International Economics

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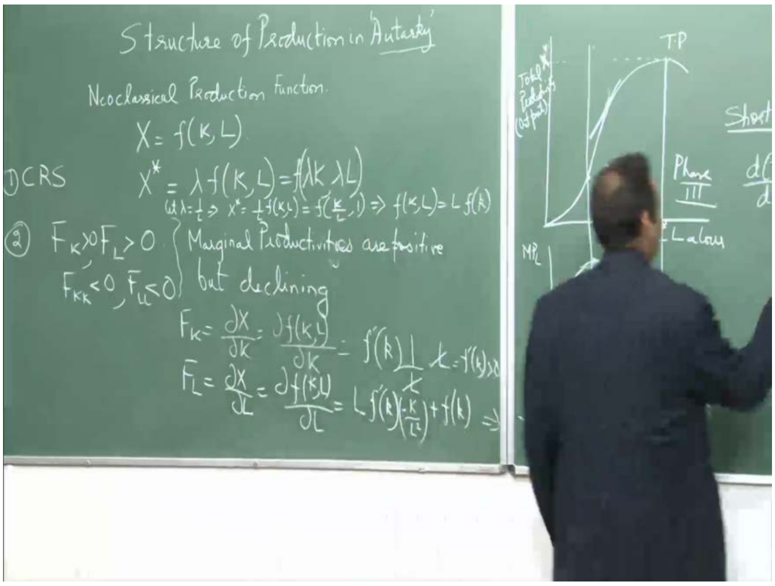

Good afternoon. Today, we are going to talk about the structure of production in autarky. Autarky is a situation, where the countries are not trading, this is a situation before trade. So, one wishes to analyse the situation before trade and then once things become clear of, what is the production and the demand structure then, we will introduce international trade in the market. Now, we have all ready discussed various theories of trade basically, the ricardian theory, the specific factor model and the heckscher-ohlin theory.

Now, I am going back to a situation, where we will analyse the production and the demand structure before trade. This is done to better understand, how relative prices are determined in an economy. Please recall from our previous lectures that, a comparative advantage. In a commodity means that, you can produce that commodity at a lower relative price. Lower relative prices also a reflection of the lower opportunity cost.

So, we wish to know, how are these relative prices determined before trade. Because, once the the relative prices are determined, that will help us to determine whether, that particular country has a comparative advantage in the production of that particular commodity.

So, I will go to the board and in next few lectures will spent time derive trying to understand the production structure in autarky. So, this is the word, which means before trade autarky, autarky is a situation before trade. So, what is assumed is the neoclassical production function. So, if X is a function of K and L, then X star. So, what is assumed is a constant returns to scale and constant returns to scale means, that if capital and labour increases by a factor lambda then, output also increases by a factor lambda. Now, this is an homogeneous production function of degrees one. So, this neoclassical production function is assumes constant returns to scale. So, this is the the first criteria of the neoclassical production function.

Second is that, what is assumed is that the marginal productivity are positive, but declining. So, a rational producer will produce at a stage, where the marginal productivity, this f K is the first derivative of X with respect to K, f L is the first derivative of X with respect to L, f K K is the second derivative of X with respect to K f L L is the second derivative of X with respect to L. Now, you can see that, the we are talking of a phase, where the marginal productivities are positive, but they are declined. And the reason is that, the rational producer would like to produce in a phase, where the marginal productivities are positive, but declining. Because, in the other phases, either the fixed factor or the variable factor, they lose in the other phases whether, it is phase one or phase three the fixed factor and the variable factor they lose by by operating in phase one and phase three. So this, in the literature is a phase, which is phase two where, the marginal productivities are positive, but they are diminishing. This f K K less than 0 f L L less than 0 is also called the law of diminishing marginal productivity, that if you increase labour then the marginal productivity of labour goes down. And there are various reasons for it. One is that, there is imperfect substitutability between capital and labour, which leads to the declining marginal productivities.

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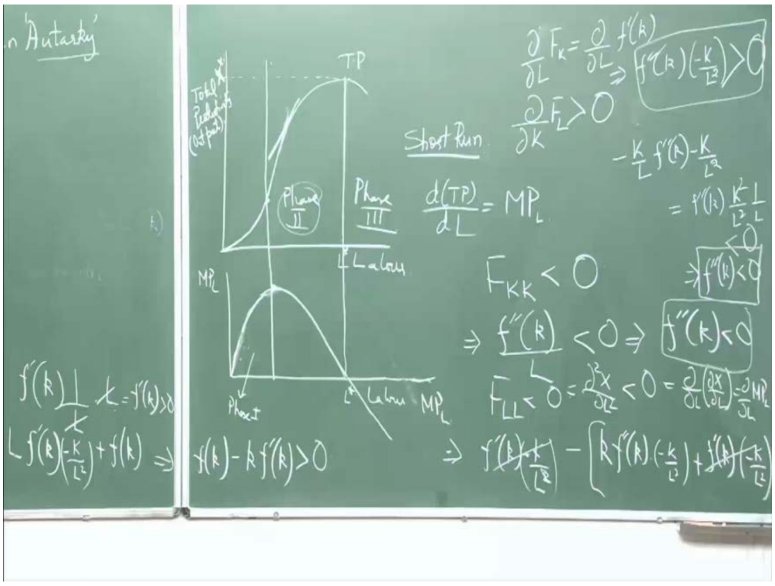

So, if you wish to draw this phase, if you put labour here, and total productivity (no audio 07:06 to 08:44). Now, see this relationship between total product and labour, this is a short run phenomena, where atleast one factor is fixed, that is capital is fixed, labour is the variable factor. Now, this is the relationship that, one imagines in an economy that with an increase in labour, first output increases at a rate which is, output increases at a rate, at a greater rate than, there will be a point where, the total output reaches a maximum and then it comes down. So, the total output first increases at an increasing rate then, total output increases at a decreasing rate, it reaches the maximum and then it comes down.

So, total output, if you increase labour total output first increases at an increasing rate, then at a decreasing rate then, it reaches a maximum and it comes down. Now, the slope of the total product curve, the slope of the total product curve is the is the marginal product. And so, the relationship between marginal product and labour is that, first it goes up it reaches a maximum. This maximum point is the point, where the total product curve changes its curvature. So, this is the point, where the curvature changes, it was this shape and then after this the shape changes this is reflected in the marginal productivity going up and then going down. Now, this phase is called phase one, this phase is called phase two and this is called phase three. Now, you can see that, no producer would like to work in phase three because, this is the after this, if they will start employing labour the marginal productivity becomes negative. And, you can see that the total product is declining. Total product, if it is declining the marginal product of labour would be less than 0. So, no production producer would like to produce at a point, which lies in phase three. Neither, it would operate in phase one because, here in this phase, what is not reflected is that the marginal productivity of the fixed factor, that will become negative. This is a phase, where the fixed factor because, this is a short run phenomena and capital is the fixed factor. So, this is a phase, where you are increasing labour, but the marginal product of the fixed factor is negative in this phase one. So then, an ideal producer would produce in phase two, where the marginal productivity is declining and yet it is positive. Now, that is what it means here, that the marginal productivities are positive, but declining. So, this is the phase in which, the producer will operate

So, now further lets workout, what would be f K f K as I said is Del X del K. So, del f K L del K could be say f dash K and then the derivative of small k and I just tell you what small k is this would be one by L. Now, further if you come back to this point, let us assume that, let lambda will be equal to one by L. This would imply that X star is equal to one by L f K L f K by L one. So, this would mean that, f K L would be L times f k. So, then, del f K L del K would be say L times f dash K L times f dash K and the derivative of small K with respect to big K will be one by L. This and this will cancel so, you get f dash k. So, this is greater than 0, by assumption marginal productivity of capital is greater than 0. F L is del X by del L will which is del f L f K L del L.

So, this would be L times f dash K minus K by L square plus f k. So, this would imply, this this is f K k times f dash K. This is greater than 0, because L and L, this will become L. So, it will become minus K by L. So, minus K by L is small k. So, minus K times f dash K f k. So, marginal productivity of capital is greater than 0. Marginal productivity of labour is greater than zero. So, you have this and then f K K is less than zero. So, f K K would be f double dash K f double dash K by L less than 0. This would imply f double dash K to be less than 0. And f L L less than 0, would imply f dash K minus K by L square minus (no audio 16:24 to 17:00)

So, you can see, now we are finding out the derivative of this, with respect to labour again. Because, f L L is less than 0 is del two del two X del L square, this should be less than zero. So, this is del by del L del X by del L, which is del by del L marginal productivity of labour. Marginal productivity of labour is this. So, the derivative of this with respect to labour is f dash K f dash K and this derivative of the small K with respect to labour is minus K by L square minus K times f double dash K and the derivative of K minus K by L square plus f dash K into derivative of small K with respect to big L is minus K by L square. Now, you will see that this term and this term because, here here you would have a minus and then you have a minus here. So, this and this will cancel. So, what would be left, would be this term, which is minus K by L f double dash K minus K by L square and this works out to be f double dash K K square L square into one by L. Now, this is by assumption less than 0. So, this will again imply that, f double dash small K is less than 0. So, from here also, you see f double dash K less than 0, from second also you see, f double dash K less than 0.

Now, what it would mean is, say for example, if you workout del by del L of f K del by del of f K, f K is f f dash k. So, del by del L of f dash K, it will be f double dash K derivative of, if this is minus K by L square. And so, if f double dash K is less than 0, this would become greater than 0. Now, what it means is that, if you increase labour, the marginal productivity of capital goes up because, labour capital now has more of labour with it. So, it would mean that, it that with more labour coming in marginal productivity of capital goes up.

Similarly, if you workout del by del K of f L, this will again workout to be greater than 0. So two things, one you have diminishing marginal productivity, but then if more labour comes, marginal productivity of capital goes up, if more capital comes, marginal productivity of labour goes up. So, this is you will see that later on, this will become important or this factor was very important, when we are discussing the specific factor model. So, the neoclassical production function assumes constant returns to scale, but diminishing marginal productivity. So, when we are discussing the structure of production in autarky, this is an important assumption

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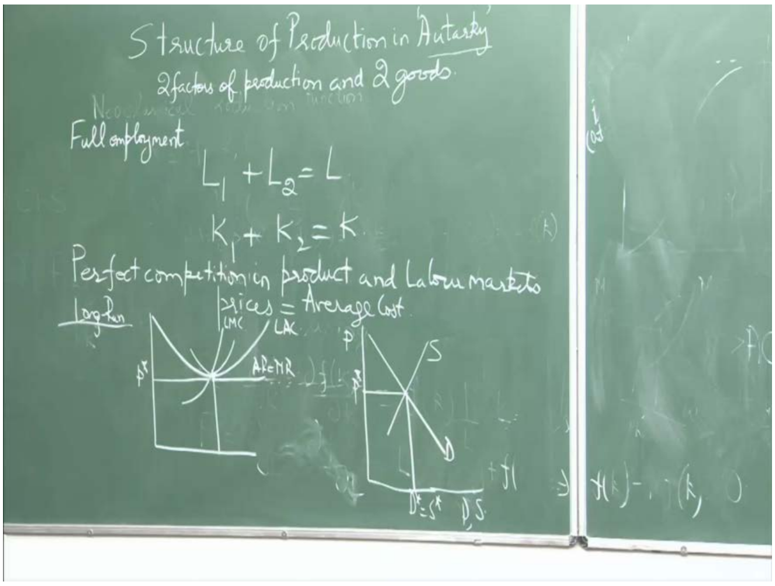

Now, let us go forward and now discuss the structure of production, where you have two goods and you have two factors of production. Now, what we have assume is full employment. This labour is used in industry one and industry two. There are two industries and then you have perfect competition perfect competition means that, there are large number of producers and consumers and everyone is a price taker. The producer are price takers.

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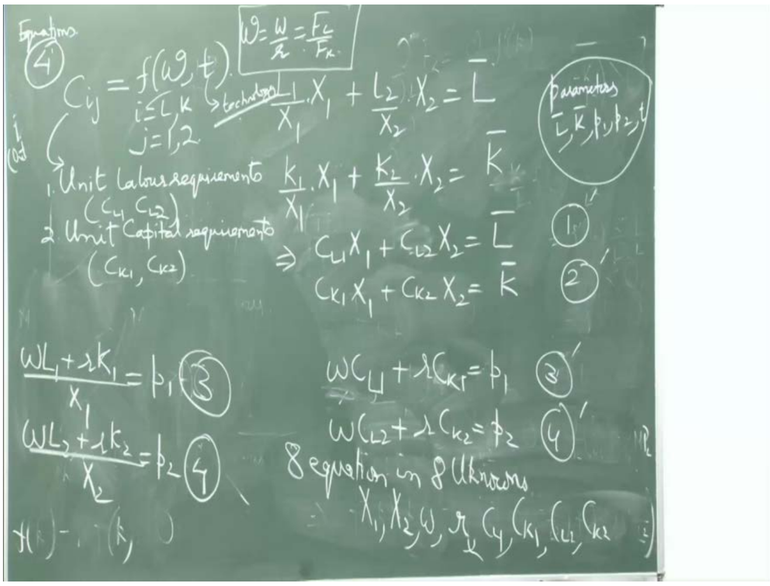

So, in this scenario, the prices are equal to the average cost. Please recall, that firm, perfect competitive firm will operate at a point, a perfect competitor firm is a price taker in the product markets. It would sell any amount at a price p star and in the long run in the long run, it will operate at the minimum of the long run average cost curve. So, prices are equal to the average cost while, it were if it were a monopoly if it were a monopoly then, the prices which are charged, prices are much greater than the prices are greater than the average cost. Because, in case of monopoly, you are a single producer. So, you can afford to charge higher prices. We dispensed with this situation. We are not talking of monopoly. We are talking of perfect competition, where the prices are, what is determined in the market and this is the price at which would sell.

Now, when prices are equal to the average cost, it would mean . So, you have these four equations. Now, you can work further on these four equations. This is fixed. (no audio 26:23 to 28:25). Now, you can see this C i j, i is L and K and j is 1 and 1 and 2. These are unit labour requirement, if it is C L 1 C L 2 amount of labour require to produce one unit of good X 1. C L 2 is amount of labour require to produce one unit of good X 2. C K 1 is the amount of capital require to produce one unit of good X 1. C K 2 is the amount of capital require to produce one unit of good X 2. So, in this model, where we are discussing the structure of production in autarky, you have these 4 equations. 1, 2, 3 and 4 followed up by another 4, which is that this input output coefficient or the unit labour requirement, this is a function of omega and t.

Now, this omega is w by r ratio and at equilibrium, it is equal to f L by f K. I will come back to this point that, at equilibrium, you have relative wage rates equal to the relative marginal productivities. But this unit labour requirements and capital requirement is a function of the relative wage rates. Because of the relative wage rate changes, the unit labour and capital requirements changes and it is also a function of technology . So, this model has 1, 2, 3, 4, 4 equations and 4 equations coming from here because, its C L 1 C L 2 C K 1 C K 2 equal to a function of omega and t omega is the relative wage rates.

So, 4 plus 4, these are 4 equations that make it 8 equations. We have 8 equations and how many unknowns, the unknowns are. So, 8 equations in 8 unknowns, which are the unknowns the unknowns are X 1 X 2 W r C L 1 C K 1 C L 2 C K 2. So, 8 equations in eight unknowns, you will get a unique value of each of these variables, which are the parameters, the parameters are L bar K bar p 1 p 2. And, you have technology L bar K bar p 1 p 2 t these are the parameters. Parameters define the population. These are fixed. These are given. These are unknowns. You have eight equations. So, you have a stable system, where you get you solve for this and you get unique values of X 1 X 2 W r C L 1 C K 1 C L 2 C K 2.

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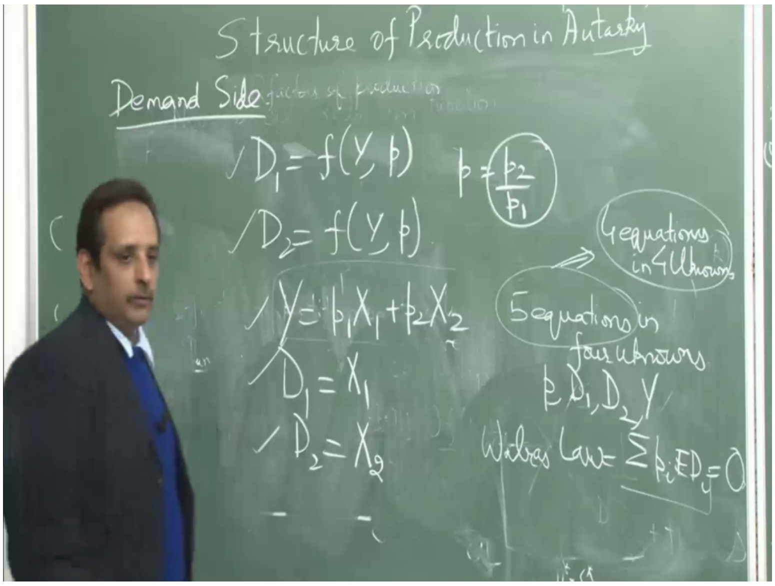

Further, this is the production side. Now, let us bring in the demand side of the model and then we will come back to these equations, for the demand side of the model. So, this is the production side, the demand side (no audio 32:43 to 33:18). Look at the demand side of the model, you have demand is a function of income and p, where p is p 2 by p 1. So, it is a function of prices and income and because, there are two goods in this country. So, you have demands for good one and demand for good two. And you have p which is equal to p 2 by p 1 and you have income which is equal to p 1 X 1 plus p 2 X 2. Because, there are only two goods that people consume. So, income is p 1 X 1 plus p 2 X 2.

And then, you have the equilibrium equations d 1 is equal to X 1 d 2 is equal to X 2. So, you have 1 2 3 4 and 5. You have 5 equations in four unknowns, which are the unknowns. The unknowns are p d 1 d 2 and income d 1 d 2 p and income. But now, there is a problem because, you have more equations in, you have more equations and less unknowns. But, to resolve this there is something called the walrus law, which says that, the some of the excess demand over the over the all over all the markets, the sum of the value of the excess demand, this should be equal to 0. So then, if you if you have an equilibrium in all, but one market, then from this walrus law, you can deduce that, there will be an equilibrium in the in the last market as well.

So and, if you have excess demand in two markets, you will have excess supply in the third market, if you have three markets and all. If you have excess supply in two markets, walrus law will say that, you will have an excess demand in the third market. Because, the sum of the value of the excess demand is equal to 0. So, then one of these equations is redundant. Because, if you if you have an equilibrium here, it will naturally flow that, you will have an equilibrium in the last market. So then, this is corrected, this will be four equations four equations in four unknowns.

You will have four equations in four unknowns. You can solve for each unknown, will get a unique value. What is to be noted that, p here is a variable while, p here was one of the parameters while, we were discussing the production side of the model. So, then the entire structure is solved, there is a production side, which is stable. There is a demand side, which is stable. After discussing this, let me come back to a point, where I said that the relative wage rates is a function of w by r and its equal to f L by f K, marginal productivity of labour by marginal productivity of capital.

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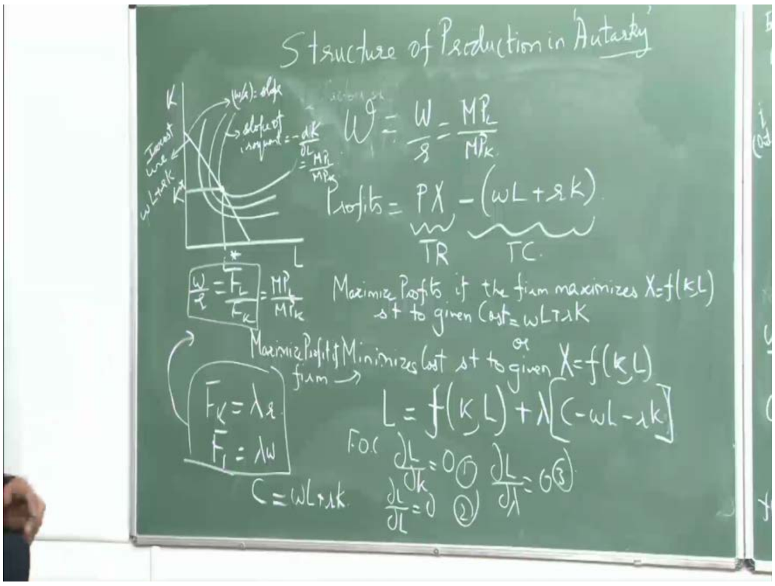

So, after discussing the stability of the model. So, we need to explain, how w by r ratio is equal to the marginal productivity of labour by marginal productivity of capital. Now profits are, now you can see that profits are the difference between total revenue and total cost. Now, you can maximize profits (no audio 38:07 to 38:57). You can maximize profits, if the firm maximizes output subject to a given cost or you can maximize profit, if firm minimizes cost subject to given output. Now, if this is the first part is expressed in terms of lagrangian. We can see that, you can maximize output, that is f K L subject to the given constraint. So, the first order condition would be del L del K equal to 0, del L del L is equal to 0 and del L del lambda equal to 0.

Now, from 1 2 and 3, you will get f K equal to lambda r f L equal to lambda w and the third would give you, cost equal to w L plus r k. So from here, you can see that w by r is equal to f L by f K, which is marginal productivity of labour by marginal productivity of capital. In diagrammatic terms, if you have labour here, if you have capital here, the (()), this is the (()) depicted by w L plus r K, these are the (()). The optimal amounts of labour and capital will be the point, where the slope of this line w by r, which is the slope is equal to the slope of (()), which is minus d K by d L. This is equal to m p L by m p K. Wherever the slope of the (()) is equal to the slope of the (()). This is this will give you the optimal levels of labour and capital. So, this condition w by r is equal to f L by f K will give you the optimal amounts of labour and capital. So, you have f L by f K, which is equal to omega. Omega is a function of marginal productivity of labour and capital marginal productivity in itself, is a function of the capital labour ratio. So then, there is a two way relationship going on. This effects f L f k, changes in f L K, changes omega. So, you have that relationship.

So, we will continue and with this model structure of production in autarky and try to build something further on this and then derive the proof of the Stolper-samuelson and the (()) theorem. Please recall, Stolper-samuelson theorems says that, a rise in the price of a commodity raises the real returns of the intensive factors and decline in real reward of its unintensive factor. (()) says that, an increase in supply of a factor keeping other things constant, will increase the output or which uses intensively the expanding factor and decline in the commodity, the other commodity the declining in the other commodity besides the one, which is using the expanding factor intensively.

So, all that can be proved once you understand the structure of production in autarky. So, I am doing this for two purposes. One, I want to derive the relative prices and why are they important because, relative prices will tell you the opportunity cost of producing well and then this opportunity cost is related to the concept of comparative advantage. So, how do countries derive their comparative advantage? So, this will help us to understand that and then second it helps us to understand the two famous theorems in international economics, which are also one can say an offshoot of the (()) model, that is the Stolper-samuelson theorem and the (()) theorem. The third thing that we will do is, we will also understand how technology is defined different types of technology, the hicks neutral technology, the capital deepening technology, the labour deepening technology. How are they defined and how does trade and technology how trade and technology related with each other. So, with these three purposes, we will continue building on this model and that we will discuss it in the next lecture. Thank you so much.