5.3. Derivation of Short Run Total Cost (SRTC) Curve

As stated before, Short Run (SR) represents such a period of time during the production process, where all the existing factors can be decomposed in fixed as well as variable factors. The SRTC curve is the graphical representation of the SR Cost function. It shows the relationship between total cost of production incurred by the producer and the level of output in the short run, i.e. SRTC curve is the locus of different combinations between Q, the level of output and SRTC.

◈ 5.3.1. Assumptions in SR Cost Analysis

(i) Firms cannot vary the fixed factors in the short run like plant size, machineries and other capital equipments.

(ii) Proper utilization of the fixed factors by the introduction of minimum possible variable factor.

(iii) Irrespective of the output level, i.e. it may even zero, the firm has to incur the 'overhead-cost'.

(iv) Application of the Law of variable proportion in the short run means the economies and diseconomies of production.

(v) Prices of the factors are fixed in the short run, i.e. wage rate and rate of interest etc.

(vi) Indivisibility of the fixed factor but divisibility of the variable factor with equal efficiency.

(vii) Constant technology of production, i.e. no improvement.

On the basis of these assumptions one cost equation can be developed. Let the short run production function is, $Q = f(L, K)$ where labor (L) is the variable factor and Capital (K) is fixed. If wage rate (w) and rate of interest (r) both are fixed in the short run then the cost equation will be,

$$TC = \bar{w}.L + \bar{r}.\bar{k} \quad \text{.......... } (i)$$

where $\bar{r}.\bar{k}$ = Total Fixed Cost = $F > 0$ [Constant]

and $\bar{w}.L$ = Total variable Cost.

$\therefore$ $TC = TFC + TVC$ .... *(ii)*

$\Rightarrow$ $C = F + f(Q)$ .... *(iii)*

From this cost function, we can determine the relationship between 'planned output' and 'expected cost'. Joining these combinations, the Total Cost (TC) curve in the short run can be obtained. *Since TC is summation of two components, TFC and TVC, therefore the shape of the TC curve can be determined by the shapes of TFC and TVC curves.*

◈ 5.3.2. Shape of Short Run Total Fixed Cost Line

From equation (i), $TFC = \bar{r}.\bar{k}$. Let $TFC = F > 0$, [constant] then the shape of TFC can be derived from the characteristics. The characteristics are as follows :

1. Irrespective of the level of output, the producer has to incur some amount as 'overhead cost' or fixed cost; i.e. $TFC \neq f(Q)$.
2. Even if the quantity is nil, we have some positive constant amount as fixed cost, i.e. at $Q = 0$; $TFC = F > 0$.

3. Since we have one coordinate (O, F), therefore the TFC line will start from positive vertical intercept.

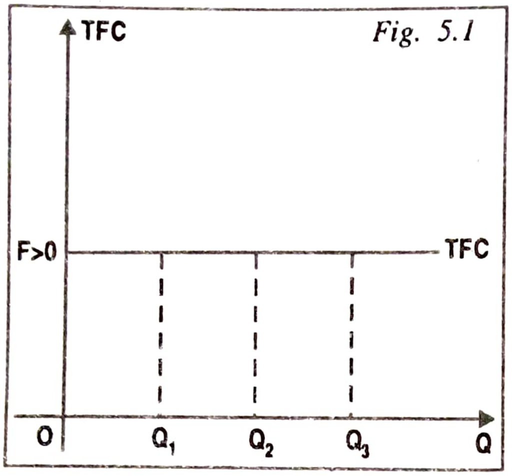


Fig. 5.1

4. Quantity may be increasing or decreasing, whatever it may be, the amount of TFC is constant. This is the reason for which TFC will be a horizontal straight line.
   By the diagram, TFC is a horizontal line, i.e. for zero, Q_1, Q_2, Q_3 – any level of output TFC is a positive constant.

◈ 5.3.3. Shape of Short Run Total Variable Cost Curve

From equation (i), TVC = $\overline{w}.L$. Since labour (L) is the variable factor, therefore $\overline{w}.L$ must be the variable cost. The shape of TVC curve can be derived from the characteristics of TVC. The characteristics are as follows :

1. For the sake of simplicity, let TVC represents the cost of raw materials. Therefore for zero output, no such cost is to be incurred by the producer. Thus at Q = 0, TVC = 0, i.e. the TVC will start from origin for the coordinate (0, 0).
2. The amount of TVC depends on the level of output, produced by the producer. Therefore TVC = f(Q).
3. Increase (decrease) in Q means increase (decrease) in TVC. Therefore TVC and Q both are directly related. Due to this direct relation, TVC will be positively sloped.
   Hence we can conclude, **TVC varies with the variation in Q, the TVC curve starts from origin and positively sloped.** But whether it is a straight line or curveture, depends on the nature of production function or the increasing rate of Q. We know, Q may increase at a higher rate, constant rate or lower rate depends on the Law of Variable Proportion, ***this is the derivation of "cost function from the production function" or derivation of Total Variable Cost Curve from the Total Production Curve.*** Since the Law of Variable Proportion (as discussed in previous Chapter 4.3) means three returns, i.e. increasing return, constant return, diminishing return to a variable factor (with 'in' the scale not 'to' scale) therefore **three possible shapes of TVC** can be obtained.
4. It is to be noted that "Increasing Return" always represents "Decreasing Cost". Therefore initially due to the increasing return, *production is increasing* at a *higher rate which automatically means the total variable cost (TVC) is increasing* at a lower rate. Hence, due to the "economies" in production, the total production curve is **convex to the horizontal axis** or total variable cost curve is **concave to the horizontal axis.** In Fig. 5.2, OA and OA_1 represent this situation.
5. At the next phase, due to the "Constant Return" or "Constant Cost", production and Cost both are increasing at a Constant rate. In Fig. 5.2, the points like A and A_1 represent this situation.

6. Then, following the nature of production function, 'Decreasing Return' will operate which means "Increasing Cost".

This is the "diseconomies" in production which means *production is increasing at a lower rate or total variable cost is increasing at a higher rate.* Thus the total production curve is **concave to the horizontal axis** or total variable cost curve is **convex to the horizontal axis.** In Fig. 5.2, AB and A_1B_1 represent this situation.

Hence, the TVC curve starts from origin, positively sloped curveture—concave, point of inflection and convex to the horizontal axis.

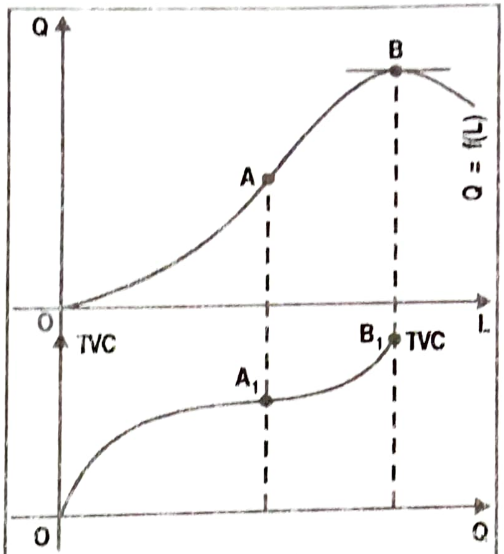


Fig. 5.2

Thus the TVC curve is the mirror image of the total production curve. Since total production curve is 'S' shaped, therefore, the TVC curve must be 'Inverse-S' shaped.

◈ 5.3.4. Shape of Short Run Total Cost Curve

Since TC = TFC + TVC.

Therefore the shape of TC curve in the short run depends on the horizontal TFC and 'inverse-s' shaped TVC curve. From these two, the shape of TC curve can be obtained by the following ways :

1. As Q = 0

   TFC = F > 0, TVC = 0

   ∴ TC = TFC + TVC = F > 0

   TC = TFC.

   Hence, both TFC line and TC curve will start from the same "positive vertical intercept".

2. ∵ TC = TFC + TVC

   ∴ the shape of TC mainly depends on the shape of TVC. TC will vary with the variation of TVC.

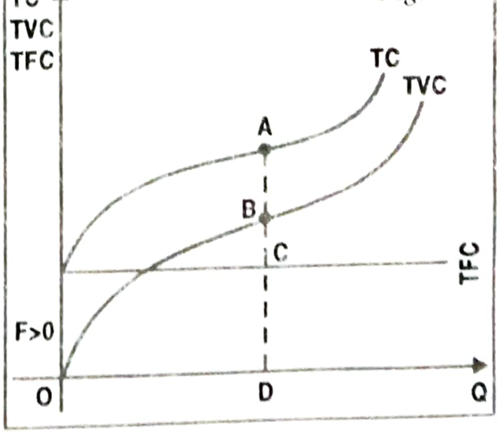
   Hence TC as well as TVC both the curves will be 'inverse-s' shaped.

3. ∵ TC = TFC + TVC

   ∴ TC − TVC = TFC = Constant.

   Hence, the *vertical gap between these two curves TC and TVC must be constant,* TFC, by which they are parallel.

Fig. 5.3



The Fig. 5.3 represents, AB = CD.

Hence the short run total cost curve will be 'Inverse-S' shaped like TVC. The former starts from positive vertical intercept where as the latter starts from origin.

◈ 5.3.5. Difference between TFC and TVC

TFC	TVC
(i) TFC ≠ f(Q)	(i) TVC = f (Q)
(ii) At Q = 0, TFC = F > 0.	(ii) At Q = 0, TVC = 0.
(iii) TFC starts from positive vertical intercept.	(iii) TVC starts from origin.
(iv) TFC is a horizontal line	(iv) TVC is a positively sloped curveture.
(v) TFC cannot represent the concept of economies or diseconomies.	(v) TVC can represent the concept of economies or diseconomies.
(vi) Marginal cost does not depend on TFC.	(vi) Marginal cost depends on TVC.
(vii) TFC is a short run phenomenon.	(vii) TVC is a Short-run as well as long-run phenomenon.

5.4. Derivation of Short Run Average Cost (SRAC) Curve

Let us consider one example first. To produce 50 uits of a product, cost of raw materials is Rs. 1,500, wage of labour is Rs. 750, rent of a factory building is Rs. 800, administrative salary is Rs. 4,000.

From this given information we can calculate the value of average cost by two ways :

1. The first way is, the calculation of average cost (AC) directly from total cost (TC).

$$\therefore \quad TC = 1500 + 750 + 800 + 4000 = 7050$$

$$\therefore \quad AC = \frac{7050}{50} = 141.$$

Hence, average cost of production is Rs. 141 for 50 units of a product.

2. The second way is, the calculation of average cost (AC) from total variable cost (TVC) and total fixed cost (TFC). By the given problem,

$$TVC = 1500 + 750 = 2250$$

$$\text{and} \quad TFC = 800 + 4000 = 4800$$

$$\therefore \quad \text{Average variable cost (AVC)} = \frac{TVC}{Q} = \frac{2250}{50} = 45$$

$$\text{and} \quad \text{Average fixed cost (AFC)} = \frac{TFC}{Q} = \frac{4800}{50} = 96$$

Hence, Average Cost = Average Fixed Cost + Average Variable Cost

$$\Rightarrow \quad AC = 96 + 45 \Rightarrow AC = 141.$$

The average cost of production is Rs. 141 for 50 units of a product.

In the short run, average cost (AC) represents the 'per unit' Cost.

$$\text{Therefore,} \quad AC = \frac{TC}{Q} = \frac{TFC + TVC}{Q} = \frac{TFC}{Q} + \frac{TVC}{Q} = AFC + AVC.$$

Hence the average cost (AC) is the summation of average fixed cost (AFC) and average variable cost (AVC). The shape of AC depends on the shapes of AFC as well as AVC in the short run. Following the equation (ii) and (ii) mentioned in the earlier section 5.3.1. we can conclude,

$$AFC = \frac{TFC}{Q} = \frac{F}{Q} \quad \text{.......... (iv)}$$

$$\text{and} \quad AVC = \frac{TVC}{Q} = \frac{\overline{w}.L}{Q} \quad \text{.......... (v)}$$

So, let us discuss AFC first and then AVC. After the derivation of AFC and AVC, the shape of AC can be derived by the process of **'vertical summation'**. One should remember that we are considering short run, i.e. it represents such a period of time during the production process where all the existing factors can be decomposed in fixed as well as variable factor.

◈ 5.4.1. Derivation of Average Fixed Cost Curve

It represents the 'per unit' total fixed cost. Since in the short run, time is not sufficient to change the fixed factors like plant size, *therefore total fixed cost (TFC) is distributed equally over the total output.*

$$\therefore \quad AFC = \frac{TFC}{Q} = \frac{F}{Q}$$

The shape of AFC depends on the characteristics of AFC. They are as follows :

1. **AFC depends on the level of output.**

   We know, $TFC = F > 0$ [constant]

   $$\therefore \quad TFC \neq f(Q)$$

   $$\text{but} \quad AFC = \frac{TFC}{Q} = \frac{F}{Q}$$

   $$\therefore \quad AFC = f(Q).$$

2. **AFC curve must be negatively sloped.**

   $$\because \quad AFC = \frac{F}{Q} = \frac{\text{constant}}{Q}$$

   Therefore increase in Q means decrease in AFC. Due to this inverse relationship, the AFC curve must be negatively sloped. Any 'first order differentiation' represents the slope, i.e.

   $$\frac{d(AFC)}{dQ} = \frac{d}{dQ}\left(\frac{F}{Q}\right) = F.\frac{d}{dQ}\left(\frac{1}{Q}\right) = F.\frac{d}{dQ}\left(Q^{-1}\right)$$
   $$= F.\left(-Q^{-2}\right) = -\frac{F}{Q^2} < 0.$$

   Since it is negative, therefore the AFC curve must be negatively sloped.

3. **AFC curve must be convex to the origin.**

   For the convexity, the 'second order differentiation' must be positive. Let us go for that, i.e.

   $$\frac{d^2(AFC)}{dQ^2} = \frac{d}{dQ}\left[\frac{d(AFC)}{dQ}\right] = \frac{d}{dQ}\left[-\frac{F}{Q^2}\right]$$
   $$= (-F).\frac{d}{dQ}\left(\frac{1}{Q^2}\right) = (-F).\frac{d}{dQ}\left(Q^{-2}\right)$$
   $$= (-F).(-2).Q^{-3} = 2F.\frac{1}{Q^3} > 0$$

   Since it is positive, therefore the AFC curve must be convex to the origin.

4. **AFC curve must be 'ASYMPTOTIC' to the axes.**

$$\because \quad AFC = \frac{F}{Q} = \frac{\text{constant}}{Q}$$

∴ AFC must be a *"monotonically decreasing function of Q,* i.e. it may very close to zero or horizontal axis but never be zero or cuts the axis. As Q increases, AFC decreases. Therefore for a large value of Q the value of AFC must be minimum but still positive, never be zero. This is the reason for which AFC curve is a asymptotic to both the axes.

5. **All the rectangles drawn below the AFC curve are of equal areas.**

$$\because \quad AFC = \frac{TFC}{Q} = \frac{F}{Q}$$

$$\therefore \quad AFC.Q = F = \text{constant.}$$

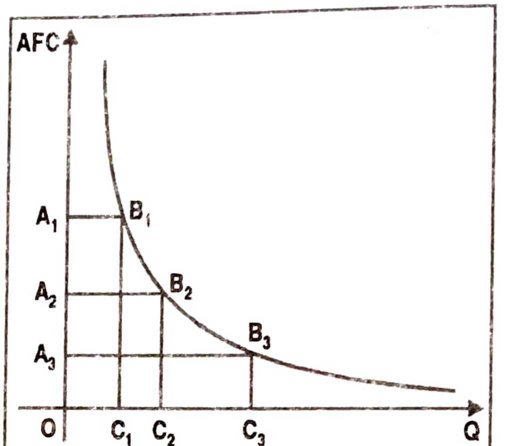


Fig. 5.4

Following Fig. 5.4

(a) ***At point*** B_1 **:**

$AFC = OA_1,\ Q = OC_1$

$\therefore TFC = AFC.Q$

$= OA_1.OC_1$

$=$ area $OA_1B_1C_1$

(b) ***At point*** B_2 **:**

$AFC = OA_2,\ Q = OC_2$

$\therefore TFC = AFC.Q = OA_2.OC_2 =$ area $OA_2B_2C_2$

(c) ***At point*** B_3 **:**

$AFC = OA_3,\ Q = OC_3$

$\therefore TFC = AFC.Q = OA_3.OC_3 =$ area $OA_3B_3C_3$.

Since by the concept, TFC is constant.

Therefore area $OA_1B_1C_1$ = area $OA_2B_2C_2$ = area $OA_3B_3C_3$.

Due to these above mentioned characteristics, the AFC curve is called as the 'RECTANGULAR HYPERBOLA'.

◈ 5.4.2. Derivation of Average Variable Cost Curve

It represents the 'per-unit' total variable cost. From equation (v), we can develop one relationship, i.e.

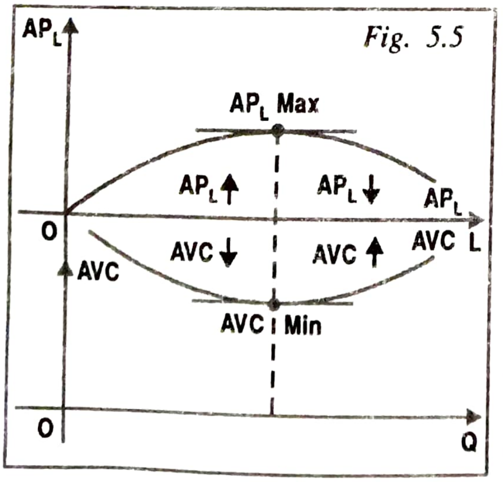


Fig. 5.5

$$AVC = \frac{w.L}{Q} = \frac{w}{\frac{Q}{L}} = \frac{w}{AP_L} \quad \text{.............} (vi)$$

where, $\frac{Q}{L}$ = Average productivity of labour

$= AP_L$.

This is the relationship by which the cost function can be developed from the production function. From the previous chapter [Section 4.3.1], Law of Variable proportion we know the AP_L curve is "inverse-U" shaped—increasing, reaches at 'its' maximum and then falling.

The shape of AVC depends on the shape of AP_L. Since the wage rate is constant, therefore, following conclusions can be drawn from equation (vi) :

1. When AP_L is rising ⇒ **then AVC must be falling.**
2. When AP_L is maximum ⇒ **then AVC must be minimum.**
3. When AP_L is falling ⇒ **then AVC must be rising.**

Therefore, the AVC curve will be 'U' shaped because the AP_L curve is 'inverse-U' shaped.

◈ 5.4.3. The Shape of Short Run Average Cost Curve

Since AC = AFC + AVC

Therefore the shape of AC depends on the shapes of AFC as well as AVC curve. We have throughout negatively sloped AFC curve, the rectangular hyperbola in one hand and 'U'-shaped AVC curve on the other. By the process of 'vertical summation', the ultimate shape of AC curve can be obtained in the short run. It is possible by two steps, discussed below :

Step–I : When AFC and AVC both are falling

Since both the curves are falling, therefore the summation of the two, i.e. AC must be falling.

⇒ **AC curve will be negatively sloped.**

[Mathematically we can say,

$$\frac{d(AFC)}{dQ} < 0, \frac{d(AVC)}{dQ} < 0$$

$$\Rightarrow \frac{d}{dQ}(AC) < 0$$

Where $\frac{d}{dQ}(AFC)$ = Slope of AFC curve

$\frac{d}{dQ}(AVC)$ = Slope of AVC curve

$\frac{d}{dQ}(AC)$ = Slope of AC curve].

Step–II : When AFC is falling but AVC is rising

Since one is falling but other is rising, therefore the result of ultimate summation depends on the relative strength. Hence the conclusion relating to AC depends on whether AFC is falling at a higher, equal or lower rate than the rising rate of AVC.

There will be three possibilities :

1. Falling rate of AFC > Rising rate of AVC
   ⇒ **AC is falling, negatively sloped.**
2. Falling rate of AFC = Rising rate of AVC
   ⇒ **AC is constant, reaches at minimum.**
3. Falling rate of AFC < Rising rate of AVC
   ⇒ **AC is rising, positively sloped.**

3. $\left|\frac{d(AFC)}{dQ}\right| < \left|\frac{d(AVC)}{dQ}\right| \Rightarrow \frac{d}{dQ}(AC) > 0.]$

From the above mentioned two steps, we have AC is falling, minimum and rising, i.e. the AC curve in the short run must be 'U' shaped.

❖ 5.4.4. Relation Between 'AVC" and "AC"

1. AC and AVC both the curves are 'U'-shaped.
2. $\because$ AC = AFC + AVC

   $\therefore$ AC − AVC = AFC.

   The vertical gap between AC and AVC curves represents AFC. Since AFC is falling, *therefore the rising portions of two curves are close to each other but never cuts* because if it cuts then AFC becomes zero, which is not possible, mentioned earlier.

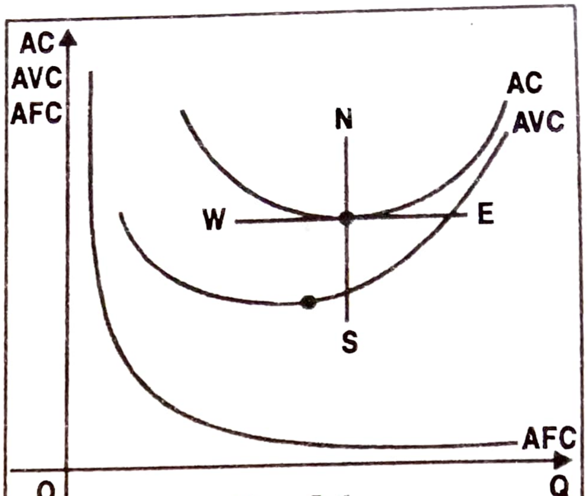


Fig. 5.6

3. The minimum point of AVC occurs at a lower output than the output corresponds to the minimum point of AC. *It means the minimum point of AVC lies at 'SOUTH-WEST' to the minimum point of AC.*

5.5. Derivation of Short Run Marginal Cost (SRMC) Curve

Marginal represents the last unit. Therefore, marginal cost (MC) represents the 'last unit' cost. It is the addition to the total cost due an increase in production by extra one unit. For example, let for 10 units of a product the total cost is Rs. 100 and for 11 units it will be 109. Therefore, marginal cost will be the extra cost for the last unit or cost for the 11th unit, i.e. Rs. (109 − 100) = Rs. 9.

If TC_1 represents the total cost for Q_1 units of output and TC_2 for Q_2, where production is increasing, i.e. $Q_2 > Q_1$,

then, $$MC = \frac{\Delta TC}{\Delta Q} = \frac{TC_2 - TC_1}{Q_2 - Q_1}.$$

Mathematical Extension

The value of MC or the equation of MC can be derived from the total cost function. Since the total cost curve is 'inverse-s' shaped, therefore the total cost function must be cubic in nature. Let the cost function is,

$$MC = \frac{d}{dQ} = \frac{d}{dQ}(Q^3) - 14.\frac{d}{dQ}(Q^2) + 69.\frac{d}{dQ}(Q) + \frac{d}{dQ}(100)$$

$$\Rightarrow \quad MC = 3Q^2 - 28Q + 69$$

Since the MC is 'quadratic' in nature, therefore it must be U-shaped.

◈ 5.5.1. Relation Between Total and Marginal Cost

The value of MC depends on the nature of TC. Three cases may happen :

1. If $TC_2 > TC_1 \Rightarrow \Delta(TC) > 0 \Rightarrow MC > 0$.
2. If $TC_2 = TC_1 \Rightarrow \Delta(TC) = 0 \Rightarrow MC = 0$.
3. If $TC_2 < TC_1 \Rightarrow \Delta(TC) < 0 \Rightarrow MC < 0$.

Hence marginal cost may be positive, zero or even negative. But rational production behaviour only considers positive value of marginal cost.

◈ 5.5.2 Derivation of Short Run Marginal Cost (SRMC) Curve

As discussed earlier, short run represents such a period of time during the production process where all the existing factors can be decomposed in variable and fixed factors. Let the short run production function is, $Q = f(L)$ where $K = \bar{k}$ = fixed

Hence for constant input prices like wage rate (w) and rate of interest (r), the total cost equation will be,

$$TC = \bar{w}.L + \bar{r}.\bar{k}$$

Now, Marginal Cost (MC) represents change in total cost.

$$\therefore \quad \Delta(TC) = \Delta(\bar{w}.L) + \Delta(\bar{r}.\bar{k})$$

$$\Rightarrow \quad \Delta(TC) = \bar{w}.\Delta L \quad [\because \Delta(\bar{r}.\bar{k}) = 0]$$

$$\Rightarrow \quad \frac{\Delta(TC)}{\Delta Q} = \frac{\bar{w}.\Delta L}{\Delta Q} = \frac{\bar{w}}{\left(\frac{\Delta Q}{\Delta L}\right)}$$

$$\Rightarrow \quad MC = \frac{\bar{w}}{MP_L} \quad \text{.......................................} \quad (vii)$$

where, MP_L = Marginal productivity of labour = $\frac{\Delta Q}{\Delta L}$.

This is one another relationship by which the cost function can be derived from the production function. From the previous chapter [Section 4.3.2], Law of Variable Proportion, we know that the MP_L curve is 'inverse-U' shaped. So with the help of the MP_L curve the shape of MC can be derived.

Since the wage rate is constant therefore following conclusions can be drawn from equation (vii) :

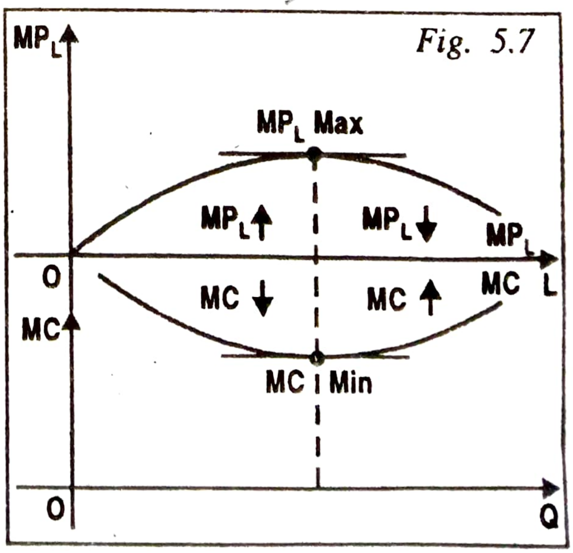


Fig. 5.7

1. When MP_L is rising ⇒ MC is falling.
2. When MP_L is maximum ⇒ MC reaches at 'its' minimum.
3. When MP_L is falling ⇒ MC is rising.

Then, in the short run, the MC curve must be 'U' shaped because the MP_L curve is 'inverse-U' shaped.

◈ 5.5.3. Relation between Marginal and Variable Cost

$C = C(Q)$ ....

Hence, the long run total Cost is a function of the level of output.

5.12. Derivation of Long Run Average Cost Curve

Like the total, the long run average cost (LRAC) curve can be derived by the different short run average cost (SRAC) curves. As we know, in the short run, we have fixed as well as variable factors. Thus the shape of SRAC depends on the shapes of AFC as well as AVC in the short run. The AFC curve is a rectangular hyperbola where as the AVC curve is U-shaped. By the process of vertical summation of these two curves the final SRAC curve can be determined. But in the long-run, we have simply the variable factors. One factor which was fixed in the short run, becomes variable in the long run. Due to the absence of the fixed cost or the AFC curve in the long run, a single 'U' shaped curve will represent AVC as well as AC in the long run.

The short run cost curves are derived from the law of variable proportion where as the long run cost curves are derived from the returns to scale. Now returns to scale can be explained in terms production as well as cost. For example, increasing returns to scale means "production is increasing at a higher rate'. Therefore with respect to the cost, the language will be "cost is increasing at a lower rate" or "per unit cost is decreasing." Hence increasing returns to scale means decreasing cost, constant returns to scale means constant cost and decreasing returns to scale means increasing cost. One better conclusion we can draw from this analysis; i.e. ***the LRAC must be 'U' shaped initially falling due to increasing returns to scale or decreasing cost, then reaches at its' minimum point due to the constant returns to scale or constant cost and finally rising due to the diminishing returns to scale or increasing cost.***

As we discussed before, in the long run, all the factors are variable. So the target of the producer is the selection of optimum or equilibrium combination of two inputs in such a way by which the total cost will be minimum for a given output level. For different output levels, there will be different equilibrium combinations. Hence a producer will move along the expansion path which is the locus of these equilibrium points. *Since in the short run, the scale of production is fixed therefore the short run curves are derived from "returns to variable factor" or "returns with in a scale" or "law of variable proportions", where as in long run the scale is variable means the long run curves are derived from "returns to scale".*

The derivation of LRAC is possible by the equation (iv), mentioned in the previous section, i.e. $C = i(Q, S) + j(S)$.

Now, for one value of 'S' means one plant size or scale of the production process. For one value of 'S', there will be one SRAC curve. So for different values of 'S', there will be different SRAC curves. From these SRAC curves, the final LRAC curve can be drawn.

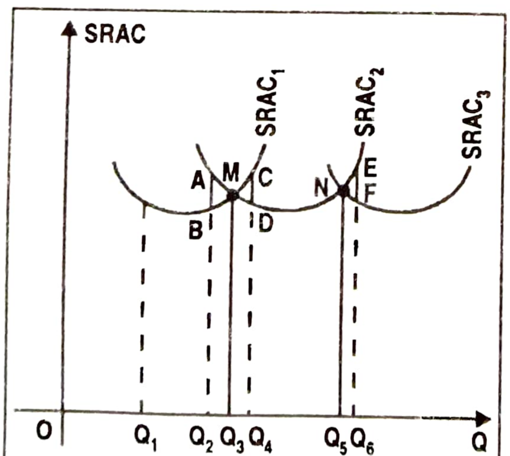


Fig. 5.17

Let us consider three different values of 'S' or three plant sizes. So we have three SRAC curves, i.e. $SRAC_1$, $SRAC_2$, $SRAC_3$. *It is very important to note that in the short run, the movement of the producer is restricted along a single SRAC curve, i.e. either along $SRAC_1$ or $SRAC_2$ or $SRAC_3$, because the plant size or scale is fixed. But in the long run, it is possible to shift or to move from one SRAC to another.* If means the producer can start to move along $SRAC_1$, then he can shift to $SRAC_2$, then $SRAC_3$ etc. It is possible due to the fact that in the long run the scale or plant size is variable. So the producer will select that plant size or SRAC curve which will lie below compare to the available alternatives.

The derivation of LRAC mainly concerned to the following problems :

(i) LRAC is flatter 'U'–shaped than SRAC.

(ii) LRAC is the envelope to the SRAC curves.

(iii) LRAC is the planning curve.

(iv) LRAC represents different returns to scale.

Let us consider the diagram. To produce OQ_1 level of output, the producer will choose the first plant size or $SRAC_1$. This is a definite choice, because following the diagram, the producer has no option, i.e. the vertical line cuts the $SRAC_1$ only. But for OQ_2 level of output, he has option. The OQ_2 level of output can be produced by the first as well as the second plant size. The vertical line drawn cuts the $SRAC_1$ at point B and $SRAC_2$ at point A. Hence choice or selection of second plant size means higher per unit cost of AB. So the producer will choose the first plant size, because the target is minimisation of cost But for OQ_3, the producer may choose the first plant size or the second plant size, because for both plant sizes, per unit cost is same. Since $SRAC_1$ and $SRAC_2$, these two curves intersect at point M, therefore MQ_3 represents the per unit cost to produce the OQ_3 level of output following the first as well as second plant size. But if the plan of the producer is expansion then he will select the second plant size.

Similarly for OQ_4, the firm will select the second plant size or $SRAC_2$, because now the first plant size represents extra per unit cost of CD. For OQ_6, the firm will select the third plant size because then the second plant size will represent higher per unit cost EF. For OQ_5, again he will be indifferent because point 'N' represents the intersection where NQ_5 will be the per unit cost following the second and third plant size.

One important feature relating to the movement of the producer in the short run is the movement must be restricted along a single SRAC curve, where as in the long run the firm will choose that portion of SRAC curve from the available alternatives which will lie below than the other. In the diagram, the thick route represents the long run movement of the producer.

It is to be noted that, for three available plant sizes or SRAC curves, we have two intersections like M and N. Hence for 'n' nos, of SRAC curves we will have (n–1) intersections. Joining these intersections, the LRAC curve can be determined. Thus the LRAC curve is the locus of these intersections. If the no. of plant sizes is large then the intersections will be very close to each other and lie below. It means the LRAC must be flatter than the SRAC curves.

The LRAC curve will be the 'envelope' to different SRAC curves, i.e. it must be the outer-target to different SRAC curves but intersects none. ***Following Lipsey, "the LRAC provides boundary between attainable and unattainable levels of cost."***

❐ Relation between SRAC and LRAC

(i) LRAC is falling due to the increasing returns to scale (IRS) and the falling portion of LRAC is tangent to the falling portions of different SRAC curves.

(ii) LRAC curves which is flatter U–shaped, reaches at 'its' minimum point due to the constant returns to scale (CRS) and there will be a single SRAC curve, where the minimum point of LRAC is tangent to the minimum point of SRAC curve.

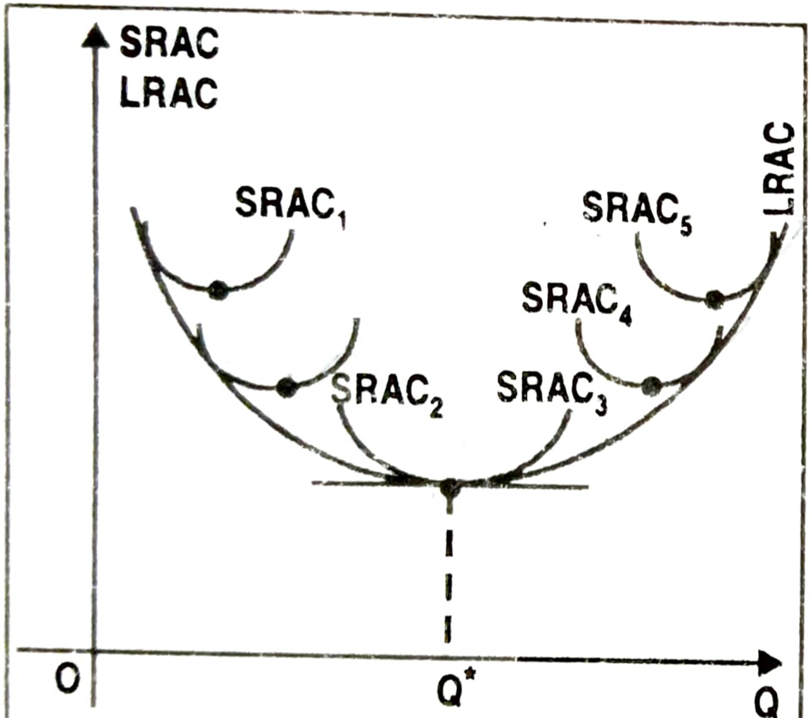


Fig. 5.18

(iii) LRAC is rising due to the Diminishing Return to scale (DRS) and the rising portion of LRAC is tangent to the rising portions of different SRAC curves.

(iv) Considering any one SRAC curve from the Fig. 5.18, we can note that at the tangential point, SRAC = LRAC. Any point other than the tangential point represents SRAC > LRAC, because the SRAC curve lies above. So, SRAC > LRAC or SRAC = LRAC. Since LRAC represents relatively lower cost of production, therefore LRAC curve is called the 'planning curve'.

(v) By the diagram, OQ represents the 'ideal' or 'optimum' output because at that level SRAC as well as LRAC both are minimum.

(vi) The shape of LRAC can represent the returns to scale as well as the utili sation of resources. We can conclude that the falling / minimum / rising portion of LRAC represents under / perfect / over-utilisation of existing resources.

❑ Exception to the Shape

For a general production function, the LRA...