

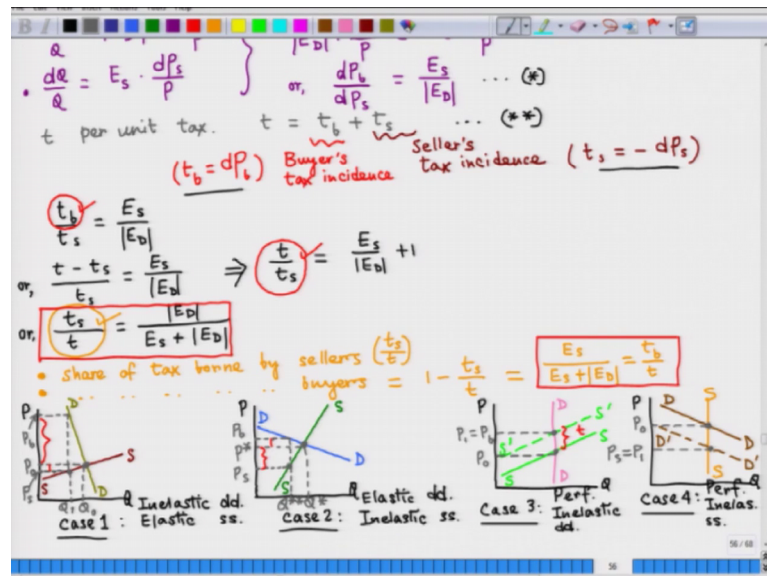
Microeconomics: Theory & Applications
Prof. Deep Mukherjee
Department of Economic Sciences
Indian Institute of Technology, Kanpur

Lecture - 43

Welfare Analysis of Government Intervention in Competitive Market (Part-2)

Hello. Welcome back to the lecture series on Microeconomics.

(Refer Slide Time: 00:18)



To interpret this, let us have a look at this expression; what does this give? This basically gives the share of tax borne by the sellers ok. So, we see that this is linked with the elasticity values. Now how we can find the share of the tax borne by the buyers? It is simple, we have to take 1 minus of this expression $\frac{t_s}{t}$ and if we do that calculation, we will see that this comes out to be.

So now, the final expression for the share of tax borne by buyers would be given by E_s divided by E_s plus E_D right. So, the implication of what we have derived mathematically is the following. So, how much of our tax will be borne by the buyers and how much will be borne by the sellers is basically dependent on the elasticity of demand and elasticity of supply values; so depending upon the various values of the demand function and the supply function the share of the tax between the buyer and seller changes.

So now, we are going to have diagrammatic illustration for some cases where you know this issue will be more clear. So now, we are going to draw some diagrams for various cases. So, this is our case number 1 which is basically the case of inelastic demand and elastic supply right. So, how do we plot this? So, as usual I measure quantity along the horizontal axis and the price along the vertical axis ok. So now, let us have a very inelastic demand function. So, it will be a very steep demand function something like this. So, let us call this DD ok.

And now we are going to superimpose the relatively elastic supply function; so very flat supply function like this, SS say ok. So now, let us see in this case, let us see how the unit tax is going to be shared between the buyer and the seller. So, the equilibrium is obtained here at the intersection we all know that and that is basically denoted by P naught right. The market equilibrium price, let me denote that by P naught and then Q naught is basically my quantity being bought and sold in the market.

Now, what I am saying is the following. Let us shift the demand function due to the imposition of the unit tax and if that is the case, we say suppose we observe another point on the supply function where the new demand function makes a tangency with the original supply function. The slope of the demand function remains same it is basically a parallel downward shift right. So, we can get a new price and that price is basically P_s right, the price the net price that seller receives after paying the tax. So, this is the post tax equilibrium quantity of output in the market. Now if you move up, then you meet this demand function right and corresponding price that can be read from the demand function for this equilibrium output level is basically P_b right ok.

So, now you look at the share borne by the consumer which is much higher compared to what is borne by the seller right ok. So now, we move to the other case where we have the opposite story, there we have kind of elastic demand function and kind of inelastic supply function. Now let us see what happens in that case. So, again we draw a fresh diagram. So now, we are going to draw relatively elastic demand function. So, a demand function which is much flat compared to the previous demand function. So, let me call that DD the initial demand function and now we are going to draw a relatively inelastic supply function right. So now, that type of supply function we know, we will have a positive intercept along the quantity axis rather than the previous case where we had a

elastic supply function which had an intercept along the price axis. So, I hope that you recall these facts from our discussion on elasticity of supply.

So now, as usual the equilibrium market equilibrium is to be obtained at the intersection between the initial demand and supply functions. And so, let us assume that the market quantity is equilibrium quantity is given by q^* and market clearing price is P^* right. Now we impose the unit tax. Now again we think about shift in the demand function to analyze the case of unit tax. So, of course, the demand function will shift downward parallelly and it will cut the original supply function somewhere right. And let us say at this point, it is going to cut the original supply function.

So, there the new equilibrium is going to be obtained right. So, in that case, we find the new equilibrium which is given by Q^{**} output level and this is the price that is obtained by the seller. So, let me denote this by P_s and we know that to find the price to be paid by the buyer can be found from the demand function. The price which corresponds to the market clearing output level or equilibrium output level which is Q^{**} . So, we move up the curve and we read the price from the demand function for that output level and that is basically my price paid by the buyer P_b .

So, here you note that the producers take higher burden of the share compared to the buyers as the difference between P^* and P_b is much smaller than the distance between P^* and P_s ok. Now we move to some more interesting cases where we have perfectly inelastic demand ok. So, in this case, we know we are going to observe a vertical demand function like this DD. And in that case we cannot change the demand function to analyze what is going to happen when the government imposes a unit tax. So, here the treatment shall be through the supply curve. We need to shift the supply curve and we know how it is going to change it is basically; suppose my original supply function is SS.

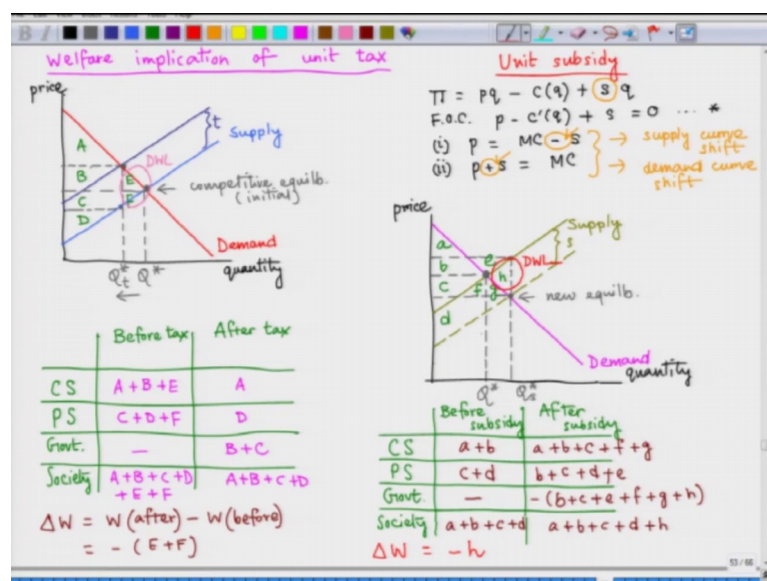
So, in this case the supply function is going to shift parallelly upward and we get a new supply function say S' and we see that entire tax burden which is basically t is basically borne by the buyer, why? Because now look at the equilibrium price, earlier it was say P^0 and now the new equilibrium is P_1 , but this is P_b as well right. So, here in the case of inelastic demand the tax is totally borne by the buyer. Now we are going to study the case of perfect inelastic supply ok.

So, now let us look at the case where the elasticity of supply is 0 that leads to an inelastic supply curve. So, in this case, if the government imposes unit tax; how that is going to impact the consumers and producers? So, let us revisit the diagram. So, when we have a perfectly inelastic supply function. That means, we are dealing with a vertical supply function like this denoted by S the initial supply function. Now as this is vertical the analysis of tax imposition shall be now done through the demand function. So, here we are going to assume a standard demand function where we have downward sloping demand function.

So, let us have an initial demand function say, DD to start with right and then of course, as the tax is imposed we know what to do to we need to shift this demand function parallelly downward and that can be represented by this broken line. Let me call this D' prime demand function right. And you note that the initial market equilibrium is obtained at the intersection between the original demand function and the original supply function. And the price is say P^* or P_0 whatever you want to call it. And the changed market price will be obtained by the intersection of this new demand function and the old supply function. So, here the price will fall to P_1 , but note that the market equilibrium quantity will remain the same, because we are working with fixed supply.

Now, note that this P_1 is equal to P_s as well. So, this is the supply price. So, here there is no impact on the buyer's price which is P_b . So, what do we see? We see when the supply is inelastic, the incidence of tax totally falls upon the seller. So, we have seen that imposition of tax in general cases where we have downward sloping demand function and upward sloping supply function, we see that imposition of tax leads to rise in market price and fall in the equilibrium quantity of output in the otherwise competitive market. So, of course, this will lead to some fall in social welfare; hence there will be some deadweight loss from imposition of tax; so now, let us going to study dead weight loss after tax imposition through a diagram.

(Refer Slide Time: 17:28)



Now, revisit our original perfectly competitive market equilibrium diagram and see the implication welfare implications of unit tax imposition. So, of course, at the intersection of demand and supply in this diagram is basically my competitive equilibrium which is my initial position. And then there is the unit tax imposition from government side. Now we take the case of supply curve. So, to analyze that unit tax imposition, let us assume that the supply curve has shifted up. So, basically the original supply curve has now shifted parallelly upward. So, this is my new supply curve and the gap between these two is basically my unit tax rate right ok.

So, of course, we know that at the intersection of this new supply curve and the original demand curve, we find another equilibrium ok. So, now, let me say that $P^* Q^*$ is basically the price quantity combination which is obtained from the competitive market equilibrium. And here after imposition of unit tax we get a different market outcome and that is basically giving us a market output level Q^* , t denotes the tax case ok. So now, we would like to geometrically analyze the welfare implication of this reduction in the market equilibrium output level. So, for that we need to name give names to some of these areas right which are generated, ok.

So now, let me name this area. So, this is area A say, this is basically my area B. So, this rectangle here this entire rectangle is my area B, then this rectangle generated just below of this rectangle B is named C, then this triangle here is named D and then this small

triangle here is E and then this is F right. So, that is basically my nomenclature ok. So, now, we are ready to draw a table which will give you the exact areas of welfare changes right.

So, we are going to draw; so, here we are going to measure consumer surplus, producer surplus ok. Then we have a third party here another economic agent that is basically government and then finally, we have society right as a sum total of the all three economic agents right. So now, we are going to measure the before tax welfare in the second column and after tax welfare areas or measurements in the third column right ok. So now, let us feel some numbers here. So here, we can see that before the tax imposition the consumer surplus was A plus B plus E, right. And after the tax imposition it is only A.

Now the producer surplus before tax imposition was C plus D plus F, but after the tax imposition it is only D right. And when there was no tax government was earning nothing. So, basically there is nothing in the sale, but now after tax imposition government receives tax revenue which is given by the area B plus C, right. So, previously before the tax imposition we had society's total welfare a equal to A plus B plus C plus D plus E plus F. And now after tax imposition it has reduced to A plus B plus C plus D, right ok. So, then what is my changing welfare? If I denote that change in welfare by ΔW , then basically I am interested in W after the tax imposition minus welfare level before tax imposition right.

So, if we take the difference then we are left with minus of E plus F. So, basically we see a deadweight loss or a negative welfare change corresponding unit tax imposition. So, basically if we go to this diagram, we talk about this triangle here right. So, that is basically my deadweight loss in this case ok. So, we have some time left and in the remaining time, I would like to briefly talk about one more issue and that is the issue of subsidy. So, we will see that unit subsidy case is basically very simple to understand because we have already discussed the unit tax case in great detail; subsidy will be exactly opposite. So, one can actually think about unit subsidy as the negative of unit tax.

So, let us quickly study what is going to happen if government gives subsidy to producers to produce some output or some product. So, let us go back to the firms case as we did in the case of tax also. So, in this case a competitive firms profit expression or equation would be written as revenue minus cost. But this time, he will receive some per

unit subsidy which is given by the symbol s and we have to multiply this per unit subsidy with quantity level that this form finally, produces right. So, of course, the next thing to consider is the first order condition. So, if we differentiate with respect to q in order to find optimal quantity of production of the firm, we get $P - C'q + s$ equal to 0, right.

So now, note that this first order condition which I am denoting by esthetics can be written in two alternative ways right ok. So, alternative number 1 is price equal to marginal cost minus the unit subsidy and the second alternative to write the same first order condition would be price plus the unit subsidy level equals to the marginal cost ok. So now, note at these two alternatives right. So, the alternative number one is basically talking about a supply curve shift and this shift is downwards because we are talking about a negative sign here right ok. And the second alternative is basically talking about a demand curve shift and this shift is basically parallelly upward, because we are talking about a positive sign here right ok.

So, again we see the same thing as we have observed in the case of unit tax that it does not matter which curve you want to shift. You can shift either curve and you get the same out model outcome, but you cannot shift both the curves together ok. So now, let us quickly have diagrammatic analysis of the unit subsidy case and there, we are going to assume that we are going to shift the supply function right.

So, quickly let us draw the demand function in the supply function with usual assumptions that there are straight lines; it does not matter actually whether I draw a straight line or not, but just to have simplified cases I am doing, ok. And let us now talk about the supply curve shift. So, we have to basically talk about a downward shift of the parallel downward shift of the supply function and that is basically giving me the difference between this broken line and the solid line. The original supply curve and the new supply curve gives me the unit subsidy rate which is given by s right ok.

Now let us look at the equilibrium and let us plot the equilibrium quantities mark them ok. So, this is basically my competitive market equilibrium, this one the initial equilibrium and the changed one is basically this one down here ok.

So, now let us plot the competitive equilibrium level Q^* and then after subsidy imposition the market outcome that is basically Q^* , if S subscript denotes the

subsidy case ok. So now, let us complete the diagram. So, we have drawn our diagram by shifting the supply curve to find a new equilibrium. So, this is my new equilibrium and this one here is my first or competitive equilibrium right ok. So now, let us we got some areas in the diagram let us name them. So, let me name them with a then b then, this area is c and then we have this big triangle here as d, and then we have this area which is e. And then finally, I name these two small triangles here as f and g ok. So, I have used the small case letters to distinguish them from the tax case I hope that will be helpful.

So now, we are in a position to draw the table and do the welfare analysis. So, as usual we are going to have a table ok. So, we have CS, consumer surplus; PS, producer surplus; government sector and society as a whole all right and then we measure the welfare before subsidy and after subsidy right ok. So now, let us note down the numbers ok.

So, here the before subsidy case the consumer surplus was a plus b right and after the subsidy it went up to a plus b plus c plus f plus g right ok. So now, what happened to the producer surplus? Previously it was c plus d, and now after the subsidy is given to the firms it changes to b plus c plus d plus e right ok. Now government earlier had no role to play. So, we can put nothing in the cell here, but after the subsidies imposed government has to be at the cost of subsidy. So, government has to spend some money and that is why we put a negative sign in front of the area that we are going to now write down. So, this is basically the area that the government has to pay a subsidy right ok.

So now, society as a whole earns social welfare gets social welfare a plus b plus c plus d in the P subsidy case and now in the post subsidy case it is going to be a plus b plus oops I sorry. So now, this area is basically h forgot to mark that. So, I forgot to mark one small triangle here which is h. So, I need that for my analysis to be complete.

So now, we are in a position to write down the government subsidy and we put a negative sign in front of that, because this is the expenditure from government's pocket. So, this is the volume of subsidy which is given to firms by the government. So, it is a loss right. So now, before the subsidy imposition the welfare was a plus b plus c plus d. Now in this case after the subsidy is given the welfare societies total welfare becomes a plus b plus c plus d plus h right ok. So, now, what is the change in the welfare? If I denote that by ΔW that is basically talking about the welfare level, the difference in welfare level after the subsidy is given and before the subsidy was given. So, if we take

the difference of these two welfare levels, we are left with minus h ok. So now, we can go to our diagram and we can see that this is basically the area of deadweight loss which is again a triangle, ok.

So, this completes our discussion on unit subsidy and its welfare implications on the economy. So, with this let us finish our discussion on taxes. Now we are going to move to other types of market failure in the next lecture.