Petroleum Economics and Management
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Module - 02
Basics of Microeconomics
Lecture - 08
Analysis of supply

Hi everyone I am Dr. Anwesha Aditya Assistant Professor in the Department of Humanities and Social Sciences of IIT, Kharagpur. I am your instructor for the course Petroleum Economics and Management. We are in module two lecture eight where we will be Analyzing about the Supply side of a market.

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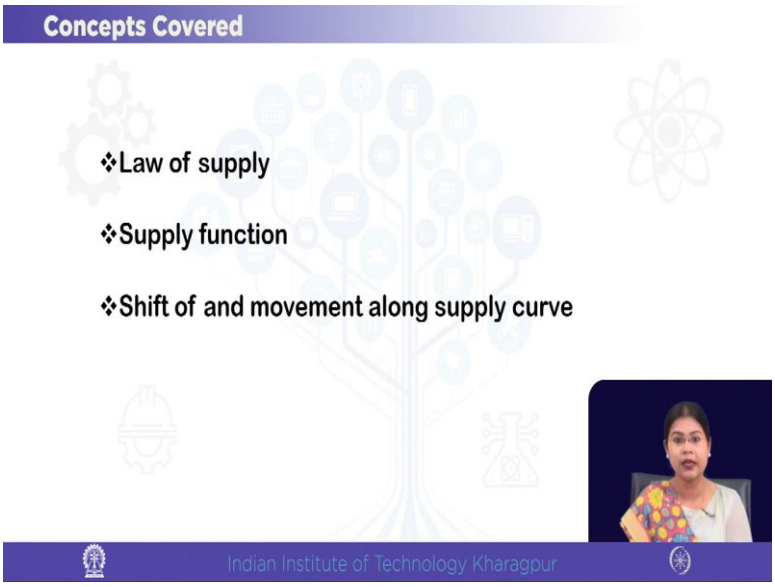

So, if you remember the way we have designed our syllabus we first discussed about the relevance of having a course on petroleum economics and we outlined our course. Then our second module started with the basic of some economics concept which we need just to understand the concepts discussed in petroleum economics and management.

Because to enable more students and other industry professionals to join the course, coming from different backgrounds of humanities science and engineering there was no prerequisite in the course. But some basic exposure to economics is required and those who already have studied economics at least to some extent the concepts to be covered in

module two will be a brush up. And those who are not at all exposed to economics for them these are new concepts and these are taught in a most simplified way.

So, in module two, we are discussing about how to find out the equilibrium price and quantity; because we will be discussing in depth about the world oil market. So, we need to know how a market functions how price and quantity are determined in a market. So, in a market as we already discussed there are two sides we already have covered the demand side of the market.

Now, its time that we come to the other side of the market that is the supply side. So, in supply side what we are going to discuss in today's class is, we are going to define supply what do we mean by supply how supply of a good changes when own price changes. So, there comes the law of supply we will define the law of supply and then we define the supply function just the way we define the demand function.

And then we will discuss what are the factors on which quantity supply of a good depends apart from its own price. So, we get the supply function and discuss the impact of this other determinants of supply. So, lastly we will be discussing what will happen to the supply function if the other factors change or own price changes. So, we will discuss about the shift and movement along the supply curve.

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So, first and foremost what do we mean by supply? The supply is defined by the various amounts of a product that the producers are willing and able to supply at various prices during some specific time period; because over time supply can change we will discuss the importance of time. So, at a particular time period what are the amounts of various product that the producers are willing and able to supply.

So, we have to be very careful about this. So, what do we mean by able to supply? Means it is not only that the producers are willing to supply the good at a particular price the producer should be able to supply the good at a particular price why what do we mean by that? Because if price falls below the cost of production of a particular good the producer will not be able to supply the good.

Say for example, if we think of any production process say automobile production. So, there are cost of production of manufacturing an automobile. So, we if you remember we discussed in the initial classes of module two, what do we mean by the resources. So, we discussed about four types of resources land, labor, capital and entrepreneur.

So, in case of producing any good the entrepreneur has to combine these resources using some technique of production to convert the raw material into the final good. So, to convert the raw material into the final good the producer needs labor and capital. So, there will be some minimum cost of producing the good.

Say for example, the table is made of wood. So, some carpenter is required to convert the table into wood using some machine tool and of course, some space is also required. So, we add up the cost of production, now if price of the good in a market falls below the cost of production the producer or the carpenter who is also suppose the entrepreneur will not be able to sell the table.

So, we are talking about the example of automobile. So, if price of automobile falls due to some reason or other. So, if it falls below the cost of producing one automobile. So, the company will be withholding the supply for the time being will not supply the good in the market; say crude oil or also the refined oil that we buy that depends on what that the crude oil price then the cost of extraction cost of refining.

So, all inclusive we buy the petrol and diesel whichever is required for our daily use. Therefore, by supply we mean that the producer should be able and willing to sell the

good at that particular price, if price is less than that minimum price producer will not be able to sell the good.

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With this we now see how price of a good and quantity supply of a good are related. So, we can very simply understand that if price of a good increases other things remaining unchanged. So, what will happen? The producer will have greater incentive to supply more quantity because by supplying more the producer can earn more. So, if price increases quantity supply in general increases.

There may be some exceptions, but overall empirically we see that, quantity supply increases with increase in price of the good other things remaining unchanged. So, this is call the law of supply.

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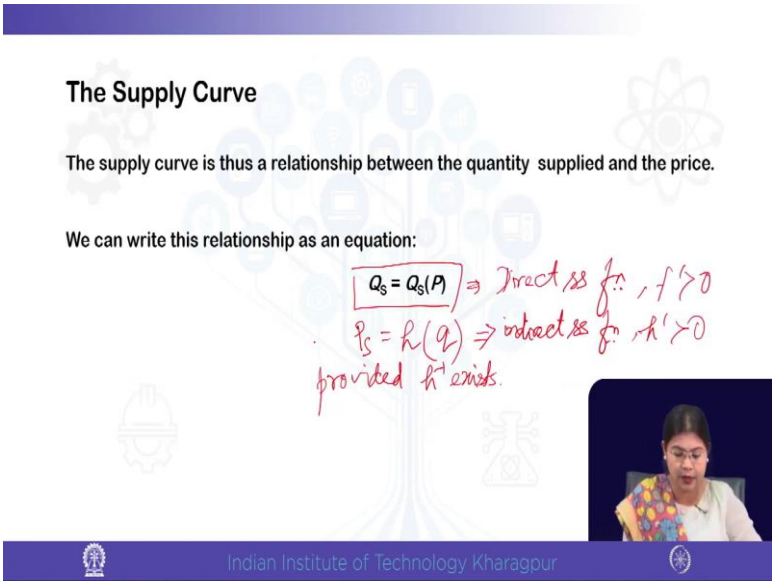

So, quantity supply as a function of its own price other things remaining unchanged is the supply function.

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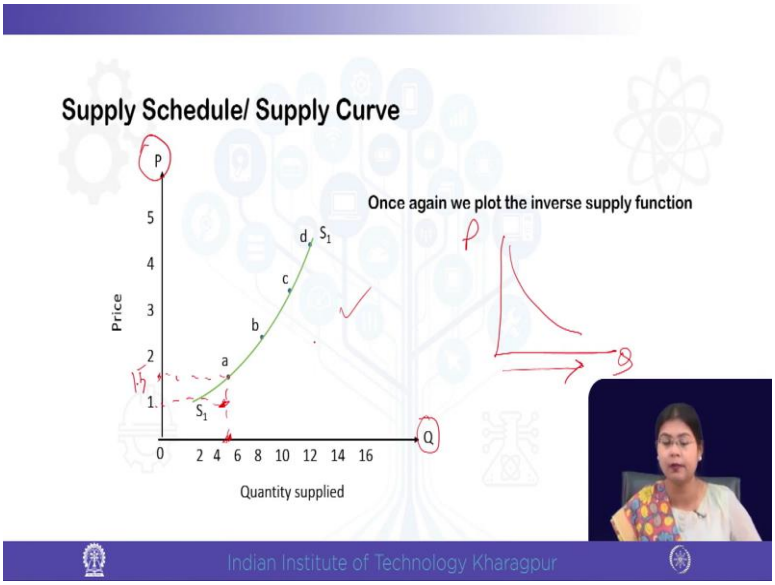

So, just we plotted the demand function, here also we can plot the supply function to get what we call the supply curve. So, we can see that we have plotted the price and quantity demanded of any good say good Q. So, once again let me re-iterate it as we in detail discussed that we always plot price on the vertical axis and quantity on the horizontal axis in economics.

So, here also its not an exception. So, just like we did with the demand that we worked with the inverse form of the demand function, in case of supply also we are working with the inverse form of the supply function. So, this quantity supply as a function of price this is the direct supply function.

Now, we are actually plotting not the direct supply function, but what we are plotting is the indirect form of the supply function. So, provided so, we are writing P_S the suppliers price or the minimum price that is required by the supplier to sell the product in a market is a function of the quantity supply ok provided we know that we need one condition for this that the inverse should exist this h inverse should exist.

So, if the inverse should exist we can work with the inverse form of the supply function. So, Q_S is a function of P this is the direct supply function. So, this is our direct supply function. So, this is SS is supply function. So, we often will be using abbreviations while using the marker and board and price as a function of quantity is the indirect supply function.

So, henceforth in the graphical analysis we will be working with the inverse form of the supply function. So, you can see we can plot price on the vertical axis and quantity on the horizontal axis again this inverse analysis is from the Marshallian point of view. So, the supply function is defined or the supply curve is defined as the relationship between price and quantity supplied or we can also define the inverse form.

So, in inverse form how do we define the supply function? So, these are the minimum prices which are required for the producer to be able to supply the good in the market. So, for example, say the producer will be able willing to sell these goods say five units if price is say 1.5 this is the per unit suppose cost of production if for some reason suppose price falls below.

So, suppose price is 1 then the producer is not able to sell the good in the market. So, this is the minimum price 1.5 over here which is required to sell these five units of the goods. So, this is the per unit price just remember that the vertical unit we are plotting is the per unit price.

So, the producer will sell the good only if the per unit price is not less than the minimum price which is required to put the product in the market. So, the inverse supply function

is the relationship between the minimum price that is required by the producer to sell the good in the market and why is the positive slope? So, this is due to the law of supply.

So, by law of supply as price increases quantity supply will increase so; that means, here quantity supply as a function of price this f prime will be positive by law of supply. Similarly in the indirect form of the supply function h prime should be positive. So, as; that means, what? That means, in the inverse form as the producers will be willing to sell more and more if the minimum price that he or she is getting is increasing.

So, this is called the law of supply and hence we get the positive slope of the supply curve, but just like we discussed about some examples of violation of law of demand; like in case of demand the demand curve may be upward rising sometimes due to giffen good or goods with "Snob appeal" in the empirical validity of violation of law of demand is very limited because mostly law of demand is found to hold in reality.

However, often the supply curve can become downward sloping and law of supply can be violated because of if there is some drastic technological change. So, then the producer can be able to sell more even if price falls. So, if you just think about the examples of suppose smartphone initially the prices were higher, but gradually with time due to technological advancement the producers are able to sell new products are available even at a lower price.

And the supply curve become can become negative downward sloping due to drastic technological advancement that leads to huge fall in the cost of production ok. Or the other reason of negative slope downward sloping supply curve may be due to economies of scale what do we mean by economies of scale?

Economies of scale means the advantage of large scale production, if we produce in large scale there may be some cost advantages like the producer the firm. For example, if it expands its size producing in more quantity it can buy raw materials at a lower price, it can take the advantage of same managerial position it can take the advantage of the factory space.

Therefore with economies of scale cost of production may fall as output increases. So, law of supply may be violated, but these are just exceptions. So, this is one example of economies of scale other example I just talked about technological revolution very

drastic technological change. Otherwise mostly we find that the law of supply holds. So, we have positively sloped supply function.

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Now just like we discussed what are the other factors on which quantity demanded depends. So, there are also factors on which quantity supply also depends apart from its own price. So, what are those other factors? First and foremost is technology yeah technology is extremely important determinant of supply.

Say for example, this online mode of education, it is not possible without technological advancement. So, we need to have very good ICT infrastructure we need to have internet and telecommunication services, broadband services for online education. Earlier it was just unthinkable just few decades ago it has started and during the pandemic it has become a very new normal almost two years almost all the education institutes across the country carried out education in online mode.

So, without technological advancement this would not have been possible. Earlier we did not have the technology of providing education or even healthcare in online mode nowadays telemedicine health service is also very common, but these were earlier unthinkable. So, technology is a major very important determinant of supply with better technology what happens?

With better technology we may produce the same good or even we can produce more amount of the good in a better quality in less time with less amount of input. Because technology can combine the inputs at a faster rate than just manual labor force. So, technology is a major determinant of supply, but if there is a technological revolution.

There is a technological revolution drastic change in technology then only the law of supply will be violated, but if it is a gradual technological improvement over time. Then the law of supply may not be violated we may be still moving means upward in the supply function means the supply function will still be upward rising.

So, technology is one of the major determinant of supply we see the market global market is flooded with in the electronic market especially flooded with new products with lot of varieties and new features with technological advancement. So, first and foremost determinant of technology second is of course, the price of raw material or input price inputs of production.

So, if the price of raw material increases cost of production will increase and the supply will be affected. Say for example, this crude oil if crude oil price increases then; obviously, the market price of oil the final price that the consumers who are buying the petroleum or other petroleum related products that price will increase.

So, input price is a major determinant of supply, but if raw material prices falls then supply can be increased same amount can be produced by a lower cost. So, the producer will be able to sell more and third and very important determinant of supply is time. Now time can also influence demand like over time the consumption pattern or taste or preference of the consumer can change, but time is a very important determinant in supply time plays more important role in case of supply.

Why? Because for most of the products we produce or the even the services also we are capacity constraint in the very short run. So, even if there is sudden increase in demand we are unable to supply more. Let us say agricultural production if there is sudden increase in demand for some agriculture crop and if the production period is over can we increase the supply instantaneously we can increase the supply until and unless there is a stock inventory stock.

But once the stock is exhausted we cannot supply more even if price continues to increase we have to wait for the next production season. So, in the very short run in the immediate effect will be constant supply even if price increases almost constant supply. Because supply can be increased only from the stock that is available if there is no stock if the storage quality is not good if the goods are no longer fresh then they will not be cannot be supplied in a very short span of time.

But over time what will happen in the next production period if the price increase trend continues? So, the farmers will be able to produce more. So, not only in agriculture where the production depends on season, but also you see in the manufacturing sector also because manufacturing also takes the input from agriculture.

Let us say textile industry it uses cotton from the agriculture sector. So, if there is sudden increase in demand for say garments. So, due to the constraint in the raw material supply that is cotton the increased amount cannot be supplied immediately, but over time even the country can buy from abroad and can import and can increase the supply of garment if the raw material is available in greater quantity.

So, time is a very important determinant of supply and what we can see is that in the very short run immediately after a price increase supply is almost fixed supply cannot be increased. So, this is not only with agriculture and manufacturing this is true even for services; especially for the developing countries you see we are constrained by the availability of skilled workers say doctors engineers teachers the skilled workers in a limited amount.

So, even if demand increases suddenly their wages increase, but supply cannot be increased at a given point of time, but over time what will happen what over time if a sector is offering better wage. So, new students will join that sector means the people will accumulate the skill over time to join the sector.

So, we see that like in the in the early nineteen nineties we had huge demand for software and IT professionals and that actually led to setting up of many engineering colleges MBA colleges and created industry professionals. So, over time the supply of those skilled workers the IT professionals increased which was not there in nineteen nineties we had limited availability of IT professionals or software professionals in the early nineteen nineties.

So, time is very important. So, not only for agriculture or for manufacturing even for service sector as well. So, these are the three important determinants of supply apart from own price. So, therefore, what we can see the supply function can be written as quantity supply as a function of its own price, but also price of inputs or raw materials time and technology.

So, other things remaining unchanged we are plotting the relationship between price and quantity supplied and we are getting the supply function.

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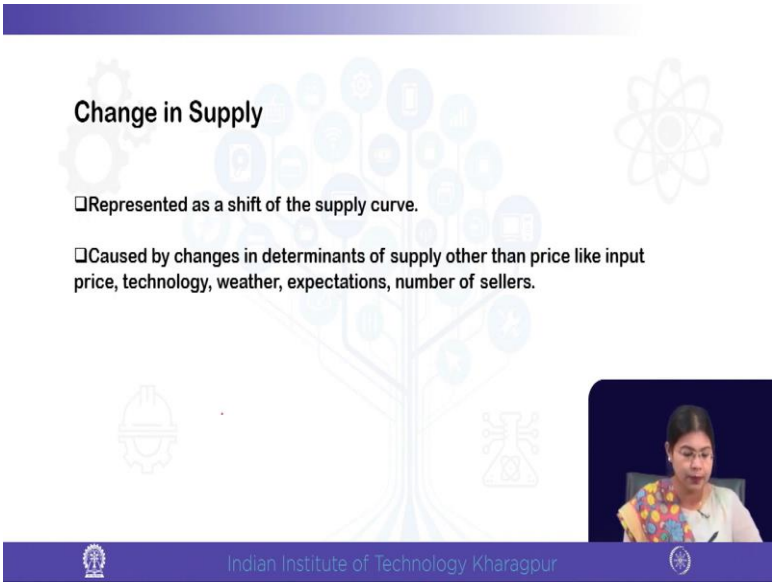

So, now, what happens when the determinants of supply change? So, for example, if we start with the example that let the other factors remain constant and price of a good changes own price of a good changes.

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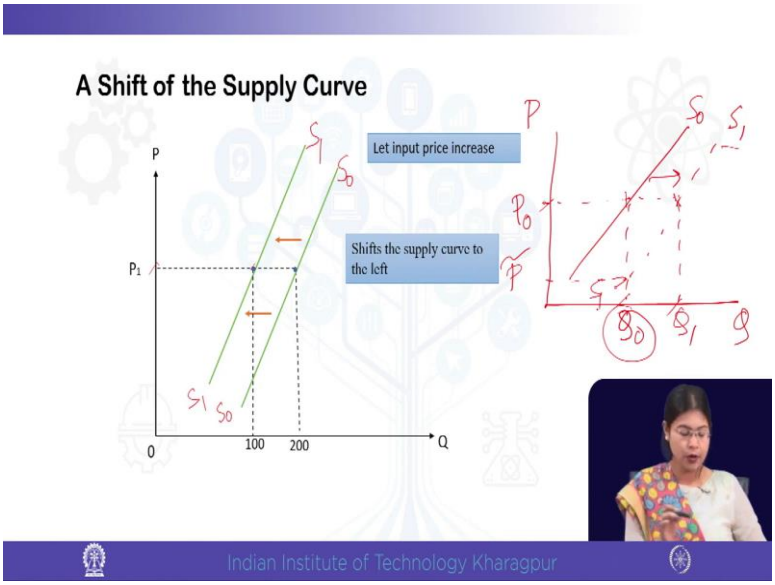

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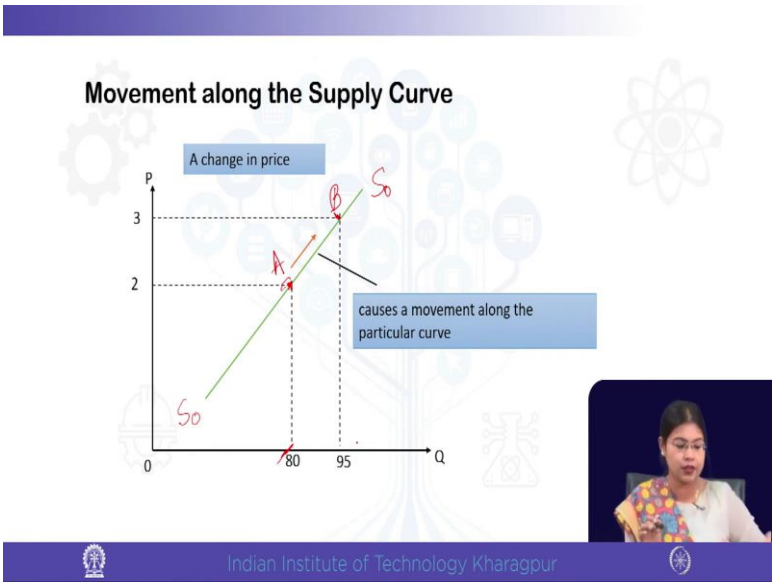

So, with the own change in own price of a good other things remaining unchanged we move along a particular supply function suppose initially the price was two and this is the quantity supplied and then if price increases. So, by law of supply we just discussed that to produce more the producer needs more factors of production, more raw material, more labor, more machinery a bigger factory space.

So, he or she will produce more only if he or she is getting a higher price. So, if price changes or price increases other things remaining unchanged. So, we move up from this point A in the supply curve to point B in this supply curve. So, we move along this particular supply curve suppose S_0S_0. So, this is called the movement along the supply curve or change in quantity supply. So, this is just same as what we discussed in case of demand change in quantity demanded versus change in demand.

So, this is the change in quantity supply due to change in own price leading to movement along a supply curve other things remaining unchanged. Now what happens when something other than own price changes? So, if something other than own price changes suppose here the example goes like this if input price increases suppose if price of crude oil increases so, what will happen? Then this at the same price the producer will be able to sell less because the input price raw material price increases.

Therefore the supply curve will accordingly shift in. So, we no longer are on the same supply function S_0S_0, but we are now in the supply function $S_1 S_1$ ok. So, this is called a

shift of the supply curve or change in supply. We can also think of other examples where there is a technological improvement so, that the producer is able to sell more at the ongoing price. So, we just took the example of input price increase and we see that the supply curve shifts in.

Now, suppose we take another example where there is a technological improvement. So, what happens with the technological improvement? The firm may be able to sell more at the ongoing price because a better technology enables the firm to produce the same amount either by using less input or at the ongoing price the firm will be able to sell more.

Therefore, the entire supply curve will shift to the right. So, you see that with technological improvement we can either interpret it from the direct supply functional point of view or from the inverse point of view. From the inverse point of view also we can see that if there is a technological improvement to supply the same amount Q_0 the producer now needs a lower price suppose P tilde initially with the earlier technology the producer required a higher price P_0 to sell amount Q_0.

But with a technological improvement the producer can sell the same amount at a lower price or from the direct supply function point of view. At the same price the producer can produce more earlier at with the initial technology at price P_0 the producer was selling output Q_0 with a better technology the producer can now sell more at the ongoing price.

Because cost of production also falls because with the technological improvement the firm can combine same amount or even less amount of input at a faster time span to produce the same output therefore, we get a new supply curve S_1S_1.

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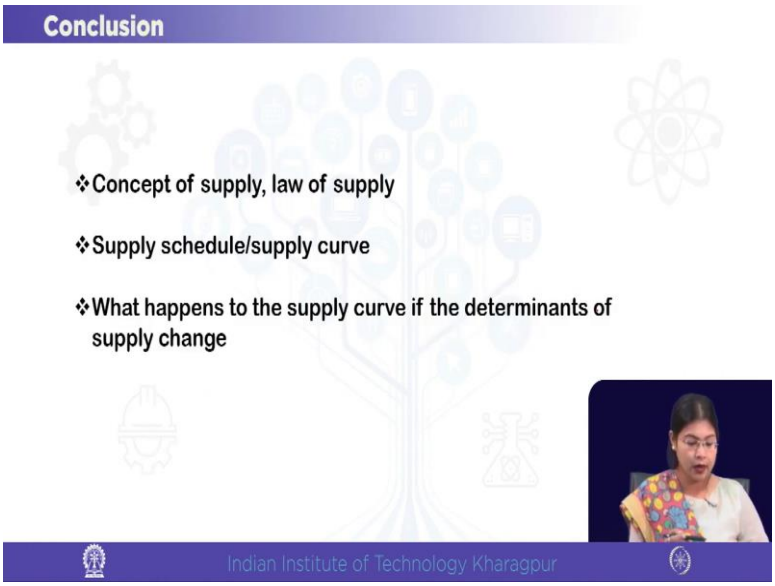

Therefore, what we can conclude is that if something other than own price changes like say for example, technological improvement or change in own price say change in input price we get a new supply curve therefore, that is called a shift of the supply curve. But if only own price changes then we get what we call the change in quantity supply.

So, we move along a particular supply curve. So, just to summarize today's class, we introduce the concept of supply we discuss the relationship between price and quantity supply and we saw that the law of supply tells that price and quantity supply usually are positively related.

But we also discussed about some cases of violation of law of supply, like economies of scale or drastic technological improvement; where the supply curve may be downward sloping, but for the rest of our analysis we will be sticking to law of supply; that means, positively sloped supply curve.

Then we defined what we mean by a supply function, we plotted the supply function and we also mention that we work with the inverse form of the supply function. Next we discussed about the determinants of supply and we saw that what will happen to supply if this determinants change.

So, we compared with shift of supply vis a vis movement along the particular supply curve; that means, change in quantity supply vis a vis change in supply. So, now, what will happen? Now we will bring the two together to find out the market outcome.

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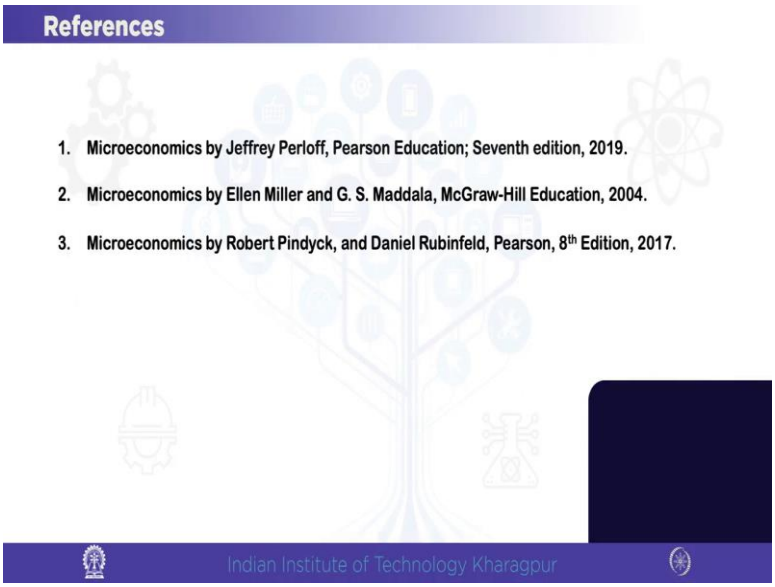

So, thank you very much we will be now meeting next when we will be discussing about the equilibrium outcome in a market; because we have already studied the two sides of the market separately.

Thank you.