Microeconomics: Theory & Applications
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Lecture – 34
Short –run Cost Curves

Hello, welcome back to the lecture series on Microeconomics.

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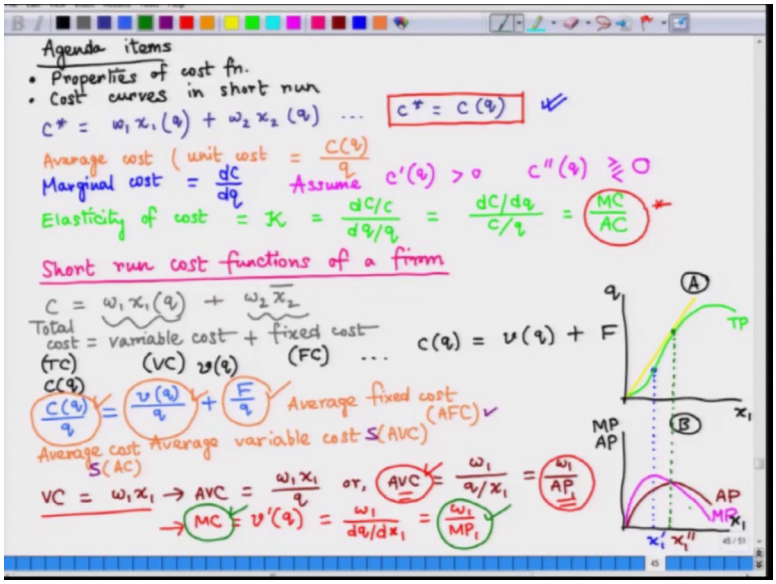

So now, we can summarize these findings through a diagram, but before that let us also do little bit of mathematics to be sure about one simple thing. So, in the case of the neoclassical production function three stages we have seen that the marginal product curve passes through the maximum point of the average product curve. So, if this inverse relationship between marginal cost and marginal product and the average product and average variable cost exists then they the marginal cost curve should also pass through, the minimum point of the average variable cost.

So, let us see whether mathematically we can prove that point on it. Then we can be very sure about the shapes of the average variable cost and the marginal cost curves.

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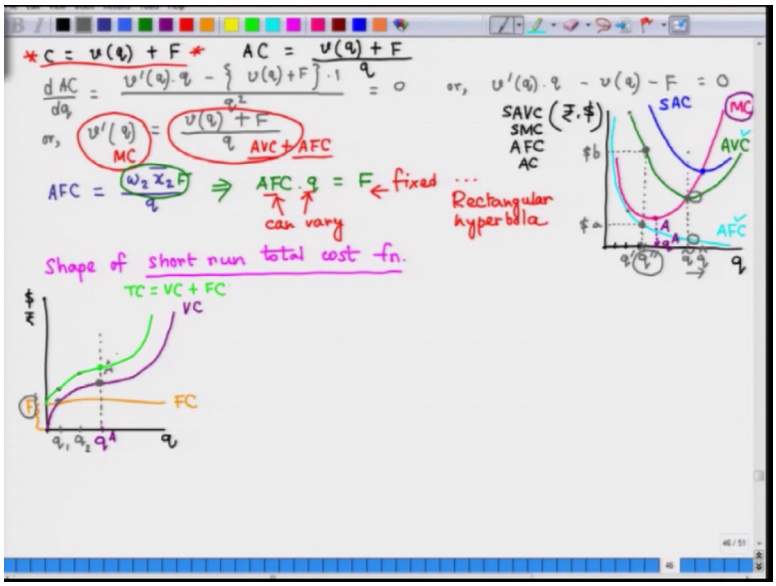

So, we will start with the cost expression v of q plus F right ok. And, then if we want to compute the average cost then we know we need to basically divide this cost expression by the quantity of output. And then basically we need to take the derivative of this expression and set that equal to 2 zero find its minimum right. So, let us do that. So then if, that shall be equal to 0 right.

So, we can write or we can write: so what does that mean? So, what is this element? So, this is basically my marginal cost ok. Now let us look at this element, what does that mean? So, that is the first component which is v q divided by q that is basically my average variable cost and F over q would be my average fixed cost right. So, marginal cost basically passes through both the minimum points of both the average variable cost and the average cost curves right. So, that is a result that we can show mathematically as well.

So, now, let us have a diagram. So, now, we are going to measure my cost curves for short run. So, q is the output level and that we measure along the horizontal axis, and then we have these cost measures or cost then you know we can you know basically represent them along the vertical axis they can be measured in different monetary units b to p be dollar whatever; so these are basically costs right ok, not total cost. So, let it be very particular. So, we are going to basically measure average variable cost and then marginal cost both in short run; so SAVC and SMC right ok; now we are ready.

So now, let us basically plot these curves. So, now, we know that due to this law of variable proportions or three stages of neoclassical production function the marginal cost curve first will fall and then it will rise. So, basically it will heat a minimum point there will be a point of inflection right and this is basically my marginal cost curve suppose right ok. So, what we have seen? We have in nutshell that there is a inverse relationship between the average product and the average variable cost and similar inverse relationship exists between the marginal cost and the marginal product. Now we know that by virtue of three stages of new classical production function or law of variable proportions, marginal product first increases then it falls same is true for the average product curve as well.

So, actually the marginal product curve passes through the maximum point of average product curve and as this inverse relationship exists and we have also shown through calculus that the marginal cost curve shall pass through the minimum point of the average variable cost curve. So now, we are going to draw a u shaped short run average variable cost curve whose minimum point shall lie on the marginal cost curve.

So now, I am going to draw. So, this is basically my average variable cost curve and this is the point, this is the minimum point of average variable cost curve through which my marginal cost curve passes ok. So, two graphs have already been drawn. Now there is a graph which is missing and that is the third and last one which is average fixed cost right. So, from here let us see how we can derive the shape of the average fixed cost curve. So, what is my average fixed cost curve? Average fixed cost can be represented as my fixed cost which is basically F or you can also represent that as w times x bar 2 divided by the output level right. So, note that this is basically my F my fixed cost right which is not going to change. So, I can rewrite AFC times q equal to F right.

Now, note that F is fixed and these two can vary right. So, I hope that you can recognize that the average fixed cost curve takes the shape of a rectangular hyperbola, because the multiplication of these two variables AFC and q always gives the same fixed constant number right. So, if that is the case let me now draw the average fixed cost here in the same diagram.

So now, I am also measuring my AFC average fixed cost in the same diagram. So, now, let me plot that. So, as it is a rectangular hyperbola this AFC this is asymptotic to the

axis, it will never touch any of the axis, but the distance between the axis and the curve will gradually diminish. So now, we have got AFC, we have also obtained AVC some of these two gives us AC which is basically the short run average cost.

So now, how can we draw this in the same diagram? So, basically if we add; suppose we take a particular level of quantity another quantity level another quantity level so for each quantity level if we move up then we see points along the average fixed cost curve and the average variable cost curve somewhere here right. Let me extend this arm of the average variable cost curve for a purpose ok.

So now, suppose we have a particular level of output say q dash. So, for that output level the average fixed cost we can get from the average fixed cost curve, so right here right these points say. Similarly if we move up we can get a point on the average variable cost curve which will give the average variable cost of production for this level of output. Similarly we can take another output level say q double prime, and then we go to the average fixed cost to note the average fixed cost of production for that output level, and if we go up we see another point on the average variable cost curve which gives the average variable cost of production for that output level.

So, if suppose now I name them, so suppose I name this point; so these suppose gives some cost level a and suppose this point gives some cost level b right. And both of them are basically for the same output level. So, I can also join, I can draw a perpendicular line which shall meet my q double prime point along the output axis here right. So, to produce q double prime level of output a dollars shall be spent as the average fixed cost and b dollars shall be spent as the average variable cost right. So, if we add these two up then basically we get the average cost of production. So, basically how to draw the average cost curve. In this case, so basically we need to fix an output level and then we need to move up to find the point on the average fixed cost and the average variable cost curves. Note down the monetary expenses and if we add them up we get the average cost of production.

So, basically the average cost of production is the vertical sum of the average fixed cost and the average variable cost curves. So, as average fixed cost is ever diminishing, but the average variable cost curve first falls and then after a point of inflection it rises. So, we can expect that average cost of production to first fall and then it has to start rising

again after some point of inflection. But note that that point of inflection of the average variable cost curve is not going to be the same point of inflection for average cost curve. Let us look at this through the diagram.

So, let us now take the point on the average variable cost curve at which it is minimum. So, this is an output level say q tilde ok. Now, suppose that the firm wants to produce another output level say q hat right. So, from here I want to move there little increase. So now, note that as this is happening there will be a very small increase along the average variable cost say this, but the average fixed cost curve as it is falling here in this part. So, this will now compensate for that rise in the average variable cost curve.

And if the average variable cost curve has slow rise or the increment in average variable cost is low compared to the fall in the reduction in average fixed cost and generally it is the case then basically for small change in output we observe small change in the average cost curve and which is basically still falling. So, basically the fall in average cost curve is dominated by the average fixed cost curve. So, if that is the case the point of inflection will lie not on the top of the inflection point of the average variable cost curve somewhere here, but it shall be to the right of this point of inflection point for the average variable cost curve.

So, let me draw this. Although I must admit that my drawing may not reciprocate what I said that you know the average cost curve is basically the vertical sum of the average fixed cost and the average variable cost curve because these are hand drawn graphs. So, please admit that problem. But, so with that caveat I can draw an average cost curve like this. So, this is basically my short run average cost curve. So, I am just adding one more variable that I am measuring along the vertical axis and that is basically my average cost of production.

So, from the diagram we can see one interesting thing as my average cost curve is ever falling and after that point of inflection average variable cost curve becomes very steep and it increases at an increasing rate then basically my average cost; so in that case in the average cost expression the contribution of the average variable cost curve becomes more and more prominent and average the contribution of the average fixed cost curve becomes less and less important as the firm produces more and more output. Hence, as a

result the difference between the average variable cost curve and the average cost curve diminishes as the firm produces more and more output.

So now, here we are ready to take a look at the shape of the short run total cost function. Remember that we have started with the short run cost function and then we have broken down this cost function to two components the fixed cost and the variable cost. And finally, we have drawn the curves for each component now it is time to look at the graph for the total cost function which is the mother function. So, that can be also derived from the intuition that we have gained so far.

So, let me again remind you at the functional form with which we started, so this is our total cost function right here: f is the fixed cost and v of q is the variable cost. So now, let us see if we draw a diagram how my total cost function is going to look like. So, I am going to measure output level along the horizontal axis and my cost numbers are monetary numbers. So, again they can be expressed in dollar terms or rupee terms whatever ok. And now, let me first draw the diagram for the fixed cost because this is the simplest possible case right. So, of course, fixed cost is constant and that is independent of the quantity being produced. So of course, this is going to be a constant number, so that can be represented as a line and that straight line has positive intercept of F and it is parallel to the quantity of output axis. So, this is basically my fixed cost curve right ok.

So now, let me draw the total variable cost curve. So, if I then add them up vertically we will get the total cost curve. So, how my total variable cost curve is going to look like that is the question. And the answer lies with the marginal cost curve right. So, let us have a look at the shape of the marginal cost curve here.

So, what do you observe in our diagram. So, marginal cost curve first falls then it reaches a minimum right here and then it starts to rise at an increasing rate ok. So, what does that mean? So, suppose we talk about this point of inflection here and we denote these by some point a and that has some output level of course, associated with that point. So, let me note that point and let me call that point say q A ok. So, output level associated with the inflection point of the marginal cost curve is denoted by q A fine.

So now, let me have that q A plotted here as well; so q A fine. So now, note that the points left to q A; there we observe the marginal cost curve is falling. So, marginal cost curve falling means that that the firm is producing extra units of output its total cost

increases, but increases at a decreasing rate. So, that is what basically a falling marginal cost means. So, if that is the case then of course, I can say that my variable cost curve in that case we will start from 0, because if you produce 0 units of output of course, my variable cost is 0. So, it will start from 0 and then it begins to rise, but it rises at increases at a decreasing rate because of this falling part of the MC we will dictate that shape.

So now, let me mark that output level here ok. So, there will be a point of inflection here. And note what is happening to the right of point A. So, here if the firm decides to produce more and more output here the cost of production increases at an increasing rate; as we have an upward sloping segment of the marginal cost curve. So, from this point of inflection, so I can call this and A as well. So, the points to the right of point A; that means that the firm produces more and more output level they are the cost the variable cost increases at an increasing rate.

So, here we get a convex shaped variable cost function to the points of. So, before when the output level was less than q A level we have observed a concave shape variable cost now we get a convex origin variable cost function. So now, we have obtained variable cost and fixed cost now we know what to do. So, basically what we can do to get the total cost we can vertical sum them. So, basically let us take different output levels say this output level q 1 that output level q 2 and so on so forth. So, if we now take these output levels one by one we have to basically go up to the variable cost curve to see what is the monetary expense to produce that level of output and then with that we have to add this fixed cost amount. So, we are talking about a vertical sum. And if we do so then we get points like this here.

Similarly we can now move to the quantity level 2 we go up and then we meet a point on the word the variable cost curve. And then if we add a constant if the fixed cost of production to it we get another point say somewhere here right. So, this is also another point on the total cost function.

So now, if we sum them up; if we join them then we get a curve like this. That is also first concave to origin due to the shape of the variable cost function. And then soon after the point of inflection right here, we see that the curve has changed its curvature and now it has become convex to origin and then this is basically my the final shape of total cost function which is basically nothing but the sum of the variable cost and the fixed cost.

So, we are going to continue with this discussion on cost curves in the next lecture.