Introduction to Market Structure
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Module 3: Perfectly Competitive Markets
Lecture 10
Derivation of Market price in Competitive market

Hello, welcome to my course Introduction to Market Structures. So, let us first do a little bit of recap. We have started Perfectly Competitive Market and the main assumption of Perfectly Competitive Markets are that the price, each firm takes the market price as given and they decide only on the amount of output they are going to produce and there is complete information and firms, there are many firms.

And also another a is that, there, it is not an assumption but is an outcome that we have got from the profit maximizing property, from the property the profit maximizing outcome that there should be decreasing returns to scale.

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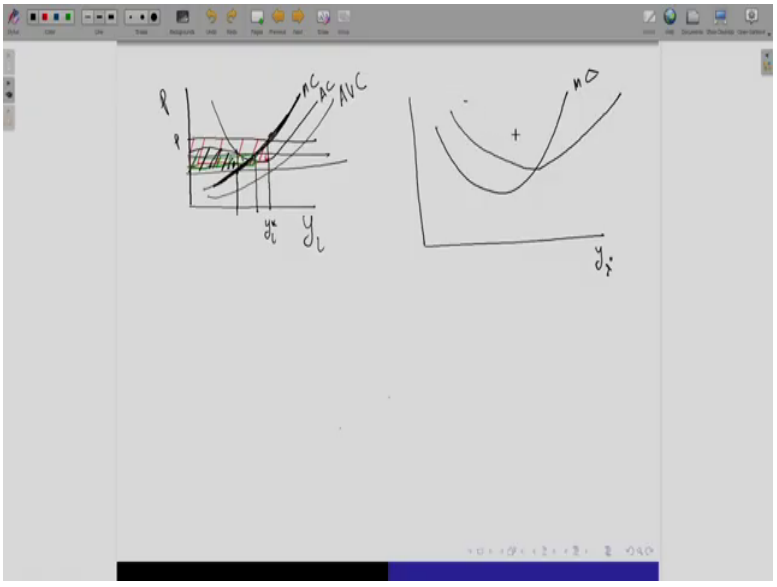

So here and suppose the output of firm i is given in this axis, price is given in this axis, we know that the, suppose this is the market price and the marginal cost is of this nature, MC and if marginal cost is like this we know average cost, average variable cost is going to be of this nature and the average cost is this. Now here, from the last class we have got this is going to be the optimal amount of output produced by a firm I, okay.

Now here, suppose instead of this price, price is this then the optimal output is this, if the price is this, then the optimal output is this. Now, here you see when the price is this, profit made by the firm is this rectangle, right? when price is this, marginal optimal output is this, average cost is here, so this green box is the profit, right? When price is this optimal output is this much and at this output average cost is this, so this box is the loss, right?

So, we get what, this curve, actually the optimal output is always in this curve and this is the marginal cost curve and this is also the supply curve of a firm, okay. This we have done in the last class. Now, so we get a supply curve is the marginal cost curve of the firm, but is it the whole marginal cost or some portion of the marginal cost?

From the shutdown condition that we have done in the last class, we get that the marginal cost curve which lies above the average variable cost is only the supply curve. Suppose the marginal cost curve is of this nature, then the average variable cost is of this nature and suppose the average, okay, let me draw again.

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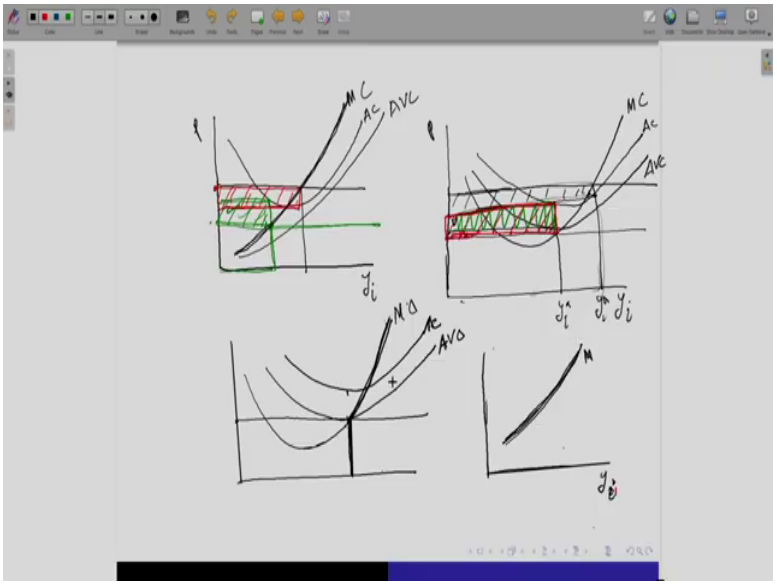

Profit is this when the price is at this level and suppose the price is this, market demand curve is this for the firm, then the optimal output is this, so cost is here, this green a is the loss because this average cost, average cost heist into the output total cost, price is this much, so price into total quantity, height is given, so total revenue, so this box is the loss. Here this box, this red box is the profit.

So, in this case we get that if the marginal cost is of this nature always increasing, then the whole marginal cost curve is the supply curve of each firm. Now, let us take another example. When, so this is suppose a and this is the price, this is again the output, this is the price. Suppose the marginal cost curve is of this nature and the average variable cost is of this nature and average cost is of this nature.

Suppose the price is here, so from the optimality condition we know this is the optimal amount of output at this price, so average cost is here, this rectangle is giving me the total cost, this rectangle and this rectangle is giving me the total revenue, so the profit is this box, right? Now, suppose price is here, then we know price is always equal to marginal cost, this is the optimal amount of output of firm, average cost is this at this output.

So, this box is the loss, right? average variable cost is here at this output. It is this, so this green box which is the green rectangle is the difference between average variable cost into output and the average fixed, average cost into output, so this box is the fixed cost green box and the loss is given by this red, whole red box. So, here loss is more than the, than the total fixed cost. So, the shutdown condition is violated.

So, the firms are not going to produce at this output. So, if we follow this argument, then we get, suppose the marginal cost is of this nature, this is average variable cost, this is average cost and price should always be above this level because this is the minimum of the average variable cost, this. If price lies below this, then firms are not going to produce because shutdown condition is violated.

So, if the price is above this then the firms are going to produce even if they are going to make loss. So, this portion is the supply curve of this type of marginal cost, so we get that the supply curve of each firm is this upward sloping portion of a marginal cost curve but not whole of the upward sloping portion of the marginal cost curve because in this case this portion is also upper sloping but this is not part of the supply curve, okay. So, it is always above the minimum of average variable cost, okay, if this is the output so supply curve of a firm is this.

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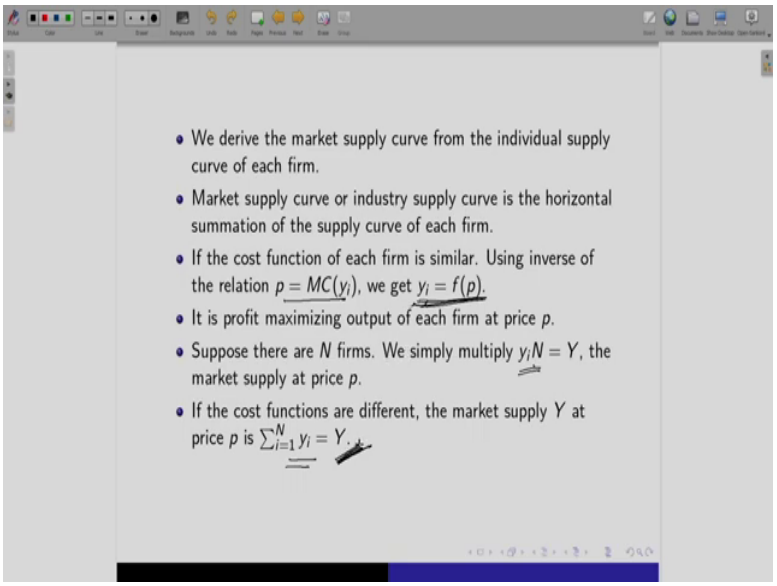

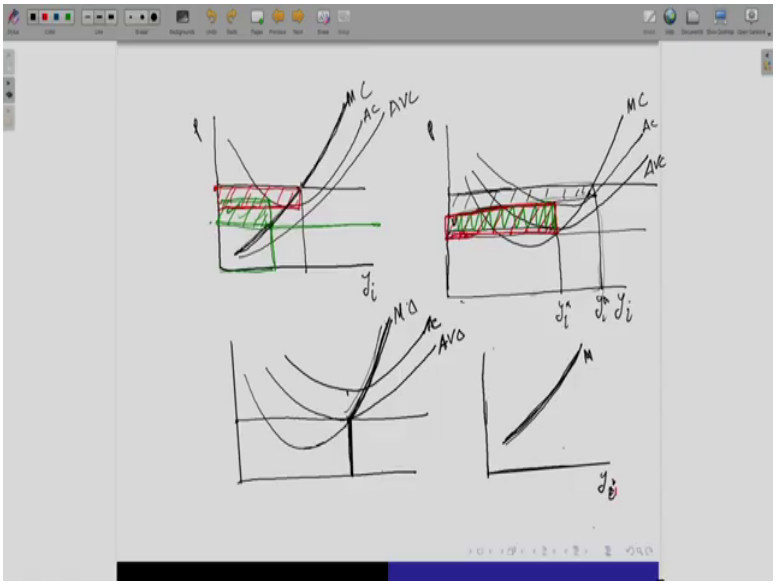

Now today what do we do, we start or derive the market supply curve. How do we get the market supply curve? So, remember in deriving a market demand curve what we have done, from individual demand curve we have done a horizontal summation and that horizontal summation has given us the market demand curve.

It is like at each price what each individual is demanding and if we sum this, the demand of each individual, we get the market demand. Similarly, here at each price how much each firm is supplying, so each firm from this condition- $p = MC\left(y_i\right)$ we can get like this- $y_i = f(p)$ which is if we take the inverse of this- $p = MC\left(y_i\right)$, okay. Since this marginal cost curve is

always increasing in this portion, is always increasing like this or here like this, so we can always have the inverse and from that inverse we will get this- $y_i = f(p)$, okay.

Now, what we do, so this we get for each price if this marginal cost is above the minimum of the average variable cost. Now, so what we do? We sum this, so we get a like this - $\Sigma_{i=1}^{N} y_i = Y$and this gives me the capital y is the market supply at the price p. If suppose this firms are similar, then this y is going to be same if the cost function are same. So, we simply do yi into n the market output- $y_i N = Y$, N is the total number of firms present in the market and this is common knowledge, okay, everyone knows about this, all the firms. So, we get this is the market.

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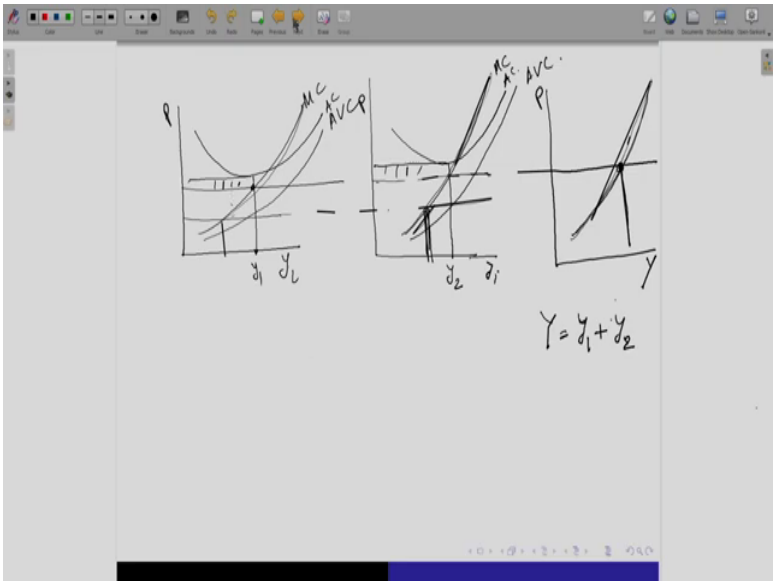

So, here what do we do? How do we get this? This is suppose, there are only two firms suppose, marginal cost is something like this, average variable cost is something like this, average cost is something like this and suppose this is the market price, okay. So, this is the loss they are making, but this is the output they are going to sell.

Similarly, we have another firm, this is MC, this is the AVC and suppose this is the AC of that firm and it produces this much amount of output, suppose y2 and it is also making a loss of this amount, it is also making a loss of this much amount and this is price, price and this… so the market supply at this price and this is capital y is equal to $y_1 + y_2$.

So at this price it will be sum of suppose this much amount of output, here this amount of output, this is what, this is y1 plus y2. So for each price we will get this much, this much, so it will be sum of this curve plus this curve, so this curve plus this curve, so the supply curve is going to be of something like this, this is the market supply curve, okay.

Now, when we, so we will get the supply curve of this and if there are suppose three firms then we will take this and horizontal summation of this three marginal cost, if there are n firms so it will be or in this way horizontal summation of the marginal cost curve of n firms and we will get a curve like this if the marginal cost are curves are of this nature.

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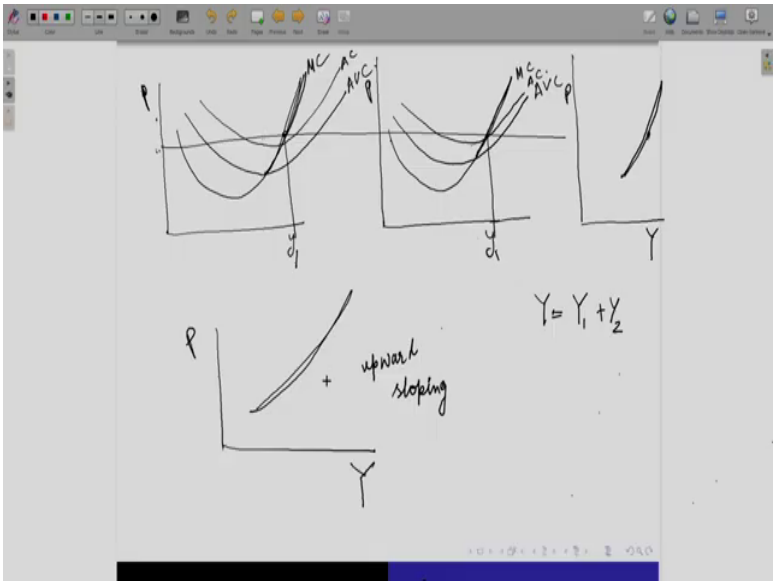

Next, suppose this is output of firm one, suppose marginal cost curve is of this nature and I hope you remember that this point is the minimum of AVC and again this point is the minimum of AC, okay. Here you just take, I have, this diagram is not that correct because this curve should have gone pass through the minimum of these two curves but remember this when you draw and suppose the market price is this, right?

So optimal output for this firm is here, optimal output is here and here this is the y2, this is the capital output, capital Y is, okay. so this is given by this point where this is sum of this output and this output, okay. Now here remember this is, supply curve is only this portion and the supply curve here is this portion, so the market supply is going to be sum of these two curve at each price is here, okay, so it is going to be a curve like this, okay, not the whole of the marginal cost.

So from this what do we get that the market supply curve, this price here is always going to be upward sloping, okay, that means as the price increases quantity supplied is always going to go up. Now we have to derive the market equilibrium price that this price, which each price, each firm takes as given we have to determine that. How do we do that?

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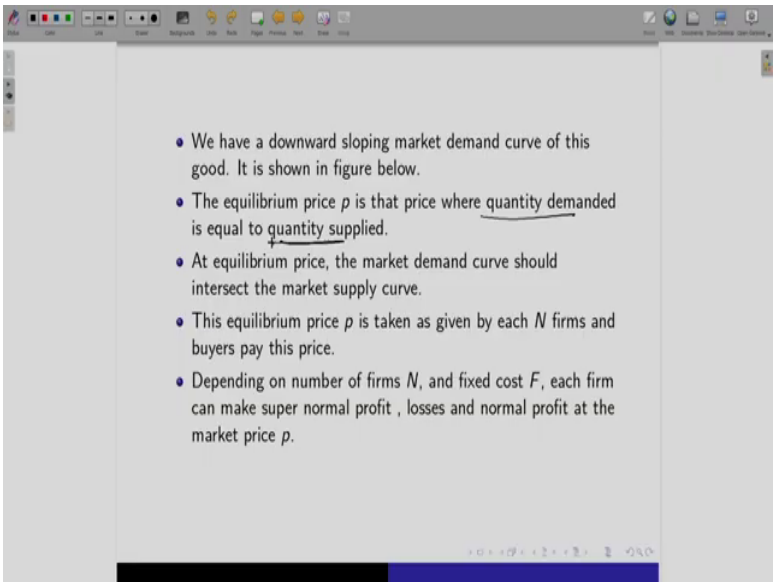

So, we know that the market demand curve is a downward sloping demand curve; we have assumed that at the very beginning. Now, we also have derived the market supply curve for a given number of firm and that is suppose n, so in that case it will be the horizontal summation of the marginal cost curve of each firm and that portion of marginal cost curve which lies above the average variable cost, minimum of the average variable cost, okay.

Now, market price equilibrium price is determined where quantity demanded is equal to quantity supply, this, this is the most important condition, it is that price at which market is cleared you can say, whatever quantity is being demanded that amount is being supplied, okay and that price is taken as given by each firm, okay so we will derive that.

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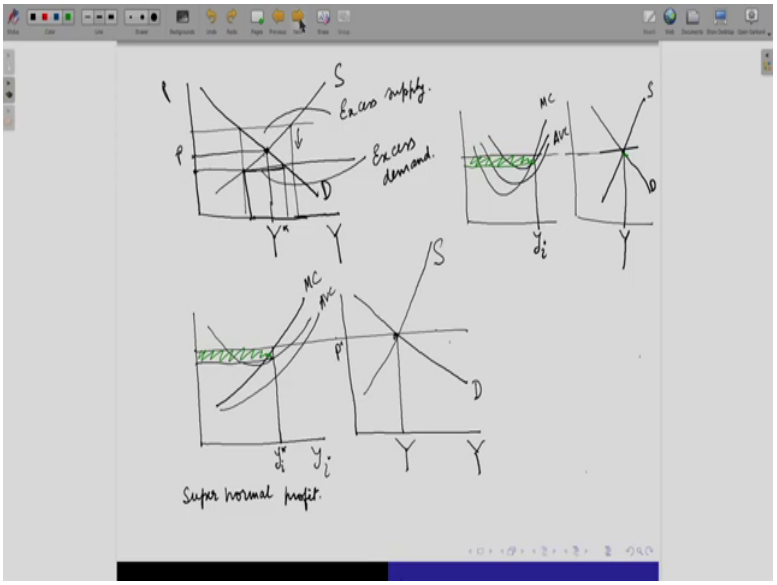

See we have the demand curve like this which is the D, price here, quantity y, market demand. Market supply is this which is the horizontal summation of the marginal cost curve. You can write this as, okay, it is going to create unnecessary confusion, simply take it like that, at this price what is happening at this price, quantity demanded is this, quantity supplied is this it is equal, but if we take this price what is going to happen?

At this price quantity demanded is this much, quantity supplied is this much, so quantity supplied is more than quantity demanded, so what is going to happen, there is going to be excess supply in the market and so price will fall and it will move here, so it will move like this and it will come down to this. If the price is here, at this price quantity demanded is this much and quantity supplied is this much.

So, there is excess demand which is this much, right? and this is the excess supply, whenever there is excess supply the price will fall and whenever there is excess demand price is going to rise and this whole thing is going to happen instantaneously, instantly. So, there are firms which are going to, which will get a signal that this is the market price, okay.

And if at that market price there is going to be excess supply, then price is going to immediately fall and it will come to this price and if at that signal the price is this, is the signal and there is excess demand, price is going to rise and it is going to rise to this point. So, this whole adjustment takes place instantaneously.

And this is an assumption and this is a very big assumption in this or you can say it is a very strong assumption which you made in the Perfectly Competitive Market that the price

adjustment takes place instantaneously , okay and as this price adjustment takes place, so firm always take the equilibrium price as the given price, because if there is excess supply then the price is going to go down and immediately there is going to be equilibrium.

And if the price is such that it is low and there is excess, demand price is going to rise and equilibrium price will be attained. Now here, this whole story we can explain it in this way, okay. see, so I hope you have understood this. So, this is suppose, take any firm and firms are, any firm i and all the firms are identical suppose, this is the market, and this is the market demand curve, okay. Suppose the marginal cost curve is of this nature, okay.

Average variable cost is of this nature, average cost is of this nature and market price is suppose this. What does this mean? That the supply curve is like this and this is the market and this is the price which is prevailing at the market at that time, and each firm is making this much amount of, producing this much amount of output, right. Here this is the average cost at this output, so firms are making this much amount of profit.

This profit is positive amount and this situation is called firms are making something called super normal profit, okay. At this equilibrium price which has, which we have attained by where market demand is equal to market supply, amount demanded is equal to amount supplied in the market, okay this or in case suppose our market are of this nature.

Suppose the marginal cost curve is this, average variable cost is this, average cost is this and suppose the market price is this, then suppose this is the market supply and this is the market demand and this is the market output, this is the output of each firm. And here in this case they are making a super normal profit of this much amount, right. So, in this situation we say that the firms are making super normal profit because the profit is more than the, means it is positive amount okay and this price is determined in this way in the market.

Now, there may be a situation that the price is such that the firms are making only normal profit. When do we have normal profit when the profit is equal to 0, that is total revenue is equal to total cost and that situation is something like this.

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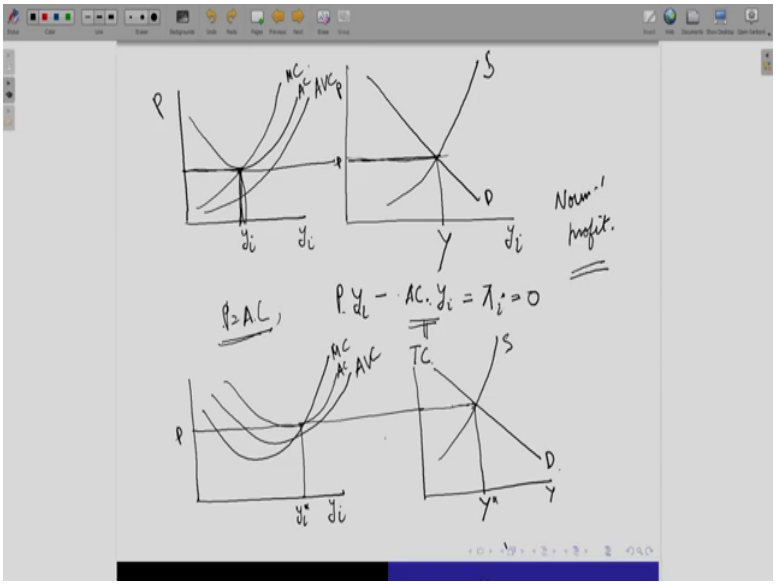

Marginal cost is of this nature, average variable cost is of this nature, average cost is this and suppose here at this price if this is the quantity and this is the price, this is the price and this is market demand is suppose this, this is suppose the market supply and this is the market equilibrium output and this is the output, optimal output of each firm, here if this is the equilibrium price suppose then what is happening.

At this price average cost is this, price is also this, so price is equal to average cost, so you can, is the profit, right? average cost into the output, this is equal to what, total cost, this is total revenue, so this is equal to 0 because when price is equal to average cost we get this, so this is situation is called the firms are earning, what is called normal profit- $P.y_i - AC.y_i = \pi_i = 0$. So, normal profit here it means that the remuneration that the entrepreneurs or the owner gets is already part of the cost, okay, otherwise why entrepreneur is going to produce.

Now, in case marginal cost curve is of this nature and the average variable cost is this, average cost is suppose this, this is the optimal amount of output and suppose this is the market price which we have got and this is the market demand, market supply, this is the market output, right? so this price has been attained in the market where quantity demanded is equal to quantity supplied and this price is taken as given by each firm.

And the optimal output produces this, at this optimal output price is equal to average cost, so firms are earning zero profit and this is a situation where we call the firms are making normal profit, okay.

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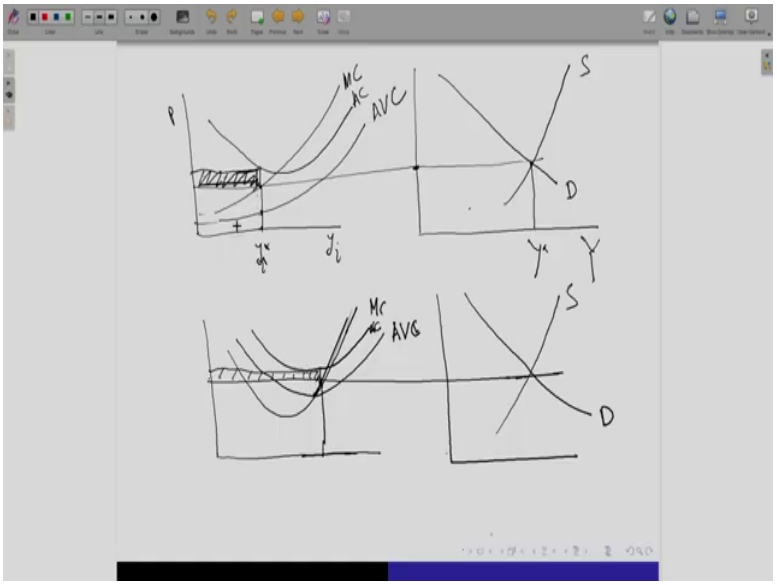

Next we will look at a situation where firms are making losses. Suppose, this is the output of firm i, this is the price, marginal cost is of this nature, average variable cost is of this and average cost is this and suppose market price is this, this is the market demand and this is the market supply. So, market price is determined at this level, and here each firm is producing because at this price, marginal cost, price is equal to marginal cost is at this point.

So optimal output of each firm is this so average cost is this much, so this triangle, this rectangle is the loss they are making and in the short run we know, since this loss is less than the fixed cost this amount, because fixed cost here is this whole big drag rectangle, because it is average variable cost is this much, so this quantity into average variable...

This rectangle is going to give you the variable cost and this quantity into this height is going to give you the total cost, so minus, total cost minus total variable cost gives you the fixed cost so which is this rectangle and this small rectangle is the loss they are making, so the loss is less than the fixed cost, so firms are going to produce some positive amount of output because only when price is below the average variable cost and that is the minimum of the average variable cost firms are not going to produce in the short run.

Now, let us take the case where the marginal cost is u-shaped, it is something like this, this is the marginal, okay and this is average variable cost, okay. This is suppose average cost and market price is somewhere here, which, here this is the supply curve, right? So suppose this is the market supply curve which we get as the sum of the horizontal summation of the marginal cost curve, here this is the optimal output produced by each firm.

And the loss they are making this is them, is this much amount, this loss is again less than the fixed cost, so firms are going to produce, so here firms are making losses. Why we have discussed this? Because now we will move to long run and in long run there is free entry and exit of firms and once there is free entry and exit of firms, then we will see how this super normal profit, normal profit and losses, how they are going to change, okay.

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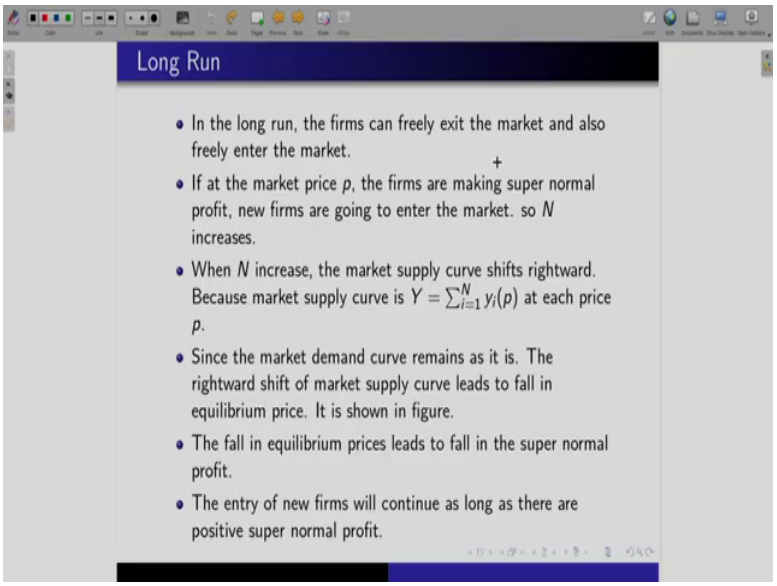

Now, let us do the long run situation. In the long run what happened, firms can freely exit the market or firms can freely enter the market. What freely, why freely is important? Because here firms do not have to make any expenditure or have to bear any cost for entering the market or for leaving the market. Now suppose firms are making some super normal profit at any price today and what happens…

So they are making super normal profit, so other firms which are want to enter this market they will observe this and they will see okay these firms are earning super normal profit that is some positive amount of profit, so they are going to enter and as the firms enter what is

going to happen, so there is at that price there is going to be, because they will enter and they will take that price as given and what will happen, there will be more entry of firms.

So, the total output is going to go up, so this means what, that the supply curve is going to shift, the moment supply curve shift what happens, the price is going to go down and as the price goes down the profit, super normal profit also goes down and this process will continue, as long as there are some super amount of super normal profit that the firms can earn there is always going to be an entry of firm.

So, firms are going to keep on entering as long as there are some positive amount of super normal profit. Once, as these firms are going to enter and there is not always, this does not take place in a very coordinated way, so what may happen that some of the firm, then some of the firms which should not have entered they have also entered, so what will happen that the firms may, price has gone down so much that the price, firms start making some losses.

In the short run we have seen that if that loss is not more than the fixed cost then the firms are going to produce, so since they are going to produce so they are going to stay in the market in the short run, but in the long run, so if they stay and since they are making loss, so no new entry, so what, it is going to happen, so they are going to make the same losses continuously.

So, since they are going to make losses continuously in each period what will happen? Some firms are going to leave this market and moment some firms going to leave this market so what is happening, at that price the quantity supplied in the market is going to be less, so supply curve is going to shift upward or you can say is going to shift leftward.

The moment supply curve shift leftward the market price is going to go up and as it goes up firms will start making some positive profit or they are going to earn some super normal profit and as there are super normal profits some more firms are going to enter and this process will go on, entry and exit as long as there are some super normal profit and there are some losses.

And so this will come to an halt when price is always equal to the average cost and it is equal to the marginal cost. So, this is the additional condition that we get in the long run because of free entry and exit of market, of firms and what is this additional condition, and this

additional condition is that that the price should be equal to the average cost and the average and it should be equal to the marginal cost, okay.

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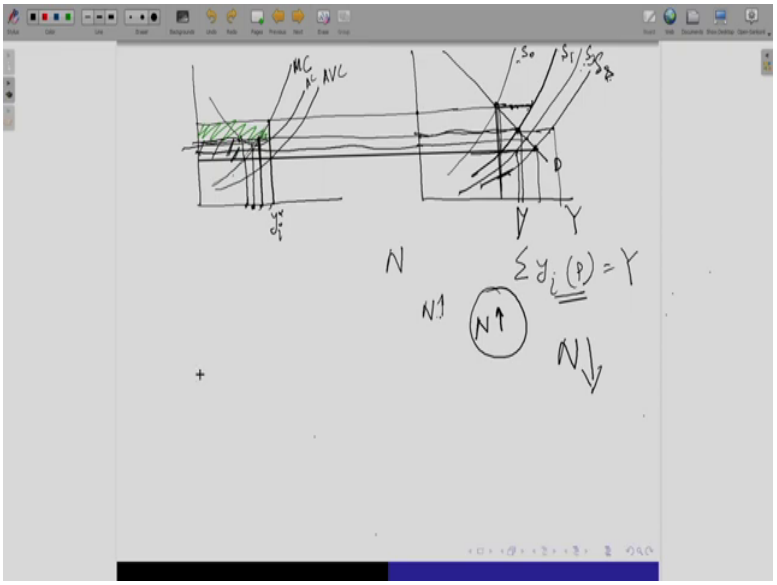

So, we will now describe this through diagram. Suppose this is the marginal cost, this is the average variable cost and this is the average cost, okay and suppose the market price is this, so in this case this is the whole of this is, so supply curve is something like this, so this supply curve is what, this is simply sum of yi at each price, right. So, each firm is making this much amount of output. So, they are making a this much amount of super normal profit.

So firms are going to observe this, new firms, so there is going to be an entry of this firm, moment there is entry of this firm so this summation was initially, suppose there are only n firm, now what is going to happen? This n firm now increases, so this sum is going to go up, so at this price we will have more output, so this new supply curve is something like this, okay. So, this is suppose initially S naught and this is S1 okay.

So at this price as there are more firm has entered what is going to happen, there is quantity demanded is this, but quantity supplied is this, so there is excess supply. Now we know this cannot be sustained because there is excess supply, so price is going to fall and what is going to be the new equilibrium, when this is the supply curve and this is the demand curve new equilibrium is this, at this price, this price the quantity demanded is equal to quantity supply.

So at this price there is going to be entry of firms, moment they enter the equilibrium price is going to change from this price to this price, this and if this is the price, what is going to

happen, each firm if they are similar then their output is going to go down, from this they are now producing this, but since the total number of firms are now more so the aggregate output is more this compared to this level okay.

So, but still if you look at this curve you see that the margin, this a is above the average variable cost, so firms are making some still some positive profit or that is the super normal profit so there is going to be further entry of firm and as there are further entry of firms, suppose the supply curve shifts like this, so some more firms have entered, so at this price market supply is this much amount, so there is excess supply.

So, the price is going to down because there is excess supply and the equilibrium price is going to be this much and at this equilibrium price if this price is taken as given, firms our optimal output is this which is again gone down, but now there are more firms, it has gone up because N has gone up further, right? so this, when we have shift this, it means that the N, N has gone up further and as N has gone further so this supply curve has shift rightward again.

So, the price has further fallen and so each firm is producing this much, which is less than earlier, initially it was this much, more entry of more firms, this much further entry of firms this much, now here at this price average cost is this, so it is average cost is more than the market price, so the firms are making losses. So, if the same number of firms stays in the market, at least in the short run they are going to stay then each firm is going to make some losses, so of this amount, this rectangle amount.

So, it means that in the long run over time some of these firms are going to leave, so as these firms are going to leave then what is happening? This n is again now going down, as this n goes down, so what is happening from this supply curve, supply curve will shift upward, that is leftward, at and each price now it is supplying less, because each firm is producing less and number of firms has also gone down because N has fallen because as all the firms are making losses, some of them have decided to leave the market.

And so supply curve shifts like this and suppose this is S3. So, this was S naught, this is S1, then S2 and this again S3. So, here what is happening? At this price it is this, the market supply, demand is this much, so there is an excess demand in the market and so the supply is, price is going to go up at this, so market price is going to be this much, at this price is this, so

margin, firms are going to produce this much, it has increased from this to this. But it is still below the average cost, so it is making some amount of losses.

So, in that period some firms are going to produce this much amount of output, but over time some of them will leave, so this N is going to go down, so what will happen, this supply curve is going to shift right and leftward further and so the equilibrium price will again rise and then finally it will be such that it will be at this level, where price is equal to the marginal cost and it is equal to average cost, okay. So, this is the whole mechanism of price, how the price adjustments are going to take place in the long run, okay. Thank you, we will continue in the next class.