Production and Costs

Roger Arnold (Chapter 8),

Krugman and Wells (Chapter 11),

- Firm → an organization that employs factors of production to produce goods/services for sale.
- Two sides to every firm—a revenue side and a cost side.
- The firm's objective is to maximize profit.
- **Profit = Total Revenue (TR) – Total Cost (TC)**

Explicit versus Implicit Costs

- An **explicit cost** is a cost that requires **an outlay of money (actual expenditure or payment)**. For example - tuition fees.
- An **implicit cost** **does not involve an outlay of money.** Instead, it is measured by **the value, in dollar/taka terms, of the benefits that are forgone.** For example - the lost income.

TABLE 9-1 Opportunity Cost of an Additional Year of School

Explicit cost		Implicit cost	
Tuition	$7,000	Forgone salary	$35,000
Books and supplies	1,000		
Computer	1,500		
Total explicit cost	**9,500**	**Total implicit cost**	**35,000**
Total opportunity cost = Total explicit cost + Total implicit cost = $44,500			

This example illustrates a general principle: *the opportunity cost of any activity is equal to its explicit cost plus its implicit cost.*

Accounting Profit and Economic Profit

- **Accounting profit = TR – TC (Explicit costs)**
- **Economic profit = TR – TC (Explicit costs + Implicit costs)**
- **Economic profit** is usually **less than** the **accounting profit**.

Normal Profit = Zero Economic Profit

- Zero economic profit = TR – TC = 0
- **TR = TC (explicit + implicit costs).**
- This is the level of profit necessary to keep resources employed in the firm.

Sunk Cost

- A cost incurred in the past that cannot be changed by current decisions and therefore **cannot be recovered.**
- A sunk cost should be ignored in decisions about future actions because they have no influence over their actual costs and benefits.

- Production = transforming inputs to outputs.
- Therefore, the quantity of output depends on the quantity of input → this relationship is known as the production function.

Inputs

- **Fixed Input** - whose quantity **cannot be changed** as output changes. For example: factory space, machinery.
- **Variable Input** - whose quantity **can be changed** as output changes. For example: workers, electricity.

- The type of input depends on the **Time Horizon**.
- **Short Run (SR)** = At least one input is fixed.
- **Long Run (LR)** = All inputs can be varied.

Production in the SR

- Suppose, you produce rice using two inputs, labor (L) and land.

Land (in acres)	Quantity of Labor (L)	Quantity of output (Q) (tons)
10	0	0
10	1	18
10	2	37
10	3	57
10	4	76
10	5	94
10	6	111
10	7	127
10	8	137
10	9	133
10	10	125

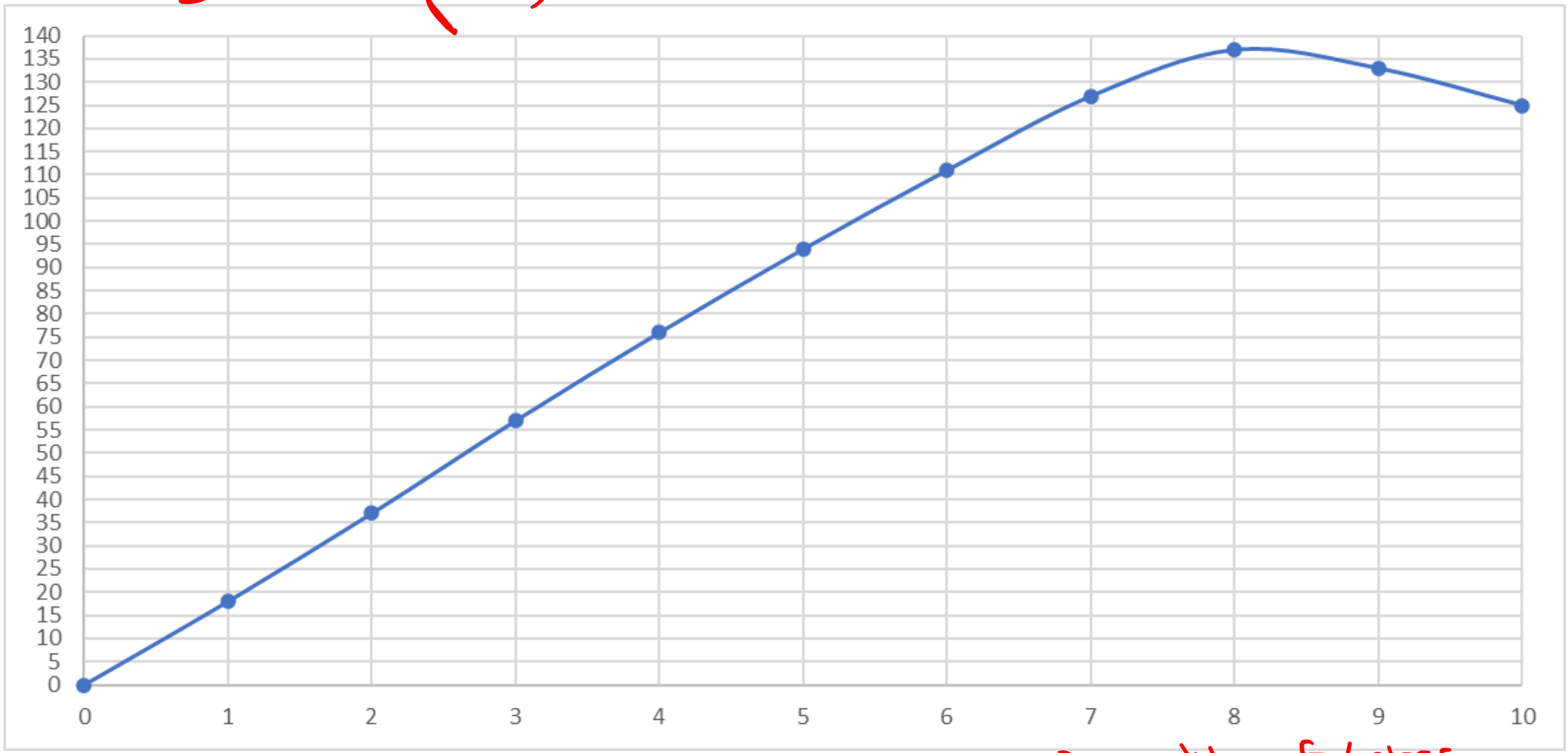
Quantity of Labor (L)	Quantity of output (Q) (tons)	Marginal Product of Labor (MPL) (tons)
0	0	
1	18	18
2	37	19
3	57	20
4	**76**	**19**
5	94	18
6	111	17
7	127	16
8	137	10
9	133	-4
10	125	-8

$$\mathbf{MPL} = \frac{\textbf{Change in Q}}{\textbf{Change in L}}$$

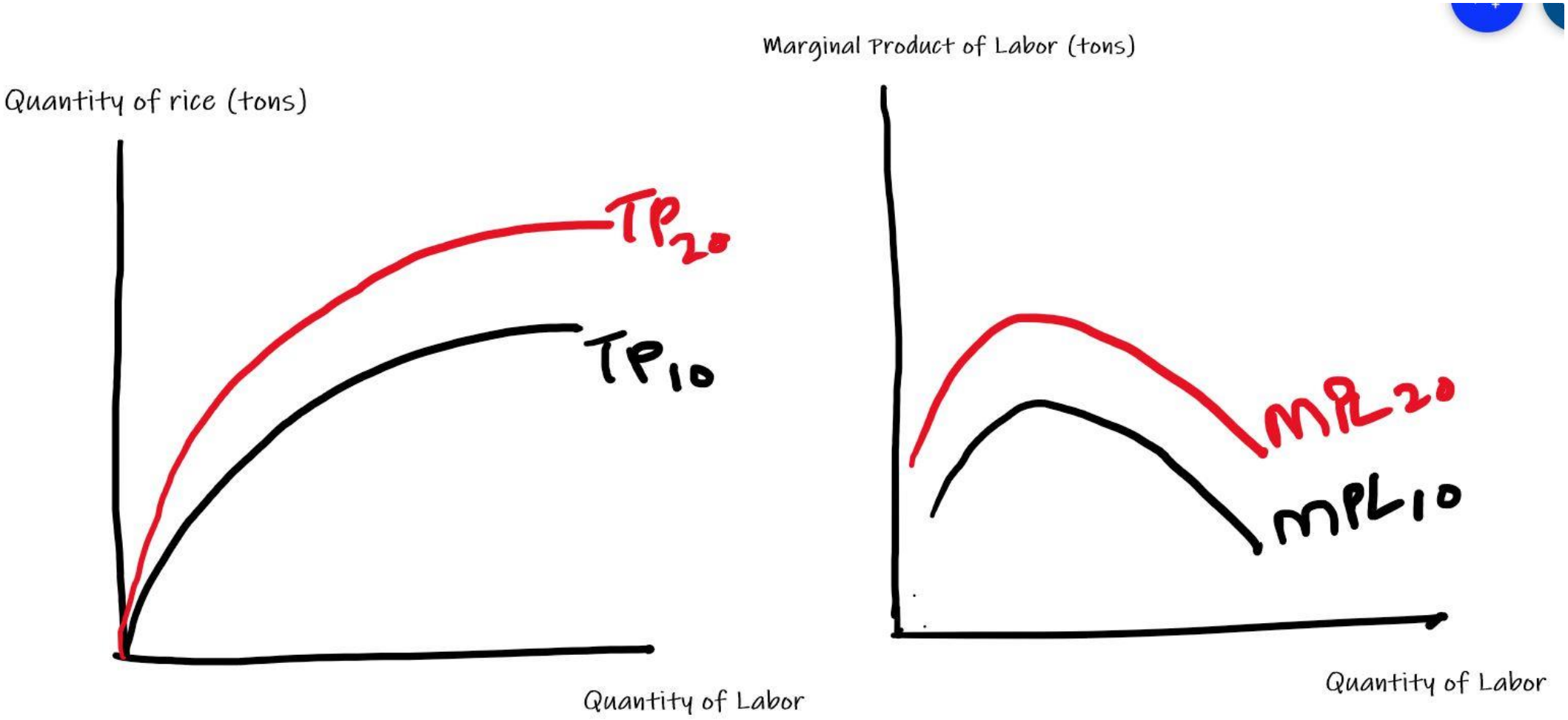
Diminishing marginal returns have set in after adding the fourth worker.

- There are **diminishing returns to an input** when an increase in the quantity of that input, holding the levels of all other inputs fixed, leads to a decline in the marginal product of that input.
- According to the **law of diminishing marginal returns** (LODMR) one more unit of the variable input, ceteris paribus, adds less to the total output than the previous unit of the variable input.

The Total Product Curve



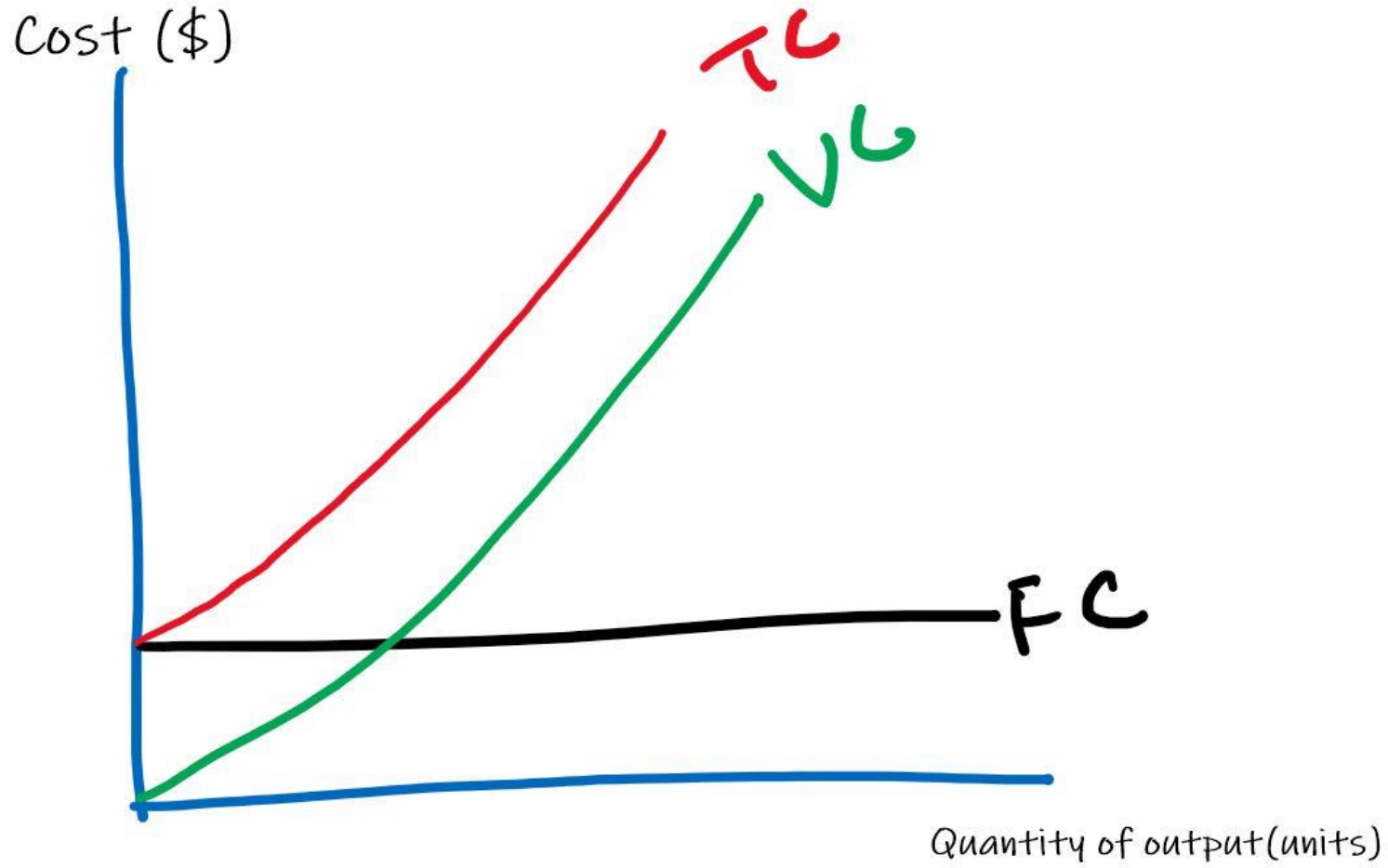
What if the amount of land changes?



Costs

- **Fixed Costs (FC)** → Costs that do not vary with output; the costs associated with fixed inputs. E.g. rent, salary of the CEO.
- **Variable Costs (VC)** → Costs that vary with output; the costs associated with variable inputs. E.g. wages of workers, electricity bill.

- **Total Cost (TC) = FC + VC.**

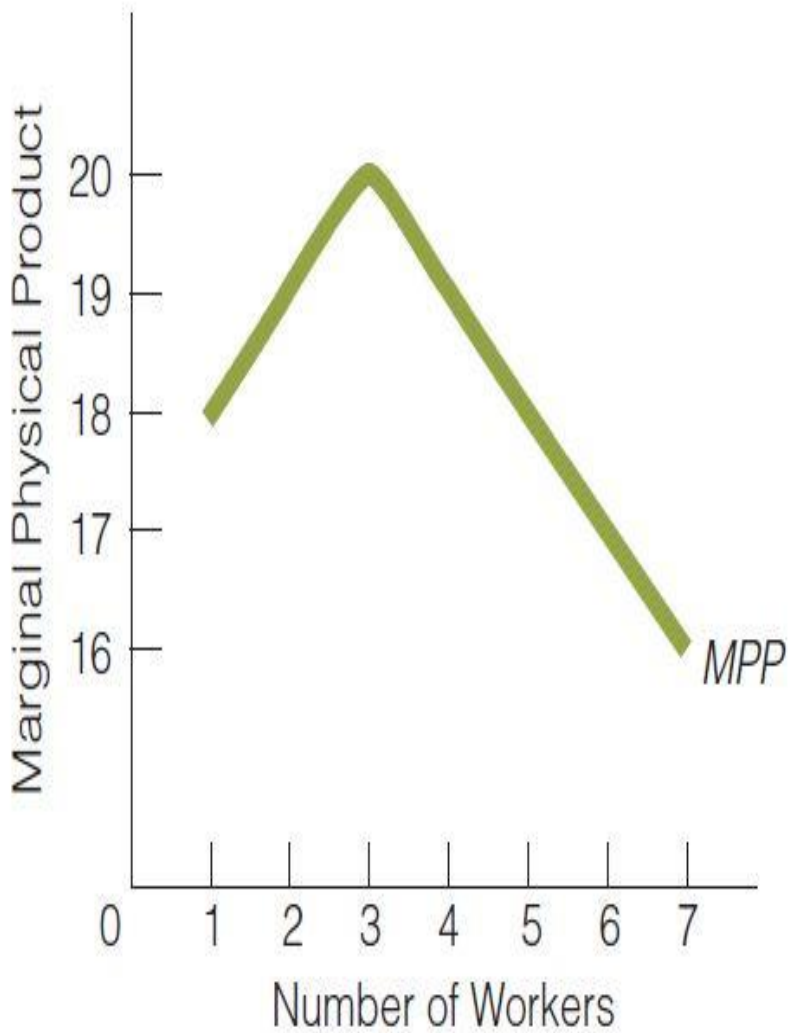


- **Marginal Cost (MC) → The change in the total cost due to a change in the output. (the cost of producing one more unit of output)**

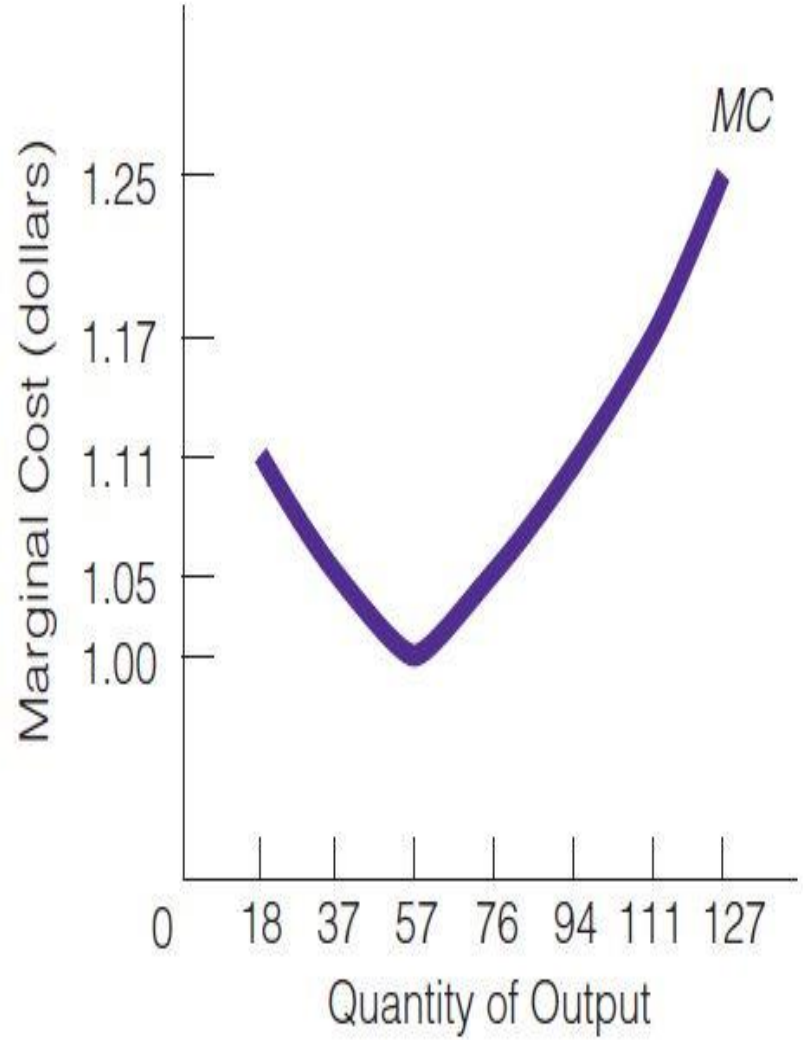
- $MC = \frac{\text{Change in TC}}{\text{Change in Q}}$

- **Given, total FC (TFC) is $40 and each worker is paid $20.**

Q of L	Q (tons)	TFC ($)	TVC ($)	TC (TFC + TVC) ($)	MC (chang e in TC/Change in Q) ($)
0	0	40	0	40	
1	18	40	20	60	1.11
2	37	40	40	80	1.05
3	57	40	60	100	1
4	76	40	80	120	1.05
5	94	40	100	140	1.11
6	111	40	120	160	1.17
7	127	40	140	180	1.25


Marginal Physical Product
20
19
18
17
16
MPP
0
1
2
3
4
5
6
7
Number of Workers

(a)


Marginal Cost (dollars)
1.25
1.17
1.11
1.05
1.00
MC
0
18
37
57
76
94
111
127
Quantity of Output

(b)

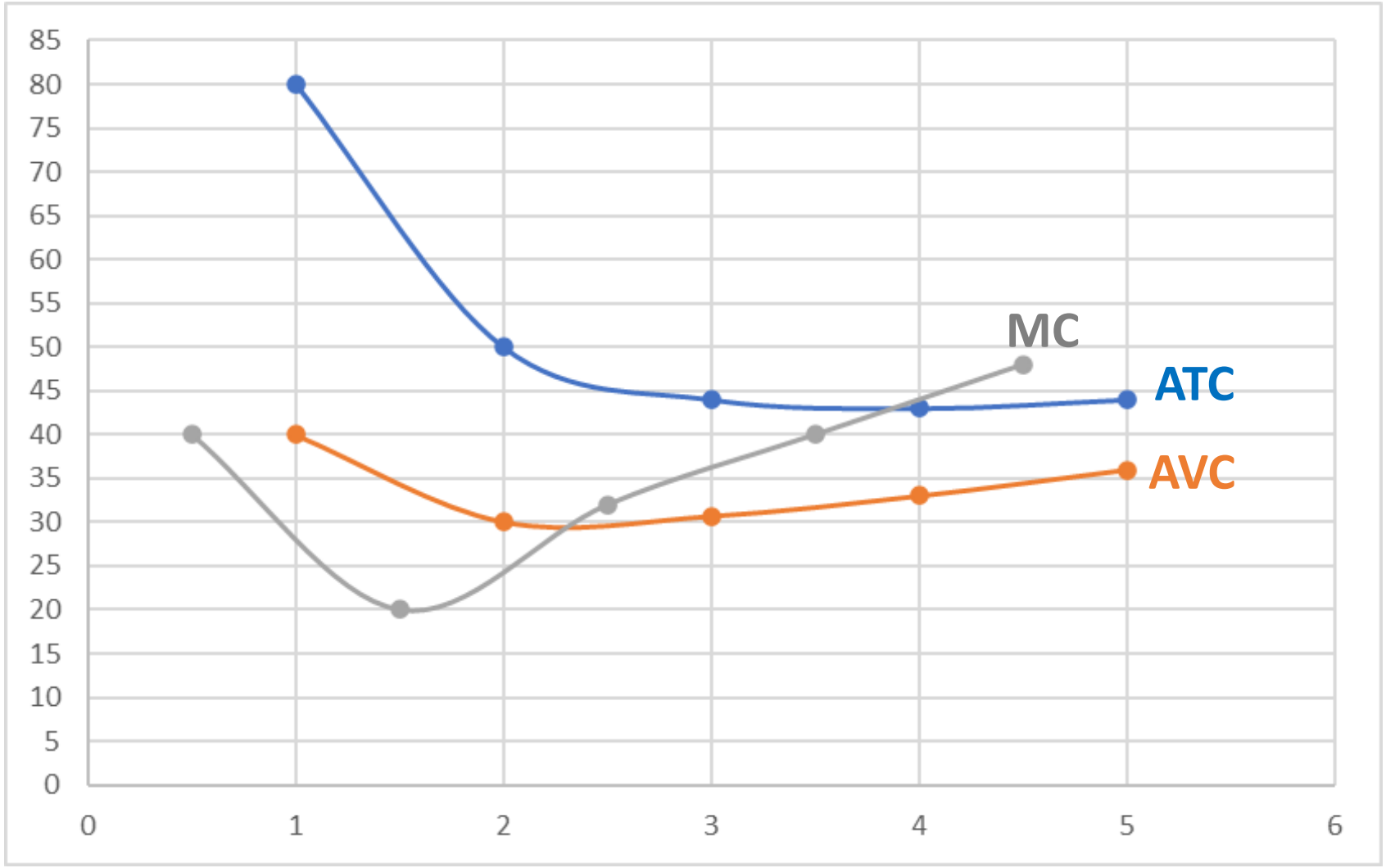
- MPL and MC move in the **opposite direction**.
- An increase in MPL implies a rise in productivity of the worker hence, a fall in the cost.
- We saw that the TP curve becomes flatter with production whereas the TC curve becomes steeper with production → same reason = LODMR

- Average Total Cost (ATC) (per unit cost) = $\frac{\mathbf{TC}}{\mathbf{Q}}$
- ATC and MC are not the same.
- Average FC (AFC) **=** $\frac{\mathbf{TFC}}{\mathbf{Q}}$ → falls with production
- Average VC (AVC) = $\frac{\mathbf{TVC}}{\mathbf{Q}}$ → usually declines then rises due to LODMR
- **ATC = AVC + AFC**

Q (units)	TFC ($)	AFC (FC/Q) ($)	TVC ($)	AVC (VC/Q) ($)	TC (TFC + TVC) ($)	ATC (TC/Q) ($)	MC (change in TC/Change in Q) ($)
0	100	-	0	-	100	-	
1	100	100	50	50	150	150	50
2	100	50	80	40	180	90	30
3	100	33.33	100	33.33	200	66.67	20
4	100	25	110	27.5	210	52.5	10
5	100	20	130	26	230	46	20
6	100	16.67	160	26.67	260	43.33	30
7	100	14.28	200	28.57	300	42.86	40
8	100	12.5	250	31.25	350	43.75	50
9	100	11.11	310	34.44	410	45.56	60
10	100	10	380	38	480	48	70

The Cost Information of Another Firm						
Q(units)	FC(taka)	VC(taka)	TC(taka)	MC(taka)	ATC(taka)	AVC(taka)
0	40	0	40	-	-	-
1	40	40	80	40	80	40
2	40	60	100	20	50	30
3	40	92	132	32	44	30.67
4	40	132	172	40	43	33
5	40	180	220	48	44	36

Cost (taka)



Quantity (units)

The shape of the ATC

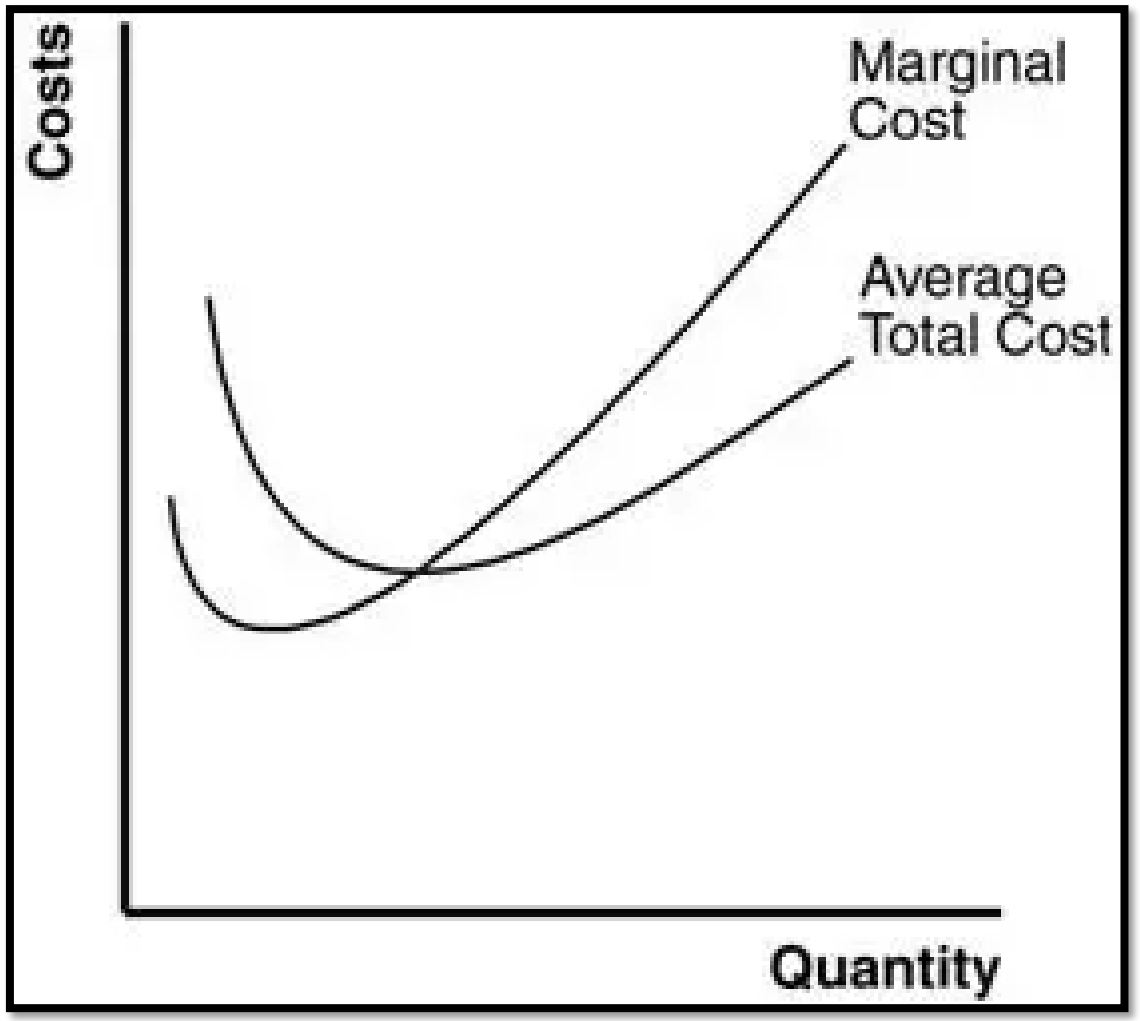
- ATC = AFC + AVC
- Two reasons:

1. **Spreading effect** → as Q rises AFC falls faster than the rise in AVC
2. **Diminishing returns effect** → as Q rises AVC rises faster than the fall in AFC

The Relationship between ATC and MC

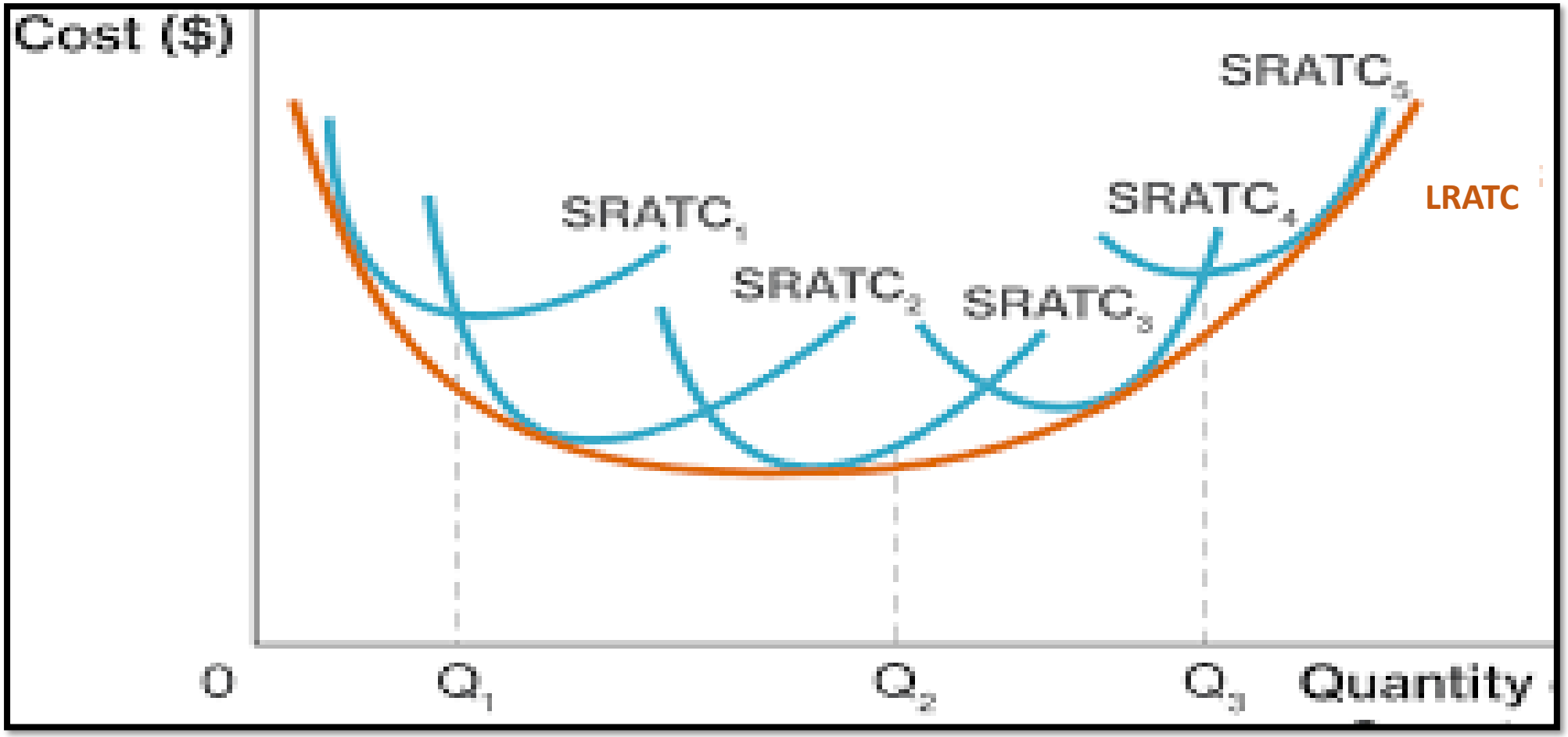
- **MC always intersects ATC at ATC curve's lowest point, i.e. at the minimum cost output.**
- **Average-Marginal Rule:**
- If Marginal Value > Average Value → Average Value Rises
- If Marginal Value < Average Value → Average Value Falls

- **So, when Q rises from levels where,**
- MC > ATC → ATC rises
- MC < ATC → ATC falls
- Only at the minimum cost output MC = ATC



Long Run Average Total Cost (LRATC) Curve

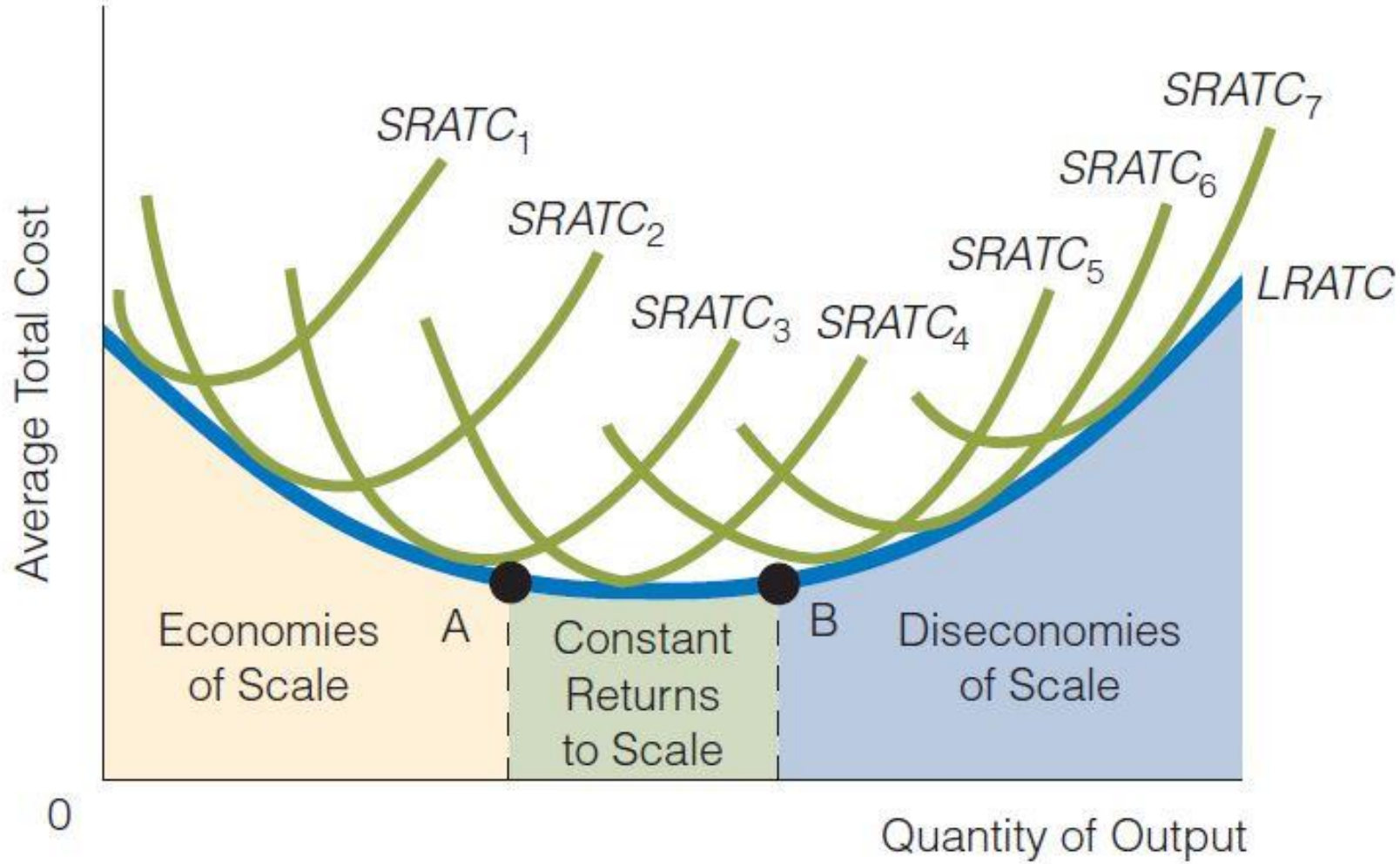
- All inputs are variable.
- You can choose between your plant size.



SRATC = Short Run Average Total Cost

Returns to Scale

- Determines the shape of the LRATC → by what percentage does the Q rise due to some percentage increase in the inputs.
- **Increasing Returns to Scale (Economies of Scale)** → LRATC declines as Q rises.
- **Constant Returns to Scale** → LRATC remains constant as Q rises.
- **Decreasing Returns to Scale (Diseconomies of Scale)** → LRATC rises as Q rises.


SRATC1
SRATC2
SRATC3
SRATC4
SRATC5
SRATC6
SRATC7
LRATC
Average Total Cost
Economies of Scale
A
Constant Returns to Scale
B
Diseconomies of Scale
0
Quantity of Output