130
4	55	105	160
5	55	155	210
6	55	225	280

Marginal Cost

- The marginal cost of production is the additional cost incurred in producing 1 extra unit of output.

$$MC = \frac{\text{(change in total cost)}}{\text{(change in quantity)}} = \frac{\Delta TC}{\Delta Q}$$

(1) Output q	(2) Total cost TC ($)	(3) Marginal cost MC ($)
0	55	
		30
1	85	
		25
2	110	
		20
3	130	
		—
4	160	
		50
5	210	

AVERAGE COST

- **Average cost** is the total cost divided by the total number of units produced.
- The average cost is the cost of each typical unit of product.
- Average Costs
  - *Average Fixed Costs* (AFC)

$$AFC = \frac{\text{Fixed cost}}{\text{Quantity}} = \frac{FC}{Q}$$

  - *Average Variable Costs* (AVC)

$$AVC = \frac{\text{Variable cost}}{\text{Quantity}} = \frac{VC}{Q}$$

  - *Average Total Costs* (ATC)

$$ATC = \frac{\text{Total cost}}{\text{Quantity}} = \frac{TC}{Q}$$

  - $ATC = AFC + AVC$

(1) Quantity q	(2) Fixed cost FC ($)	(3) Variable cost VC ($)	(4) Total cost $TC = FC + VC$ ($)	(5) Marginal cost per unit MC ($)	(6) Average cost per unit $AC = TC/q$ ($)	(7) Average fixed cost per unit $AFC = FC/q$ ($)	(8) Average variable cost per unit $AVC = VC/q$ ($)
0	55	0	55		Infinity	Infinity	Undefined
				30			
1	55	___	85		85	55	30
				25			
2	___	55	110		55	___	27½
				___			
3	55	75	130		43⅓	18⅓	25
				30			
4*	**55**	**105**	**160**	**40***	**40***	**13¾**	**26¼**
				50			
5	55	155	210		42	11	___
				70			
6	55	225	280		46⅔	9⅙	37½

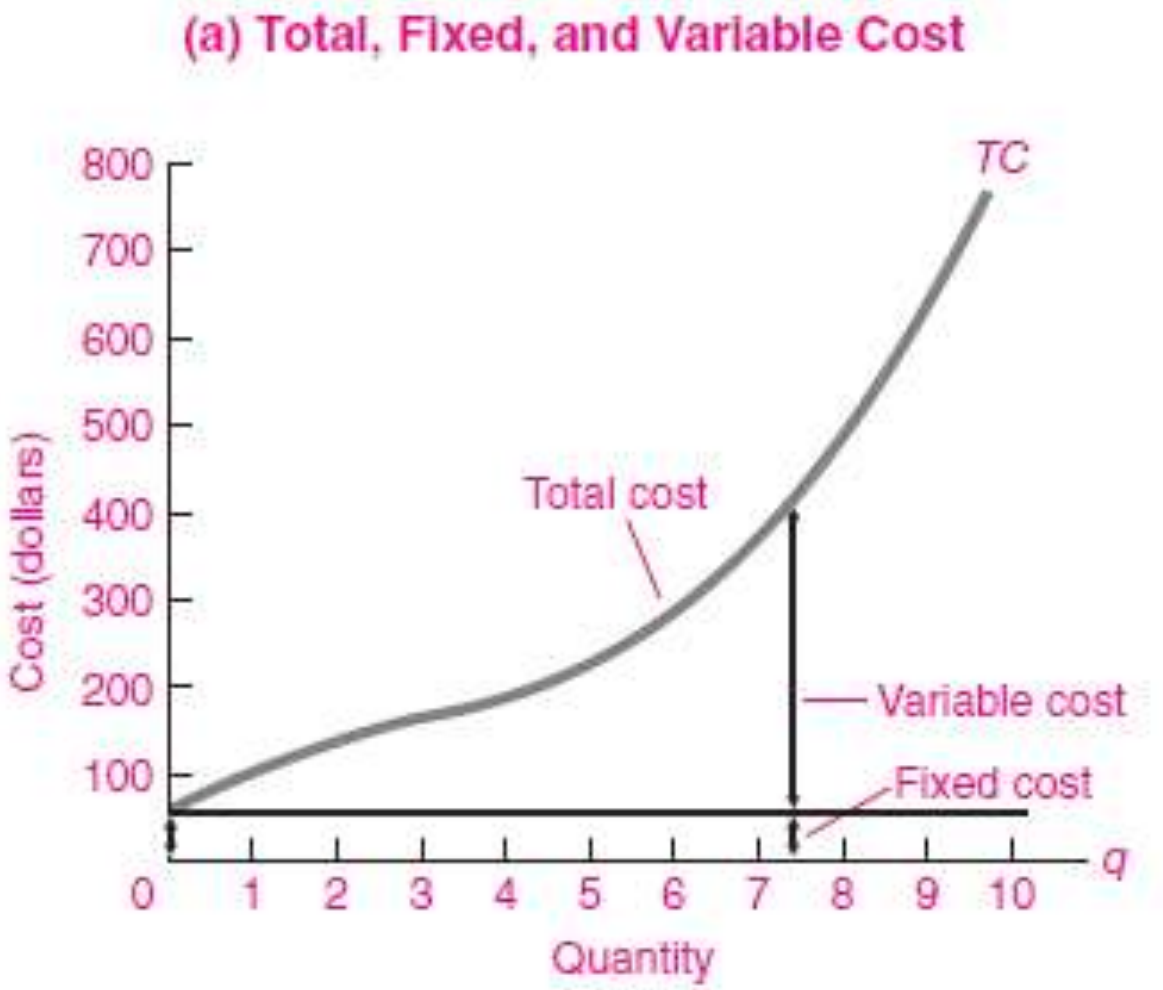
*Minimum level of average cost.

The Relation between Average Cost and Marginal Cost

1. When marginal cost is below average cost, it is pulling average cost down.

2. When *MC* is above *AC* , it is pulling up *AC* .

3. When *MC* just equals *AC*, *AC* is constant. At the bottom of a U-shaped *AC*, *MC* = *AC* = minimum *AC*.


(a) Total, Fixed, and Variable Cost
Cost (dollars)
800
700
600
500
400
300
200
100
TC
Total cost
Variable cost
Fixed cost
0
1
2
3
4
5
6
7
8
9
10
q
Quantity


(b) Average Cost, Marginal Cost
Average and marginal cost (dollars)
80
70
60
50
40
30
20
10
MC
AC
AVC
M
M'
AFC
0
1
2
3
4
5
6
7
8
9
10
q
Quantity

THE LINK BETWEEN PRODUCTION AND COSTS

(1) Output (tons of wheat)	(2) Land inputs (acres)	(3) Labor inputs (workers)	(4) Land rent ($ per acre)	(5) Labor wage ($ per worker)	(6) Total cost ($)
0	10	0	5.5	5	55
1	10	6	5.5	5	85
2	10	11	5.5	5	110
3	10	15	5.5	5	130
4	10	21	5.5	5	160
5	10	31	5.5	5	210
6	10	45	5.5	5	280

- The *short run* is the period of time that is long enough to adjust variable inputs, such as materials and production labor, but too short to allow all inputs to be changed. In the short run, fixed or overhead factors such as plant and equipment cannot be fully modified or adjusted. Therefore, in the short run, labor and materials costs are typically variable costs, while capital costs are fixed.
- In the *long run*, all inputs can be adjusted including labor, materials, and capital. Hence, in the long run, all costs are variable, and none are fixed.

CHOICE OF INPUTS BY THE FIRM

- **Least-cost rule:** To produce a given level of output at least cost, a fi rm should buy inputs until it has equalized the marginal product per dollar spent on each input.

- $$\frac{Marginal\ Product\ of\ L}{Price\ of\ L} = \frac{Marginal\ Product\ of\ A}{Price\ of\ A}$$