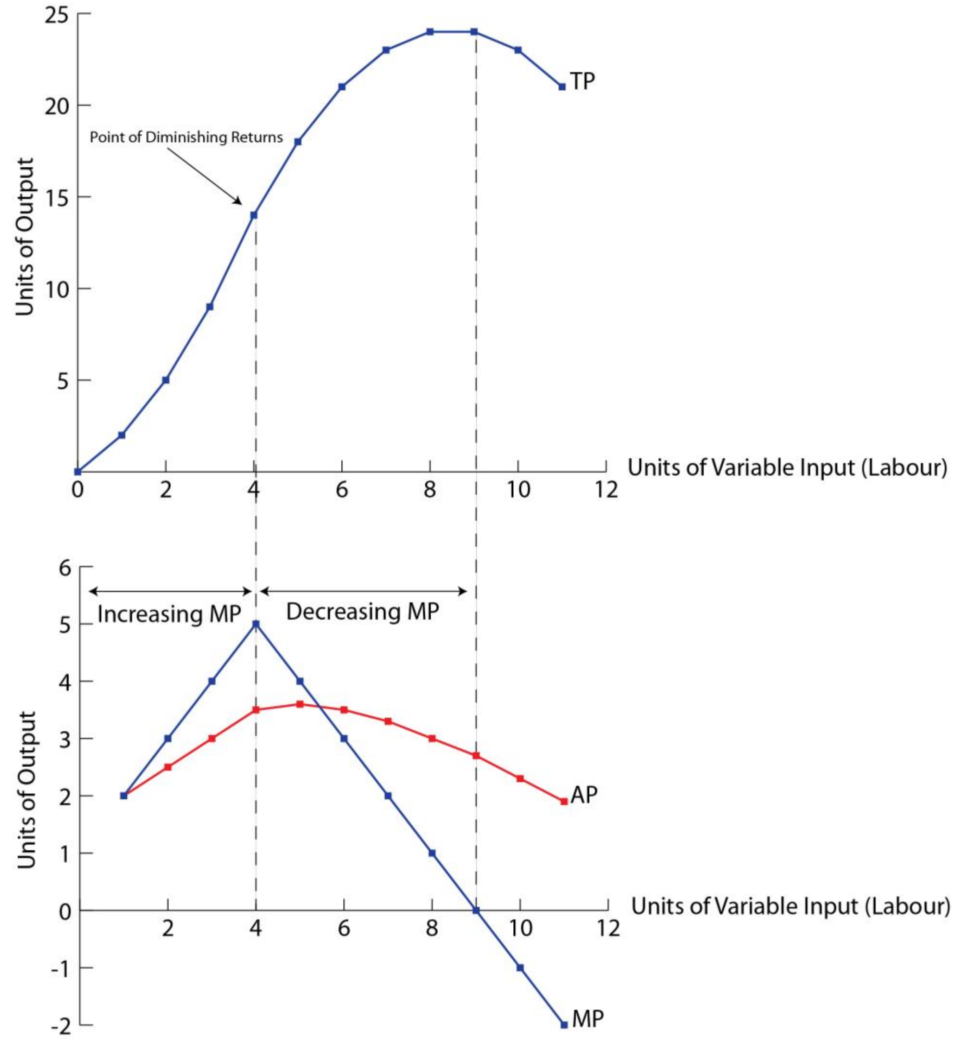
Production & Costs in the Short-run

Total, Marginal & Average Product

- **Total Product (TP):** is the total quantity of output produced by a firm
- **Marginal Product (MP):** is the extra or additional output resulting from one additional unit of the variable input
  - It tells us by how much output increases as labour increases by one worker.
  - **MP = ΔTP ÷ ΔLabour**
- **Average Product (AP)**: is the total quantity of output per unit of variable input, or labour
  - This tells us how much output each unit of labour produces on average
  - **AP = TP ÷ Labour**

Example; TP, MP and AP

Labour (L)	Total Product (TP)	Marginal Product (MP) $MP = \Delta TP \div \Delta Labour$	Average Product (AP) $AP = TP \div Labour$
0	0	–	–
1	2	2	2
2	5	3	2.5
3	9	4	3
4	14	5	3.5
5	18	4	3.6
6	21	3	3.5
7	23	2	3.3
8	24	1	3
9	24	0	2.7
10	23	− 1	2.3
11	21	− 2	1.9



- **Law of Diminishing Returns:** as more and more units of a variable input (such as labour) are added to one or more fixed inputs (such as land), the marginal product of the variable input at first increases, but there comes a point when it begins to decrease

Economic Costs

- **Economic Costs:** are the sum of explicit and implicit costs, or total opportunity costs incurred by a firm for its use of resources, whether purchases or self-owned.

  - **Economic Costs = Explicit Costs + Implicit Costs**

  - When economists refer to ‘costs’ they mean ‘economic costs’

- **Explicit Costs:** payments made by a firm to outsiders to acquire resources for use in production

- **Implicit Costs:** the sacrificed income arising from the use of self-owned resources by a firm

Short-Run Costs

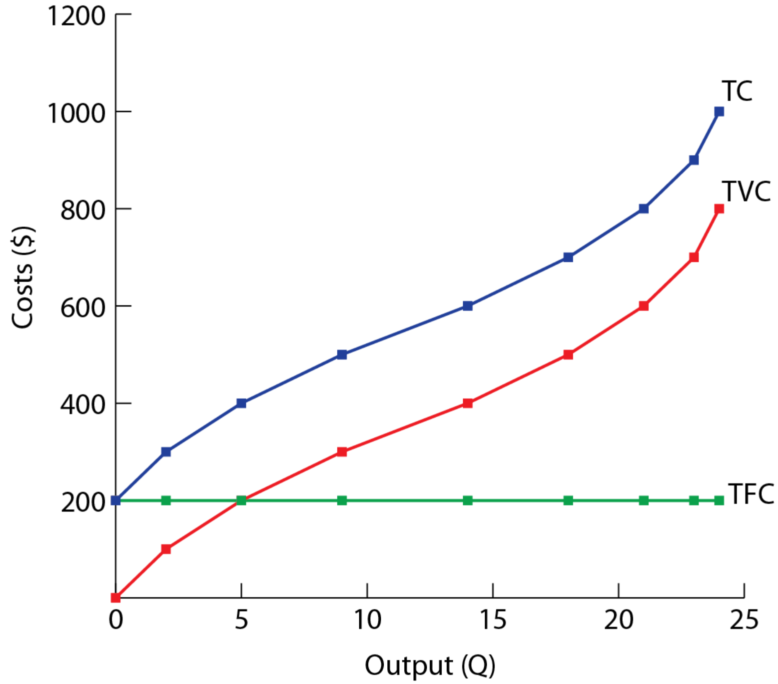
- **Fixed Costs (FC):** arise from the use of fixed inputs. Fixed costs are costs that do not change as output changes.
    - **Example;** Rental payments, property taxes, insurance premiums
- **Variable Costs (VC):** arise from the use of variable inputs. These costs change as output increases or decreases.
    - **Example;** Wage cost of labour
- **Total Costs:** in the short-run, a firm's total costs are the sum of fixed and variable costs.
    - In the long-run there are no fixed costs, therefore a firm's total costs are equal to its variable costs
    - **TC = TFC + TVC**

Average and Marginal Costs

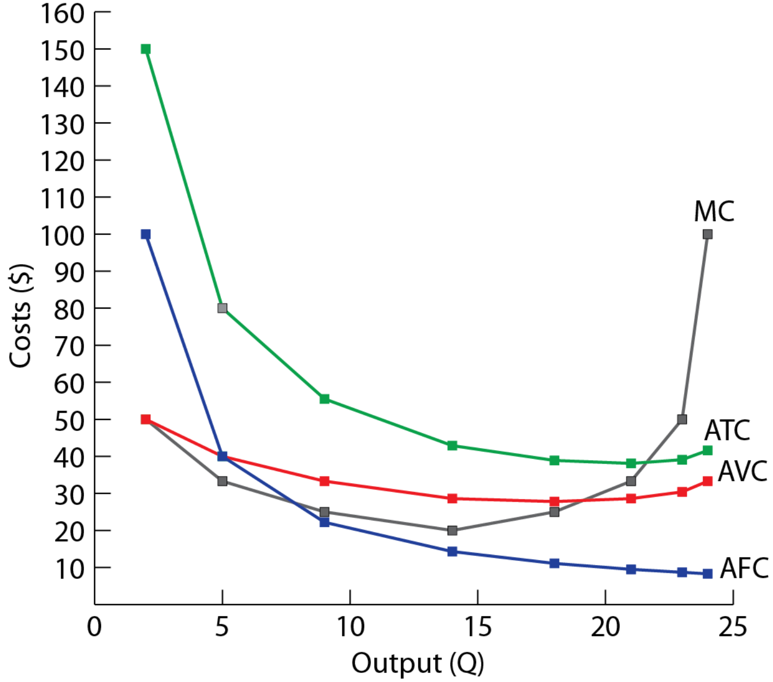
- **Average Costs:** are costs per unit of output, or total cost divided by the number of units of output.
  - **AFC = TFC ÷ Q** (Average fixed costs)
  - **AVC = TVC ÷ Q** (Average variable costs)
  - **ATC = TC ÷ Q**
    = AFC + AVC (Average total costs)
- **Marginal Cost (MC):** is the extra or additional costs of producing one more unit of output.
  - **MC = ΔTC ÷ ΔQ**
    = ΔTVC ÷ ΔQ

Example; Cost & Product Curves

Total Product (TP)	Labour (L)	TFC	TVC	TC	AFC	AVC	ATC	MC
0	0	200	0	200	–	–	–	–
2	1	200	100	300	100	50	150	50
5	2	200	200	400	40	40	80	33.3
9	3	200	300	500	22.2	33.3	55.5	25
14	4	200	400	600	14.3	28.6	42.9	20
18	5	200	500	700	11.1	27.8	38.9	25
21	6	200	600	800	9.5	28.6	38.1	33.3
23	7	200	700	900	8.7	30.4	39.1	50
24	8	200	800	1000	8.3	33.3	41.6	100



Costs ($)
Output (Q)
TC
TVC
TFC



Costs ($)
Output (Q)
MC
ATC
AVC
AFC

Summary

Concept	Definition	Equation
Product Concepts		
Total product (TP)	The total amount of output produced	
Marginal product (MP)	The additional output produced by one additional unit of variable input.	$MP = \Delta TP \div \Delta L$
Average product (AP)	Output per unit of variable input	$AP = TP \div L$
Cost Concepts		
Total cost (TC)	The sum of fixed and variable costs	$TC = TFC + TVC$
Average fixed cost (AFC)	Fixed cost per unit of output	$AFC = TFC \div Q$
Average variable cost (AVC)	Variable cost per unit of output	$AVC = TVC \div Q$
Average total cost (ATC)	Total cost per unit of output	$ATC = AFC + AVC$
Marginal cost (MC)	The change in cost arising from one additional unit of output	$MC = \Delta TC \div \Delta Q$ $= \Delta TVC \div \Delta Q$