Module 9
Industrial organisation and Conservation
Lecture 1
The costs of production

Namaste! Today we begin a new module which is Industrial Organisation and Conservation. This module will have 3 lectures: The Cost of Production, competition and monopoly. So, let us begin with the cost of production. Now, in economics we say that people do rational decision making which means that people take into account all sorts of information that they can have access to and process that information to maximize their benefits, that brings us to the topic of cost benefit analysis.

Rational decision making is based on cost benefit analysis which means a study that compares the cost and benefit of providing a good or service. So, essentially what it says is that, everybody tries to maximize the benefits that they have while reducing the cost as far as possible. If you have maximum benefits at the lowest cost, then that is the most relational decision that can be taken.

This is the cost benefit analysis, a study that compares the cost and benefits of providing a good or a service, but herein lies a problem. When we say that the benefits need to be maximized and the costs need to be reduced as far as possible in a number of cases this reduction in cost may also have severe environmental considerations.

And we have observed a number of environmental disasters that have occurred because of cost cutting. Common example is the Bhopal gas tragedy. We shall explore the Bhopal gas tragedy in more detail in a later module but in short what was happening was that the union carbide plant was working at only 20 percent of its capacity because the insecticide that it was manufactured called 7 it was not selling at that fast phase.

And so, the plant management decided to go for fast cutting because they were having a huge stockpile of insecticide that they were accumulating. Now, this cost cutting involved things such as making of the gas methyl isocyanate, it was stored in a liquid form, but this compound was made in large quantities.

It was stored which was against the norms of the company. Then it was stored in tanks that had to be around 50 percent full of mech and the rest of the space had to be kept empty, but they were filled above the capacity. The refrigeration system was shut down to cut cost and the plant was very yield maintained because of which water entered inside the tank and it started a runaway exothermic reaction.

In a normal plant there were a number of measures that could have stopped this gas from coming out. So, if there was any gas leak then it would have led to the sounding of alarms, but then the plant in Bhopal it was not computerized did not have those sensors. Then if the gas still leaked away, then there were options of neutralizing the gas using chemicals, but then those towers were not working.

If the gas was able to pass those chemicals, then any amount that remained should have got burned in a flare tower. In a flare tower there is a flame that is kept on so that any gas that passes through it gets burned, but then this flare tower itself was not working again because of a cost cutting measure.

Because of several cost cutting measures the locals were untrained, they did not have the equipment, they did not have the resources to tackle any gas leakage. So, because of a huge number of cost cuttings the disaster occurred. The gas leaked in 1984. So, this is one environmental disaster that can be linked to cost cutting and the tragedy still continues.

There are a number of disabled people in Bhopal because of this and this was heavily documented. Another environmental disaster due to cost cutting is the love canal tragedy. In this case there was a firm that took the chemicals that were untreated industrial waste and they just dumped them into the love canal.

So, this canal was converted into a dump site and later on this site was handed over to the civil authorities for the construction of a school and so, a school was constructed on top of a dump site that was having a very huge quantity of untreated industrial effluents and a lot number of children got exposed to those chemicals. Now here again the company was only interested in doing the cost cutting, but even 35 years later it is still losing poison.

Another example is the Minamata disease. In which case the Chisso Corporation in Japan dumped the untreated methyl containing catalyst into the oceans into the seas. The fishes started to die off, the animals started to show neurological symptoms and in a short while people also started to show a large number of neurological symptoms and disabilities.

Here again the company could have installed equipment to treat the waste, but it was not done for cost cutting. Cost cutting leads to a very significant influence on the environment sacrificing health to corporate profits. Itai Itai victims settling with the mining operation release of large quantities of dioxin from this plant in severe soil or in recent past cost cutting leading to the Gulf of Mexico oil spill.

BP's cost cutting was blamed for the avoidable deep water horizon oil spill. So, in all these cases what we are observing is that cutting of cost by firms can lead to a large number of environmental disasters. But then the firms are doing this cost cutting because they seem to be racial decisions for these firms.

Because in economics we assume that everybody is a rational decision maker and in a number of cases this cost cutting does appear to be rational. This is rationality in the short term: in the long term it can have very tremendous consequences, but then in the short term people do think that these are rational decisions.

Now, because cost cutting has such huge impacts on conservation, it is prudent that we should understand what is cost, what is the cost of production and why do companies go for a cost

cutting. So, the firms go for a cost cutting because the firm's cost determines the profit and in this context we can define the total revenue, total cost and the profit. Total revenue is the amount a firm receives for the sale of its output - when a firm is selling something the amount that it receives for the sale of this output. When it is selling something, the total amount that it receives is the total revenue and total cost is the market value of the inputs a firm uses in production. So, to take an example let us say that there is a firm that is manufacturing some of us.

Now suppose in a day the firm sells samosas worth rupees 1,000. Now this sale has broadened a revenue to the firm which is rupees 1,000. So, they have sold samosas that have worth 1,000 rupees, but then this 1,000 rupees is not the profit of the firm because there are several costs involved.

You have the cost of the raw materials, you have the cost of electricity, you may have the cost of the workers, wages, you may have a rental cost because there is a space that has been rented to make these samosas. You can have n number of costs and suppose all these costs add up to rupees 750. So, in this case we will say that this is the cost of production and the difference between the revenue of 1,000 rupees and the cost of rupees 750 will give us the profit.

The profit is 1,000 minus 750 is rupees 250 for this particular day. So, total revenue is the amount a firm receives for the sale of its output, in this case 1000 rupees total cost is the market value of the inputs a firm uses in production. Now we are emphasizing market value because we will not say in the case of raw materials, we will just say that the raw materials is 150. We will not say in this case that the raw material is maida or it is water or it is salt, but what we are doing is that we are taking the market value of all of these and we are saying that raw material is in total 150 rupees. So, the total cost is the market value of the inputs a firm uses in production and profit is total revenue minus total cost.

Now, when we talk about the cost there are explicit costs and implicit costs. Explicit costs are input costs that require an outlay of money by the firm. The important thing here is the outlay of money such as wages to workers cost to cost of raw materials. So, in the case of explicit costs we are asking the question what are the inputs for which the firm is paying money.

The firm is paying money to buy maida, the firm is paying money to buy potatoes, the firm is paying money to get salt, the firm is paying money to workers, the firm is paying money for say electricity, fuel, rent and so on. Now, all those things for which the firm requires an outlay of money are known as explicit costs. Implicit costs are input costs that do not require an outlay of money by the firm.

So, these still are costs, but they do not require an outlay of money. Example the opportunity cost of foregone income from other sources, the opportunity cost of capital that could otherwise have earned interest. An example of this opportunity cost is say there is a person who was working in a software industry and was earning say 60,000 rupees in a month.

Now, this person leaves his job and starts a startup company to say uh manufacture spectacles. Now when the person is making spectacles in this startup, he is not earning the 60,000 rupees that he was earning in the software firm in his earlier job. Now this 60,000 rupees is something that this person has given up to start the startup.

This 60,000 rupees is an opportunity cost that has been given up and so, we will count this as an

implicit cost in making of the spectacles. So, this is an input cost that does not require an outlay of money by the firm. So, the spectacles firm will not say that we have forgone this 60,000, but then this is a cost for this person. Another example is the opportunity cost of capital that could otherwise have earned interest.

Suppose this person, to make his spectacles factory, spends say 20 lakhs of rupees to get the space and to get certain equipment. Now this 20 lakhs of rupees had he not invested it in making of uh this startup firm could have been say put into a bank and in that bank this money would have earned certain interest.

When this money is being used for the startup firm, then the person is losing out on that interest that this capital would have earned otherwise. So, this again is an implicit cost. So, this is a cost that this person is paying, but this is not a cost for which the firm will put up an outlay of money. So, this is an implicit cost.

Depending on whether we include the expense, the implicit cost or not in the computation we have two different kinds of profit. Now economic profit is defined as total revenue minus total cost including both the explicit cost and the implicit cost.

Which means that, if the person who is starting this startup, suppose in the first month the earnings or the revenue is rupees 1 lakh and the cost of inputs that is the cost of the raw materials, electricity, payment of wages and so on is rupees 30,000. So, this is the explicit cost. Now, let us look at the implicit cost. This includes the 60,000 rupees that he otherwise would have earned in the software firm plus say 20,000 rupees that he would have earned as an interest. In this case we will say that the implicit cost in total is 80,000 rupees. Now when we talk about the economic profit, we are saying total revenue minus total cost which is in this case the total revenue is 1 lakhs of rupees, total cost is 30,000 plus 80,000. So, in this case the total cost is rupees 1.1 lakh.

Now, this is the total cost and this is the total revenue 1 lakh. In this case we will say that the economic profit is rupees 1 lakh minus rupees 1.1 lakh is minus 0.1 lakh rupees. In this case what we have computed is that, the economic profit is minus 0.1 lakh which means that this person is at an economic loss because the profit is negative whereas, the accounting profit is total revenue minus total explicit cost.

Total revenue is 1 lakh of rupees. This is the total revenue total explicit cost is 30,000 rupees and so, we will say that the accounting profit is 1 lakh minus 30,000 rupees is 70,000 rupees. So, this person is earning an accounting profit of 70,000 rupees, but an economic profit of minus 10,000 rupees. So, there is a big difference between the profit or loss that a person would feel when there is a computation being done on an accounting basis or on the economic basis.

In this case the accountant might say that ok this person every month is earning 70,000 of rupees. So, this person should continue to be in this startup, but the economist would say that no this person is actually suffering a loss of 10,000 rupees every month because had he not set up this startup, probably he would have been working in the old company earning 60,000 rupees from there and getting 20,000 rupees out of the interest income from the money that he kept in the bank which now he has spent in making of the startup.

And so, in that case he would have earned more in the previous position as he is earning in the

current position. And so, there is a big difference between economic profit and accounting profit. That is when we are taking an economic versus accounting view, if we talk about the total revenue. So, in both the cases total revenue remains the same, explicit cost remains the same, but when we take an economic view of a firm, we also deduct the implicit cost from the total revenue to get an economic profit.

Whereas, in the case of an accounting firm they do not incorporate the implicit cost and so, the accounting profit in a number of cases is much greater than the economic profit. Now this distinction between economic view and accounting view has a very big bearing for conservation because say a company or a firm that is manufacturing goods and is polluting the environment. Now how would this uh the accountant and the economist view such a firm?

Now let us say that the net revenues of this firm are rupees 10 lakhs and the explicit cost is say rupees 3 lakh, but then when the firm say does not install a device to control the pollution, it also harms the environment because of pollution and the harm to the environment is say rupees 5 lakhs. Now the economist would say that this harm to the environment is leading to an implicit cost because if the environment was not harmed, then probably this 5 lakhs would have been accrued to the society.

This is an implicit cost. Now this harm to the environment could probably have been removed by installing a pollution controlling device, which would have caused the company 1 lakh of rupees. Now let us look at the view of this firm from an accounting point of view. From an accounting point of view the accountant would say that the net revenues are 10 lakhs, the explicit cost is 10 lakhs, but if we install this device then the explicit cost would be 3 lakhs plus 1 lakh is 4 lakhs.

The explicit cost increases when the pollution controlling device is installed and currently the profit is 10 minus 3 lakhs is 7 lakhs, but if this device gets installed then because there is an extra explicit cost then the profit will come down to 6 lakhs and in this case the accountant would say that oh this company should not install this device whereas, the economist would say that currently the total cost which is the explicit cost plus the implicit cost is 8 lakhs.

If the device gets an explicit cost, we will forego this implicit cost. So, when once the device gets installed then the total cost would be 3 lakhs of the explicit cost today plus 1 lakh is 4 lakhs, but we will be saving on this 5 lakhs and so, the profit would be 10 lakh minus 4 lakh is 6 lakhs, but currently the without the the device the total cost is 8 lakhs of rupees and so, the net profit is 10 minus 8 is 2 lakhs.

Currently the profit is 2 lakhs with the device it will increase to 6 lakhs. So, the economist would say that the firm should install this pollution controlling device. Now in both of these cases we are doing rational decision making, we are doing a cost benefit analysis, but when we incorporate all the explicit and all the implicit costs then we have a much better picture of what the firm is doing to the society and in that case our decisions will be much better.

When we look at things from the accountant point of view, we do not incorporate the implicit costs and in such a scenario in a number of cases it is possible that we will take a decision that will not be in the best interest to ourselves or to our society. Now, similar to the example of the person who left his software job and started a startup, in that case the accountant will say that this person is earning a profit and so, he should continue in this startup whereas, the economist

might say that no he was in a much better position earlier.

Similarly, in this case the accountant will say that this device should never be installed because it will bring down the accounting profit because it will increase the explicit cost by 1 lakhs of rupees. But the economist would say that by increasing the explicit cost by 1 lakh we are saving 5 lakhs in the implicit cost. So, there is a net saving of 4 lakhs of rupees which is much better. So, this is why we need to understand the difference between the economic view and the accounting view.

Now, when we are doing this cost benefit analysis another thing that we need to keep in mind is the marginal product. Marginal product is the increase in output that arises from an additional unit of input. So, now, what we are trying to do is, we are asking how much of things should be produced. So, there is a cost of production we have implicit cost we have explicit cost there is a profit.

Now, the thing is, should we make more and more of this stuff or is there a limit to which we should be making this stuff? How do we decide that? So, for that we are now getting into how much to produce. So, in this context we can talk about a marginal product which is the increase in output that arises from an additional unit of input.

A good example is this firm that is making samosas. Now if the number of workers is 0 in that case the total output is 0 because there is nothing that is being made, but in this case there will be certain fixed cost because even when you are not producing this the samosas even then you have installed the machines you are paying the rent for the land and so, there are certain fixed costs. So, the fixed cost remains the same whether you make the product or not.

Now, if the firm employs 1 worker and the output of samosas now becomes 50. Now the marginal product would ask the question: how much is the increase in the output because of one additional unit of input? In this case the input is the labour. So, the marginal product of labour in this case is 50 minus 0 is 50.

If the firm employs two workers and the samosa output increases from 50 to 90, then the marginal product will be the increase in the output that is 90 minus 50 because of an additional unit of input. The marginal product in this case becomes 90 minus 50 is 40 and so on. With each additional input of a worker there is a change in the output marginal product is asking the question how much is this change.

So, the marginal product is the increase in output that arises from an additional unit of input. Now this input can be anything, this input can be in terms of the workers that are employed, this input can be in the terms of raw materials, it can be in terms of the number of machines that are installed in the factory and so on.

But for any input when we increase the input by 1 unit what is the net increase in the output is what marginal product is asking. And in the case of marginal product we normally observe a diminishing marginal product which is the property whereby the marginal product of an input declines as the quantity of input increases. What we are saying here is that when the number of workers is increasing from 0 to 6, the marginal product is reduced in each case.

That is when you increase the number of workers from 0 to 1, you get a much greater increase in the marginal product than when you increase it from 5 to 6. So, in this case from 0 to 1 you are

getting a marginal product of 50 whereas, when you increase it from 5 to 6 you are getting a marginal product of only 5. So, this is the law of diminishing marginal product.

The property whereby the marginal product of an input declines as the quantity of the input increases. That is when we plot the number of workers on the x axis and the marginal product on the y axis, the marginal product with increasing number of workers goes down and there are several reasons for this. One is that there can be crowding in the factory.

Earlier each worker was getting sufficient space to work, but now because of the overcrowding people are not getting sufficient space to work, sufficient space to move. That would reduce the efficiency of every worker because earlier the worker could move from point a to point b say in 30 seconds, but now because there are 5 people standing between point a and point b and this worker has to negotiate the path.

In place of 30 seconds now he is taking say 2 minutes and so, the output per unit time will go down. Another reason could be insufficient access to equipment. So, probably there is only a single mixer in this factory and so, when there was only 1 worker, this worker was having 100 percent access to the equipment.

But now what is happening is that when this worker - when you have 6 workers and when 1 worker is going to that equipment he finds out that there are two people already in the queue. So, now, he does not have sufficient access to the equipment. At the same time another reason could be things like chit chats.

With more people there is more chit chatting and so, the people are not putting up that much amount of output as they were doing without the chit chats. So, there is a certain amount of social loafing. But the thing to remember is that we have a law of diminishing marginal product. As you increase the amount of input the marginal output of or the marginal product of the input would go down.

Another concept here is the production function which is the relationship between the quantity of inputs used to make the good and the quantity of output of that good. That is what we are asking here is that when the input increases like this. How does the output increase? So, here we have it in the form of a table, but we can plot it in the form of a production function.

The production function is telling us that as the number of workers increases, the output increases from 0 to say around 160, but the shape of the curve is telling us that earlier when the number of workers was increasing the output increases at a much faster pace, but later on it is now getting more and more leveled which is another way of showing the law of diminishing marginal product.

The increase in the output at this point because of an additional worker is much less than the increase that we were getting at this point. So, typically the production function looks like this. Earlier we have a large increase in the output when the input is increased, but later on it becomes more and more flat enough and we can also plot the total cost curve now total cost.

If the output increases there will also be a change in the total cost. Why? Because in any firm we have a certain fixed cost now fixed cost will remain the same for any amount of output. So, even when the output is increasing from 0 to 155, the fixed cost remains the same, but then to increase this output we are also employing certain labour, certain workers.

The cost of these workers will go on increasing with the number of workers because, say the wage rate is 10 units of money per worker. So, if only 1 worker is employed then the cost of the worker is 10, if 2 workers are there then the cost is 20, 6 workers are there the cost is 60.

This is a variable cost that we have. So, we have fixed cost here variable cost and the sum of the fixed cost and the variable cost will give us the total cost. So, when no worker is being employed then the fixed cost is 30 rupees, the variable cost is 0 rupees and so, the total cost becomes 30 when 1 worker is employed then fixed cost plus 30, the variable cost is 10, and so, the total cost increases to 40 and so on.

In this particular example we are not talking about the cost of the other inputs because we are looking at only one input. So, the total cost increases as the output increases and with this we can plot the total cost curve. Now here on the x axis we have the output. It increases from 0 to close to around 160 and we have the total cost.

As the output increases the cost also increases mainly because of the variable cost because the fixed cost remains the same, but the variable cost increases, but in the case of the total cost curve we will observe that the curve starts in a flatter manner and then it starts to increase at a very fast rate. Because here again what we are observing is that because of the law of diminishing marginal product to increase the output from 140 to 160 we will require a very great amount of input.

Because now the inputs are not working that hard, they are not giving that high an output whereas, when we increase the output from 0 to say 50, the costs involved are really less because the inputs are putting up a very large amount of output.

As the inputs are increased their marginal product decreases because of which for any additional amount of output we will need to put up a very large amount of input which would also mean that we would have to spend a very large amount of money. So, the total cost increases, it increases more gradually in the beginning, but later on it increases at a very fast pace. So, this is the total cost.

And total cost includes the fixed cost and the variable cost. Fixed costs are costs that do not vary with the quantity of output produced such as the cost of rent, the cost of security and so on. Whether the firm produces 0 samosas or whether it produces 150 samosas in an hour the rental cost of land will remain the same.

The cost of security will remain the same because even when the production is going up you do not have to employ a larger number of security guards, but even when you are not doing any production, you will still require the security guards to protect the equipment to protect the premises.

The cost of security is a fixed cost. Then we have variable costs. Costs that vary with the quantity of output produced such as the cost of raw materials, the cost of wages and so on. So, if the firm is producing less number of samosas it requires less number of potatoes, it requires a lesser quantity of maida, it requires lesser number of workers, it requires lesser amount of electricity, but when it is producing a larger quantity of samosa, then it requires a larger quantity of all of these.

This is a variable cost: a cost that varies with the quantity of output that is produced. Total cost is

fixed cost plus marginal plus variable cost and marginal cost is the increase in total cost that arises from an extra unit of production. So, what we are asking in the case of marginal cost is that, if you increase the output by 1 unit if you want to increase the output by 1 unit what is the cost involved to increase that? Now the cost in this case is smaller and the cost to increase 1 unit of production in this case is much larger.

The marginal cost in this case is increasing with the output. So, marginal cost is the increase in the total cost that arises from an extra unit of production. Now we take a firm example. Let us look at the cost of a firm that is making coffee and in this case when the number of coffee cups per hour increases from 0 to 10 the fixed costs remain the same, the variable cost goes on increasing and the total cost is given as fixed cost plus variable cost.

In this case for 0 cups of coffee we have a fixed cost of 3, variable cost of 0. So, total is 3 for 1 cup of coffee, the fixed cost is 3, the variable cost is 0.3. So, the total cost is 3.3 for 2 cups of coffee that becomes 3.8 and so on. This is the total cost. The marginal cost is the cost of increasing 1 unit of the output. From 0 to 1 when the number of coffee is increased from 0 to 1 the total cost increases from 3 to 3.3.

And so, the marginal cost of 1 cup of coffee in this case is 0.3. 3.3 minus 3 is 0.3, but when it increases from 1 to 2 then the total cost increases from 3.3 to 3.8 which means a marginal cost of 0.5 when you subtract 3.3 from 3.8 you get 0.5. So, here the marginal cost is 0.5. The cost of making an additional cup from 2 to 3 is 0.7. So, here we are observing that the marginal cost is increasing.

If we plot these costs we will find that the fixed cost remains the same, say 3 rupees, whether the firm is making 0 cups of coffee or it is making 10 cups of coffee. So, the fixed cost remains the same; it is a flat line. The variable cost shown in green increases with the number of cups because with more cups you require more sugar, more water, more milk, more coffee.

The variable cost goes on increasing. If you look at the total cost then total cost because it is the sum of the fixed cost and the variable cost it will also increase because fixed cost is the same variable cost is increasing and so, total cost will also increase. And when we look at marginal cost we are asking the question: what is the difference from this point to this point in terms of cost?

What is the difference from this point to this point in terms of cost? And in this case we are observing that the marginal cost is increasing. To make an additional unit of coffee an additional cup of coffee the costs are increasing. Earlier we required a lesser cost to make a cup of coffee or to increase the production of coffee by 1 unit, but later on we require much more money to make an additional cup of coffee.

Now, this is because of the law of diminishing marginal product because our inputs that we are buying from uh the cost they will not be giving out that large an output. So, these are the costs. Now we can also look at the average cost. So, we have the average fixed cost which is the fixed cost divided by the quantity of output.

In this case the fixed cost is the quantity of output when it increases we can find out the average fixed cost, another one is average variable cost which is the variable cost divided by the quantity of output. The third is the average total cost which is the total cost divided by the quantity of

output and the fourth cost is the marginal cost which is the change in the total cost divided by the change in the quantity of output.

In this case we have a fixed fixed cost, we have an increasing variable cost and so, the total cost is also increasing. Now in finding out this uh average cost, for average fixed cost we do 3 divided by 1 is 3 in the next line we have 3 divided by 2 is 1.5. So, the fixed cost is remaining the same. So, in this case the numerator remains the same fixed cost, but the denominator is increasing.

And so, the average fixed cost rate goes on decreasing. What about the variable cost? The variable cost for making 1 cup of coffee is 0.3. So, the average is 0.3 to make 2 cups of coffee it is 0.8. So, the average variable cost is 0.8 divided by 2 is 0.4, to make 3 cups of coffee the variable cost is 1.5. So, the average is 1.5 divided by 3 is 0.5 and so on.

And here we are observing that the average variable cost is increasing. Now the average variable cost is increasing because of the law of diminishing marginal product. Now if we look at the average total cost. So, we have this total cost divided by the number of cups of coffee. So, 3.3 divided by 1 is 3.3 1.5 3.8 divided by 2 is 1.9, 4.5 divided by 3 is 1.5 and so on.

Average total cost is the total cost in that particular row divided by the number of cups of coffee and that would give us the average total cost. Marginal cost is an increase in the total cost divided by the increase in the number of cups of coffee. So, for each increase for each additional cup of coffee what is the cost involved?

Here we can find out the marginal cost by dividing the value in this row by the value in the previous row. So, 3.3 minus 3 is 0.3 3.8 minus 3.3 is 0.5 4.5 minus 3.8 is 0.7 and so on. So, in this case we can find out the average fixed cost, the average variable cost, average total cost and the marginal cost.

This is how it looks when we plot them. The red curve is showing us the average fixed cost. Now the average fixed cost goes on decreasing. The average fixed cost decreases from 3 to 1.5 to 1.1 and so on. It is going to decrease, which is what we are observing here. The average fixed cost is going on decreasing, but earlier the decrease is very large and later on the decrease is much lesser.

Now, this is because in the case of the average fixed cost is the fixed cost divided by the amount of output. Now earlier what we are seeing is 3 divided by 1 or it is 3 divided by 2 and 3 divided by means 3, 3 divided by 2 is 1.5. So, there is a large change from 3 to 1.5, but when we do say 3 divided by 9 and 3 divided by 10. So, 3 divided by 9 is 1 by 3 is 0.33 and 3 divided by 10 is 0.3.

Here the change is very less the the change is the only 0.03 whereas, here the change was much larger it was 1.5, which is what we are observing here in this curve that earlier the fixed cost it decreased by a very large amount, but later on the change is very less because the denominator is increasing the numerator is kept fixed the denominator is increasing and the impact of this increase in denominator will be much built in the beginning than at the later stages.

The average fixed cost goes on decreasing. The average variable cost and the marginal cost go on increasing with the number of cups of coffee per hour because of the law of diminishing marginal product. Now to make each additional cup of coffee we require more of the inputs because now the inputs are not working that hard and that would increase both the marginal cost

and also the variable cost.

The variable cost and the marginal cost go on increasing. The average total cost decreases in the beginning and later on it increases. Now the decrease in the beginning is because of the decrease in the average fixed cost. Now what we are observing here is that the total cost is equal to the fixed cost plus the variable cost.

The average total cost is the total cost divided by the output. So, if we divide the whole of the additives also by output we will get this. Now TC by Q is the average total cost is equal to the fixed cost by Q is the average fixed cost plus the VC by 2 is the average variable cost. So, the average total cost is equal to the average fixed cost plus the average variable cost.

As the number of cups of coffee increases we find earlier a very great decrease in the average fixed cost. The average fixed cost decreases very quickly, but at later stages it will decrease at a very less amount. So, we can say that after a while it will tend to become constant, but earlier it decreases very fast.

But the second component is the average variable cost. Now the average variable cost goes on increasing. Now in the beginning when we look at the average total cost the average fixed cost is very high the average variable cost is very less. So, in the beginning what we are observing is that in the beginning the average fixed cost is very much greater than the average variable cost.

The average fixed cost shown in rate is very much greater than the average variable cost and so, the average total cost is roughly equal to the average fixed cost because in this case we can neglect the average variable cost. But later on what happens, the average variable cost becomes very much greater than the average fixed cost which is what we are observing here.

The average variable cost because the average variable cost has been increasing with more cups of coffee, it has increased to a large value whereas, the average fixed cost has continued to decline in its value. So, later on the average fixed cost is less, the average variable cost is very high and so, we can write that the average total cost is approximately equal to the average variable cost.

Because later on we can say that we can neglect the average fixed cost because the average variable cost is very high. So, we can neglect the average fixed cost.

Now, in the beginning what is this telling us, if we look at the curve in the beginning the average total cost is roughly equal to the average fixed cost which means that when the average fixed cost decreases then the average total cost also decreases because it is roughly equal. So, the average total cost is roughly equal to the average fixed cost because we can neglect the average variable because they are very less.

In this case when the average fixed cost will decrease the average total cost will also decrease, but later on the average variable cost are high and the average fixed cost are less and so, the average total cost is roughly equal to the average variable cost which means that, when the average variable cost increases the average total cost will also increase.

In this case we can see that in the beginning the average total cost shows a decreasing trend, but later on it shows an increasing trend which is what we are observing here the average total cost earlier it shows a decreasing trend, but later on it shows an increase in trend which means that there is some point somewhere that is the minimum of the average total cost. Because before this

point we are observing that it is going down. After this point it is increasing which means that there should be a minimum.

What we can see here is that the marginal cost rises because of the diminishing marginal product, the average fixed cost decreases because of fixed cost by increasing the quantity of output, the average variable cost rises because more inputs are required for the output, but the average total cost is U-shaped because earlier it lowers because of reducing average fixed cost and later on it rises because of the increasing average variable cost.

And the point where we have the minimum of the average total cost that gives us the efficient scale. Efficient scale is the quantity of output that minimizes the average total cost which means that when you look at this curve, then this point. So, at this point the average total cost is minimum.

This quantity, which is 6 cups of coffee, we will say that this is the efficient scale because this quantity of output minimizes the average total cost. So, the average total cost is the least at 6 cups of coffee, but then how do we reach this lowest value? Is there any correlation between all of these costs?

So, we can find out that the relationship between the marginal cost and the average total cost is that the marginal cost curve cuts the average total cost curve at the efficient scale where the average total cost is the minimum. Now why is that so? When we talk about the marginal cost, the marginal cost is the cost of producing an extra unit of coffee, the increase in cost for making one more cup of coffee. Now in this case before this point say. So, to the left of this point the marginal cost is less than the average total cost which means that if one more cup of coffee is produced then the average total cost will further reduce.

Whereas, to a point to the right of this the marginal cost is more than the average total cost. So, when the marginal cost is more it means that to make an extra cup of coffee it will now cost more than the average total cost which means that at this point to the right of this efficient scale, we will find that the average cost will increase.

It is decreasing here, it is increasing here. At this point where both of these curves are, it should be the minimum of the ATC line. So, the marginal cost curve cuts the average total cost curve at the efficient scale where the average total cost is the minimum because to the left of this point the marginal cost is less than ATC and the ATC is falling to the right of this point because it has cut here.

To the left it is less than ATC, to the right it is more than ATC. To the right of this point the marginal cost is greater than ATC and the ATC is rising. To the left it is falling to the right it is rising. So, the point has to be the minimum. This is the relationship between the marginal cost and the average total cost curve, that the marginal cost curve cuts the average total cost curve at the efficient scale.

And this also brings us to the economies and diseconomies of scale. Economies of scale is the property whereby the long run average total cost falls as the quantity of output increases which means that when we talk about economies of scale it makes more sense for the company for the firm to produce more output because when the output is more the long run average total cost falls a good reason is because of specialization.

So, different components that are required to make the product are brought together and so, the output increases. Diseconomies of scale is the property whereby the long run average total cost rises as the quantity of output increases because of problems in coordination and a constant return to scale is the property, whereby the long run average total cost stays the same as the quantity of output changes.

What we are saying here is that, in the case of certain firms which show economies of scale, what happens is that with more production, more and more specialization is brought in which increases efficiency because of which the average cost further reduces. So, the larger the firm, the lesser the average cost in the case of diseconomies of scale the larger the firm the larger is the problem of coordinating different units and so, the larger it becomes the more the cost will rise.

So, different firms will show different tendencies, some will show the economies of scale, some will show diseconomies of scale and some others will show a constant rate return to scale.

To summarize, costs determine the levels of profits. At the market equilibrium the firm with the lowest cost will have the largest profits and will be a winner in the competition between different firms which is why every firm wants to be a winner and so, it tries to lower the cost.

And this is the reason why firms try to cut the cost even at the risk of environmental damage.

That is all for today. Thank you for your attention. Jai Hind!