- We derive the market supply curve from the individual supply curve of each firm.
- Market supply curve or industry supply curve is the horizontal summation of the supply curve of each firm.
- If the cost function of each firm is similar. Using inverse of the relation $p = MC(y_i)$, we get $y_i = f(p)$.
- It is profit maximizing output of each firm at price p.
- Suppose there are N firms. We simply multiply $y_i N = Y$, the market supply at price p.
- If the cost functions are different, the market supply Y at price p is $\sum_{i=1}^{N} y_i = Y$.

- We have a downward sloping market demand curve of this good. It is shown in figure below.
- The equilibrium price p is that price where quantity demanded is equal to quantity supplied.
- At equilibrium price, the market demand curve should intersect the market supply curve.
- This equilibrium price p is taken as given by each N firms and buyers pay this price.
- Depending on number of firms N, and fixed cost F, each firm can make super normal profit , losses and normal profit at the market price p.

We say firms are earning super normal profit at price p when $\pi_i = py_i^* - c(y_i^*) - F > 0$ where y_i^* is the profit maximizing output at price p.

Each firm is earning normal profit when $\pi_i = py_i^* - c(y_i^*) - F = 0$ where y_i^* is the profit maximizing output at price p.

Each firm is making loss when $\pi_i = py_i^* - c(y_i^*) - F < 0$ where y_i^* is the profit maximizing output at price p.

Long Run

- In the long run, the firms can freely exit the market and also freely enter the market.
- If at the market price p, the firms are making super normal profit, new firms are going to enter the market. so N increases.
- When N increase, the market supply curve shifts rightward. Because market supply curve is $Y = \sum_{i=1}^{N} y_i(p)$ at each price p.
- Since the market demand curve remains as it is. The rightward shift of market supply curve leads to fall in equilibrium price. It is shown in figure.
- The fall in equilibrium prices leads to fall in the super normal profit.
- The entry of new firms will continue as long as there are positive super normal profit.

- It may happen that when the numbers are so many that price falls by greater margin. So firms start making losses.
- In short run, if the amount of loss is less the fixed cost, the firms are going to produce positive amount of output.
- If the amount of loss is more than equal to the fixed cost, the firms are not going produce any output in the short run. It is the shut down condition.
- In the long run firms are not produce or stay in the market, if they are making loss.
- If the price is below average cost but above the average variable cost. It means firms are making losses but the amount of loss is less than fixed cost. If this price persists over a period of time. Some of the firms will leave the market.
- when some firms exit the market, N decreases.
- When some of the firms exit the market or N decreases, the market supply curve shifts leftward. Because $Y = \sum_{i=1}^{N} y_i(p)$.

- When the market supply curve shits leftward. The equilibrium price increases. If at the new equilibrium price firms are still making loss.
- Some more firms will leave the market. So N will further decrease.
- This go on till price is equal to average cost that is $p = AC$. At this price firms are making normal profit.
- In the long run, the equilibrium price p must satisfy the condition; $p = MC(y_i) = AC(y_i)$ for each firm.
- The first order condition of profit maximization gives; $p = MC(y_i)$ for each firm i.

- If this price is above average cost, the firms are making super normal profit so new entry of firms. If this price is below average cost, there is going to be exit of firms.
- So in the long run, we need additional condition that is $p = MC(y_i) = AC(y_i)$
- We know that average cost curve and marginal cost curve intersects at the minimum of the average cost curve.
- So the long run market price is given by the minimum of the average cost curve of the firms provided that the cost function of each firm is similar.
- We can also determine the number of firms going to be there in the long run.

Example: Suppose the market demand curve is $A - p = Y$, where p is the price and Y market demand. Suppose there are N firms. The cost function of each firm is similar. It is $c(y_i) = cy_i^2 + F$. Each firm maximizes profit taking price as p. It is

$\pi_i = py_i - cy_i^2 - F$, $i = 1, 2, ...N$.

$\dfrac{d\pi_i}{dy_i} = p - 2cy_i$

First order condition gives, $\dfrac{d\pi_i}{dy_i} = p - 2cy_i = 0$.

$\Rightarrow y_i = \dfrac{p}{2c}$. This the optimal or profit maximizing output of each firm i.

There are N firms and each firm is similar. So the market supply at price p is $Y = \sum_{i=1}^{N} y_i = \dfrac{Np}{2c}$.

The equilibrium market price is such that quantity demanded is equal to quantity supplied. $A - p = \dfrac{Np}{2c}$

$\Rightarrow p = \dfrac{2Ac}{N + 2c}$.

Note that equilibrium price is a function of number of firms present in the market.

In the short run, the equilibrium market price of this good is $p = \dfrac{2Ac}{N + 2c}$ when there are N firms.

The profit maximizing output of each firm is $y_i = \dfrac{p}{2c} = \dfrac{A}{N + 2c}$.

At this market price, the firms may make super normal profit, normal profit or loss.

$\pi_i = py_i - cy_i^2 - F$, substituting the optimal output and equilibrium market price we get

$\pi_i = (\dfrac{2Ac}{N + 2c})(\dfrac{A}{N + 2c}) - c(\dfrac{A}{N + 2c})^2 - F$.

$$\pi_i = \Big(\frac{A}{N+2c}\Big)^2 c - F.$$

At $p = \dfrac{2Ac}{N+2c}$, average cost

$$AC = cy_i + \frac{f}{y_i} = c\Big(\frac{A}{N+2c}\Big) + \frac{F(N+2c)}{A}.$$

The firms make super normal profit, if $p > AC$ at $p = \dfrac{2Ac}{N+2c}$.

It means $p > AC = c\Big(\dfrac{A}{N+2c}\Big) + \dfrac{F(N+2c)}{A}$. This implies that

$\Big(\dfrac{A}{N+2c}\Big)^2 c > F.$

The firms are going to make normal profit, if $\Big(\dfrac{A}{N+2c}\Big)^2 c = F$

The firms are going to make loss, if $\Big(\dfrac{A}{N+2c}\Big)^2 c < F.$

Long run outcome. In the long run, the entry and exit of firms are possible.

So, at the equilibrium price we have $p = MC = AC$. It is the minimum point of the average cost curve.

The minimum point of average cost is

$$\frac{dAC}{dy_i} = c - \frac{F}{y_i^2} = 0.$$

$$y_i = \left(\frac{F}{c}\right)^{\frac{1}{2}}.$$

So AC is $2\left(cF\right)^{\frac{1}{2}}$. So the equilibrium price in the long run is

$$p = AC = MC. \text{ So } p = 2\left(cF\right)^{\frac{1}{2}}.$$

The market demand is $A - 2\left(cF\right)^{\frac{1}{2}} = Y$ at the long run equilibrium. It is equal to market supply. The output of each firm is $y_i = \left(\dfrac{F}{c}\right)^{\frac{1}{2}}$.

So, $N = \dfrac{A - 2\left(cF\right)^{\frac{1}{2}}}{\left(\dfrac{F}{c}\right)^{\frac{1}{2}}}$.

This is the number of firms going to be there in the market in the long run.

They are going to earn normal profit.