Lecture – 14

So, I have the assets market description and that is all description, it is not the crucial assumption that we used. If you remember, this was that the rate of interest and prices of assets are inversely, none are inversely related whether it is true in the economy. Suppose, you go back to early days like even 10, 15 years 20 years back in Indian economy interests were all much regulated. So, stock market price and interest rates were never related because they were regulated interest rates, RBI was putting a restriction on interest rates and banks did not have the freedom to increase or decrease them.

Now, we are entering a regime where interest rates are set free, so banks are deregulating them, deregulating them means they are saying we put any restriction banks, what interest rate is going to be, what you want to charge. So, in a system, now it is very funny you probably have different banks have different interest rates. Earlier, when I was growing up, any bank you go to particularly public sector banks were there, private sector banks hardly we know there were no Citi bank, no standard chartered, no Hong Kong bank, no deutsche bank, nothing.

I have never seen them, before I saw them, only a few years back, so any public sector bank you go to government bank which were all nationalized in India in 1969 Allahabad bank, Punjab national bank, state bank of India, you know Canara bank, Bank of Baroda. Funny thing was any bank you go to it is a public sector bank, it is more or less the same interest rate or if not exactly the same interest rate you will get.

So, why do different banks exist you wonder actually their origin was different their origin was different. They were all in the private sector, they were nationalized and they remained a separate entity, they were initially before nationalization, they were private sector banks. So, it is debatable, but we need not go into that, we are into macroeconomic theory, understanding if macroeconomic theory fails to explain something, some of the assumptions that we are making are not realistic.

We will have to take note of that at the time of discussing that particular issue say about Indian economy. Now, interest rates are regulated well LM function invalid, you cannot have a LM function like that. At least, you got to connect it with the stock market, then the model becomes more deficient and if you have interest rates regulated what would happen is LM model. You can have excess supply, excess demand situations, you may not have an equilibrium point. If you are regulating it, controlling it, it is not a free variable.

Then, it cannot correct the imbalance and like demand supply function may not intersect, the price may be at a place where demand is more or the supply is more because you have fixed it. It does not change same thing will happen in LM model if interest rates are regulated, they will get fixed, you have permanent disequilibrium, and it cannot correct and go to the intersection of LM. So, these issues are there, but we need not worry about it because we want to know the macroeconomic theory.

Now, in LM model, yesterday I was doing something one more theoretical exercise, I will do before I go into those x multipliers etcetera is that, I was trying to talk about not in this simultaneous equation system that you have. We have two equations and x and y variables that have to be solved are output and interest rate, you know simultaneous equation. It is no big deal, you know that, so the two equations will solve for the values of rate of interest and output. Those were those will be the equilibrium values the question is if you are in the disequilibrium zone like the zone 1, zone 2, zone 3, zone 4.

Then, you have various kinds of disequilibrium is goods market disequilibrium is one type may be excess supply, but money market may be excess demand. In another case, where the goods market has excess demand and money market has excess supply, so you have a whole lot of combination of disequilibrium. So, with what we call a phase diagram, I was trying to find out that given the assumption that whenever there is a goods market disequilibrium output will adjust y.

Whenever there is a money market disequilibrium, the rate of interest will adjust to clear the money market. If you make that assumption that rate of interest response to any disequilibrium in the money market and output responds to any disequilibrium in the goods market. Then we get those arrows horizontal arrows were showing y adjustments vertical arrows were showing rate of interest adjustments.

Now, when two variables are adjusting suppose there is a disequilibrium in both the markets, then that combination of the two will be the final impact on the economy. So, I had an oscillating path assuming it reaches equilibrium over time alright, but the economy really does not go through an oscillation like that. Economy usually goes through a disequilibrium adjustment as I was trying to tell you on kind of a one line non linear line may be passing through the equilibrium point. It goes and cashes that line and comes down the ladder or goes up the ladder, it does not keep on oscillating.

It remains within one zone, after it gets hold of that equilibrium path and then goes up and down to reach the point intersecting point. Now, algebraically we can also talk about this stability these stability issues, so stability of the model we can also talk about algebraically. Now, in microeconomics what we do as opposed to macroeconomics in microeconomics, we say a company is maximizing profit goods, but we obtain algebraically the first order conditions for an optimum the tangent will be zero slope. It is a curve is reached an optimum the tangent there will be zero slope, so that tangent is called in algebraic term.

This is first derivate say equal to 0, but whether it has reached the maximum or it has reached a minimum, we put the second order condition the second order conditions for a maximum goods. If you have reached a maximum, beyond that point the curve should be coming down and for a minimum. If you have reached a minimum, then beyond that point, the curve should be climbing up. So, in terms of second derivatives, you have negative second derivate less than 0 for a maximum and for a minimum, you have positive.

Now, this second order condition's parallel issues, these are also called stability issues in microeconomics. The parallel issues in macroeconomics are these stability conditions that if you reach an equilibrium whether it is stable or not. You know if you are dislodged from the equilibrium whether you can come back to it or not like I have a toy which has a spring attached to it, I shoot it, but then I want it to become, I want that to return to me. Then I call it equilibrium, if disequilibrium, I shoot it and it keeps on flying out like in space if you throw something, it goes into some other orbit.

So, that is disequilibrium in differential equation systems if you have done mathematics what you have is you have three kinds of paths. You can get from differential equations

when they talk about stability issues one is an oscillating path keeps on going up and down around the equilibrium point never reaches. The oscillating path continuous, it is same amplitude mathematics differential equation to talk about the equilibriums. One can be an oscillating path, one can be a converging path that means the differences go down and down and reaches equilibrium point.

One can be a diverging path, which is an exploding the cycles if you talk about kind of a cycles or whatever path to equilibrium, one can be converging. One can be diverging and one can be oscillating on and the diverging are ruled out for stability purposes only the converging path. So, the question is as soon as you have in the LM model a disequilibrium what will happen.

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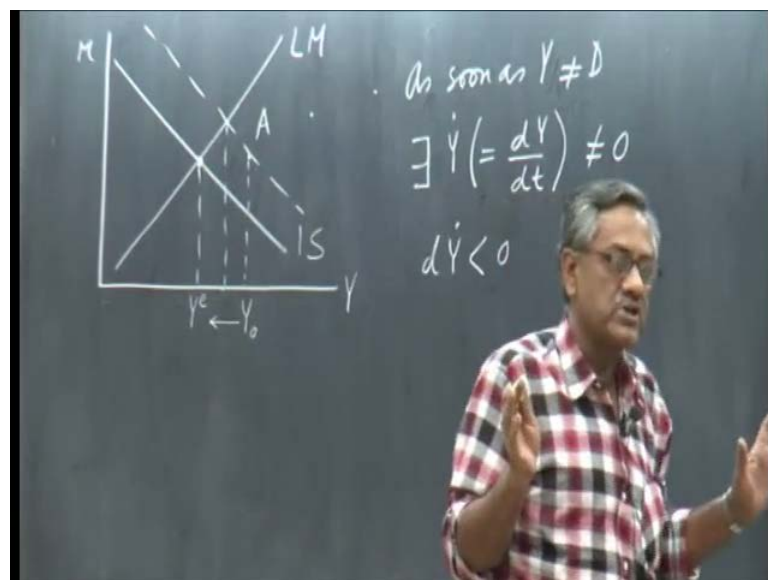
The Point is if there is a shock to the system, you are thrown out do you come back or you reach a new equilibrium point there are the two issues. Suppose, the IS curve shifts graphically I know the intersecting point is there that is the equilibrium point that is very easy to say. It is like a first order condition, but do we reach that, so there is a path to reach that, now suppose I say there is a shock to the system, say you are at a point A. Now, at point A, you have disequilibrium, you have some output in the economy say A demand y, but output is at some equilibrium value say y e.

Now, if the demand shifts for some reason, there is an economy which can say that you have reached a point where you have some sort of a disequilibrium. So, whether you

return to the equilibrium point or not, so the companies would say suppose the companies are saying this is the point we actually are producing, but the IS curve has the demand in it. The demand is here not here, so what the companies would do companies would reduce output. So, what you have here is that you require a movement in this direction, alternatively I can say suppose the IS curve has shifted.

So, output is here, but demand has gone there or somewhere for overall equilibrium, you need the intersecting point. So, does the economy travel from this point to this point either way if the IS curve shifts because of increase in demand. I was talking of g increases, then suppose the IS curve shifts to some point and you know graphically this is the equilibrium point what has happened is the demand has shifted there that is why IS has shifted. So, the companies are producing at y e, but the demand is somewhere in between suppose not in between somewhere here.

So, the question is whether the companies would produce more number one and whether you would reach here which requires a rate or interest adjustment, where the rate of interest also climbs up to this point two adjustments are required. Then you reach the equilibrium point if you do not if there is any shock the economy goes out to somewhere here. Then here it is far away from the equilibrium point that is an unstable situation, now this kind of stability issues are like second order conditions in macroeconomics. Similar to microeconomics in simple terms, suppose you have one variable y forget about rate of interest.

Now, suppose one variable y what will happen if demand curve shifts or the economy was here which I was trying to explain earlier. So, it is more they are producing, then what the demand is now the demand is here, but economy is producing here, it will reduce supply or if IS shifts because of demand increases. Then output should increase to a new equilibrium point here and the rate of interest also will increase. Now, in case of one variable, if you look at one variable you are saying if there is a disequilibrium as soon as y is not equal to d, there is a y dot.

There exists a y dot y would change there exists a y dot output would change companies would start revising their production plans unintended inventory changes, which I was talking about which would signal them change output level. So, they would change output the question is if that y dot the change in output y dot is what d y over d t that is y

dot if output changes. If you find over time, it is becoming smaller and smaller that means the companies are realizing that and making the extra output smaller and smaller means what, they are reaching an equilibrium point.

They can see that market is getting happy saturated satisfied, but if companies have a reaction where output changes are becoming larger and larger, they are getting the wrong signal market cannot be an ever expanding market. If the output changes over time, if you find becoming larger and larger you have some sort of a disequilibrium in this situation why it is there we do not know, but the companies are responding by increasing output bigger and bigger, but I know I have to go there. What happens in a car to start the car, you start at a slow speed, then you go to the second gear, third gear, when the road is smooth the traffic is not big go to fourth gear.

You travel as you see, you are approaching the destination, then what happens from the steady speed, and you start lowering it to third gear. Then second gear, finally you reach the destination, one gear the speed slows down mean you are reaching the destination, but if some lunatic is there who wants to go from distance a to b cannot see b. Instead of slowing it down or reaching a steady speed at some point, it keeps on increasing the speed does not come down from the fourth gear. So, from 80 kilometer goes to 100 kilometers 120 kilometers, it will overshoot the equilibrium and go out.

If he does not see more, if there is some barrier he may just crash have an accident that is unstable path in case of a stable path the change in output, of course will be there because there is a shock to the system. Either demand has gone up or they were producing more as like a, so they should come down, this equilibrium output they were producing. So, they should lower it or if demand shifts like IS shift, then they would increase output, but if the increase in output becomes through knowledge through learning how market adjusts.

If you see firms are getting more confident in increasing, but slowing it down increase no need to panic. We can see the destination how much we have to increase for the market to remain satisfied that means the market has a stable path to an equilibrium, you understand what I am saying. So, the y dot term will be there non zero, but the question is whether d y dot is less than 0 or change in y dot becomes smaller and smaller or not,

you see what I am saying y dot will be non zero as soon as y is not equal to g this y dot will be non zero not equal to 0.

Then, when y dot becomes 0, means d y dot has to become negative smaller and smaller and smaller and smaller. Then finally y dot is 0, no change in output, further out change in output is required because it has reached the equilibrium. So, y is at the new equilibrium value matches the demand, no more requirement to change the output, so y dot is 0, no more change in output, do you understand. So, if in case of one variable, I can talk about the stability issue simply in terms of these y dot and d y dot variable is the intuition, anybody has a problem, no problem.

The problem is in the module, you just do not have one variable which would respond or react to this equilibrium, you have r also, now we will have two dynamic variables and the equilibrium point r dot will also be 0. It has reached equilibrium, no more changes required y dot is also 0, but at some point r dot or y dot both may be non zero like phase 1, phase 2, phase 3, phase 4 with those arrows. I was showing r is changing, y is changing, so both can change in this case the algebra becomes a little bit more complicated.

I do not want to give you an algebraic proof, but I want you to accept if you want references where to get the proof of this kind of a thing. I can also keep something at copy point, if any of you interested in the mathematics of it what happens. Then I need A, I need to work with two dynamic variables y dot r dot, where I will get a matrix and the stability conditions are the properties of that matrix.

So, I use some, I impose some conditions on that matrix, now just not y dot when you have two variables. So, can I just explain that to you how that matrix is used a little bit, whereas please do not ask me where is the theoretical proof. This is the stability condition in case of two variables adjusting, I can show that to you, I have some algebraic proof, I can keep that in copy point, I can give you references, but it will unnecessarily take up time. In fact, I forgot to prove it, I have to open the book and prove the theorem, and it is like a theorem.

So, I want to use the theorem in case of two variables, it is simple you have 2 by 2 matrix you will have and in case of 2 by 2 matrix, what you have the determinant will be positive. The trace will be negative that is all in case of one variable, it will be one

element, one component of the matrix which has to be negative d y dot d y has to be negative. Essentially, in case of two variables, you will understood d y dot negative, why did I say that the change in y dot becomes smaller and smaller. You are approaching equilibrium converging path and in case of 2 by 2 matrix, 2 by 2 because of two variables.

It will have 2 by 2 matrix, it will be the determinant of the matrix is positive the trace is negative, what it will be there. So, what I would do, now I would use the IS LM model, I am talking about the IS LM model. I have used the assumptions that we already have and try to find out whether the IS LM model ensures that a matrix like that is has a determinant positive and trace negative or not. Even if it is true, do not ask me why the determinant positive and trace negative required, I require the mathematic the theorem to be proved, please do not ask me. I can give you some reference to that where it is available, it is not very difficult, you require differential equations to solve it.

So, let me go back to the hypothesis we have by decreasing y not r not are we creating a case of recession. The change is not reducing y change in y dot can be positive or negative depending upon where you are in that phase diagram. If you go back to yesterday's diagram in some zones y was required to come down to reach equilibrium in some zones y was required to go up. So, the y dot can be negative or positive the question is when you are reaching equilibrium the d y dot becomes smaller and smaller or not. You are reaching equilibrium number, when you reach equilibrium y dot is 0, no more change in y because y dot is d y d t change in y over time.

I am going to run to your place, so I start running and then when I am reaching the destination. Essentially, I am slowing down that is what I am saying, otherwise I will overshoot do you understand what i am saying, so I start at a large at higher speed. Then I slow down now what is the assumption that I am making output would adjust to inventory signals that firms get. Whenever there is a disequilibrium in the goods market rate of interest would adjust God knows why do not ask me.

I will try to explain whenever there is a money market disequilibrium primarily banks would respond to that that is a bank's behavior rate of interest of interest is primarily the banks domain and money supply demand for money someway in the monetary system. So, may be Central Bank does it or whoever does it, so now we will write two equations

find out whether it makes sense or not y dot means change in output is in response to disequilibrium in the goods market.

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So, I can write an equation y dot is equal to a y minus d where a is the speed of adjustment is like less than 0, why because if y is greater than d, here a positive number. Here, what does it mean, excess supply y greater than d means more output produced than demand, excess supply firms get unintended inventory changes is positive, they cannot sell it, so what they would do they would reduce output. So, y dot will be negative, so I make the coefficient a less than 0, when there is a positive number inside the bracket with a negative coefficient outside y dot becomes a negative number less than 0 firms respond by lowering output level.

They reach the equilibrium again what will happen to y dot when y is equal to d what is y dot 0, no more y changes are required it is not a question of recession this is not a question of expansion. This is a question of correction in the market, when you are off the equilibrium point, you are in a disequilibrium area whether you reach equilibrium or not it is not a question of recession or expansion or anything like that. Similarly, I am saying that the rate of interest will adjust to disequilibrium in the money market, so my m say m not over p not is the supply of money. I have the supply in here supply of output minus demand for money which you can put what is the demand for that.

I put an m d, so it is m d over p not which is the demand for money function again b is less than 0, when supply is greater than demand, rate of interest falls when supply is greater than demand rate of interest falls when banks have enough cash. For instance, the demand for money is not so high, why would banks pay a high interest rate to you, one explanation I am trying to give they have enough cash. They do not have to attract your money through deposits etcetera by paying higher interest rate. So, that acts as an incentive so rate of interest is like the price of money, so if the money is enough there supply of money more rate of interest will be can come down to adjust.

So, here again r not is negative when you have b less than 0 and supply of money is greater than demand for money. Now, the problem is you have two differential equations, now I will set up the matrix all I do is very simple, I have to this y dot is equal to a here y minus d what is d not minus c into 1 minus t y minus i function of r. This is the function you have and you r not is equal to b is m not over p not and what is a demand for money the demand for minus h y minus l r. This theorem is not very complicated, if you want reference I can give it to you, I will keep some copy. If you are interested, write a mail to me at copy point, I will keep a proof of this theorem, it is not very difficult at all.

So, now what I do, I totally differentiate this totally differentiate what you have is d y dot is equal to A. Now, b y and here is a d y, so it will be 1 minus c into 1 minus t b y and d a not is 0, I am assuming for stability purposes r and y to change to change only. I do not want continuous shocks in the system, you will never reach equilibrium, so d a not is 0 no extra variables are changing, so you have minus, then you have minus I r d r, this is the first equation you have.

Then, you have d dot which is equal to b here m not over p naught, supply of money is constant is 0, so what you have here is minus h d y minus l r d r. Now, what you see here in the right hand side, you have d y in both the equations d r in both the equations, the simultaneous equation system is here you have a coefficient.

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So, if you arrange them in matrix format, so in matrix format what it will be in matrix format what it will be a into 1 minus c and then A into minus I r. In the second equation, it will be minus b h and minus b l r and it will be multiplied by this rector d y d r. Now, what I was trying to tell you about this example, here with one variable essential in case of one variable what you have the second component is not there. The second line is not there only this element is there, so what you get as a second order condition is d y dot over d y is equal to this whether that is negative or not. As d y changes, d y dot becomes smaller and smaller or not as y changes d y dot becomes smaller and smaller or not that is the coefficient for one variable.

For one variable, what you have is d y dot over d y negative or not you can see A is a negative term, in the bracket you have a positive term. So, it is negative, so model is stable, but for two variable, I need that matrix, it can be easily shown mathematically. For two variable, you need that matrix and what the stability conditions are twofold, there are two stability conditions. The stability conditions two one determinant which we often write as delta or something should be positive and b trace of the matrix should be negative. Now, you check whether determinant is positive and trace negative or not what is the determinant of that.
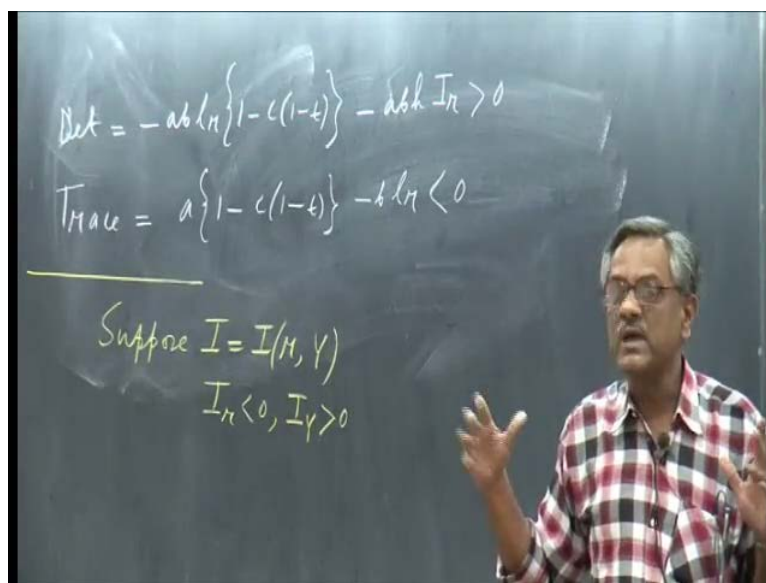
Matrix determinant is how much det or capital D capital d a b minus a b l r, second bracket 1 minus c into 1 minus t. Then you have minus plus minus a b again h I r or something like that, this is what you have as the determinant. This is positive, it is very good news, look I have not assumed anything, only thing I have assumed that output would adjust which I have been saying right from the beginning. When firms see unsold stocks piling in the go down, they will lower output unintended inventory changes are positive increasing that is the simple logic. Rate of interest is the one I added when supply is more than demand, it is a simple demand and supply assumption rate of interest would fall.

Rate of interest is like a price in the money market, it is like a price in the money market like price of money. If anybody asks you what the price of money is, you can say it is rate of interest because if you hold money and do not put it in the bank, you lose that interest. So, that is why in that in negative inverse sense, it is price, it is like opportunity cost of holding money. So, price of money is interest rate, you want to take a loan from the bank money, so price of money is like interest rate. So, excess supply excess demand we already know if there is a excess supply cannot sell their goods.

So, they will lower their price simple and if it is too much demand like the housing sector i was talking about there is too much demand then what do the builders, do they increase and increase the owners of the houses. The rent the price excess demand price

goes up, so that is the thing I am saying, no big deal nothing all common sense from algebra it looks like my goodness, so much of things we are doing. It is not actually, it is very simple, so this determinant is positive you is the trace negative trace is how much the diagonal elements some of the diagonal elements.

So, it will be A 1 minus c into 1 minus p and then plus minus b l r is this negative it is negative given the assumptions of the model. So, having done all this, I sit quietly here saying we have a stable model in our hand to deal with the famous IS LM model when IS LM the paper was written, probably these conditions were not obtained. They were obtained later, I found them later and I just make it a complete thing here by saying this is a stable model. Now, there are dynamic kind of in the static framework kind of a dynamism is there in the background the shifts can taking place two variables changing.

We do not know in which direction economy would go well from the algebra, it is like a pathological test that doctors ask you, it fever looks like you have a typhoid, but let us do a blood test typhoid confirmed. This world looks like stable from the phase diagrams, but there is a possibility that the oscillation can get bigger and bigger and diverge away that is also possible. It did not does not say everything that is going to hit the center the intersection, so algebraically it test that like a laboratory test and I say second order conditions are satisfied. The model is stable it is a theoretical thing we do in economic theory in models, we check the second order conditions.

As I was giving the example of optimum can be maximum or minimum, but if you want to reach maximum and the rule of that you have to reach minimum, you check the second order condition that is all. So, the model is stable, I give you one example you just think about it what happens before I start the next part. Suppose, I make a small change in the assumption, you will see how this model is vulnerable, also to a small change. Suppose, I make a small change this model looks very nice, but suppose I make investment a function of rate of interest and output, I can do that or income as company see more output is more income is there.

More demand is there, companies can produce more, why not it is just not the cost of borrowing money from the bank that determines how much investment, but investment can depend upon how much income the economy has generated. I am going on a recovery path more and more income is generated not recession going on a recovery

path. More and more output and income inspires the company to produce more because the demand is going up. That means similarly in a recession as the output is falling, the company gets a disincentive to invest when y falls because they go by news in the market and demand the demand for goods are going down investment.

All this excess capacity and then then they cannot sell it this is true this is how businessman know, they do not live like on a IIT campus and after teaching a course goes back to the residential office does some work and goes back. It has no touch in reality, businessman are the real economists and this is how they do they plan things, so investments there is a valid reason for investment to be a function of output now and a positive function.

So, what you have here is that I r is negative and I y is positive, now when you work on the stability conditions here minus I r and this differentiation will have minus I r d r minus I y d y. Another term will come, I will give you a homework, suppose you have this I y greater than 0 as an extra thing, you will see the second order conditions are violated immediately. So, this model is very vulnerable to even a small change which is quite realistic like I y greater than 0, a small change and the model is very vulnerable to that. Immediately, you will see the stability conditions are disturbed you do not know whether they are theoretically speaking model is stable or not.

It may not be you can do that as an exercise either in class or when you go back immediately. So, the model is restrictive, but is very popular this IS LM model and we often use the IS LM model to talk about various things you understand what I am saying in this condition. Here, when you work out you just add that minus I y d y because I is a function of r and y and you get the matrix and then you get the stability conditions determinant and trace you will see my goodness.

In real life, our investment is a function of y and in certain phases of the economy investment is more a function of y say in the upswing, but then the problem is an IS LM model like you know says it may or may not be stable in real life. That is also the issue the theoretical model may say, it may become unstable, but in real life, these are very difficult questions to ask. I do not think the economy is that unstable though algebraically theoretically speaking the model can become unstable. You can check that

yourself, it is a simple arithmetic you have to do there, I have the formula everything written there.

So, all you have to make i is a function of y again in addition to r and you will get a new result you will get. We need to do some comparative static exercises which are comparing two equilibrium points, when does it arrive? It arrives when these shocks are there to the system say government expenditure has increased, tax rates have changed because government decided to change tax rate RBI decided to pump in more money supply increase. So, this kind of situations we have a disturbance, so in simple words either the IS curve is disturbed or the LM curve is disturbed.

So, you require a new equilibrium the question is how far is an equilibrium, so you get in two multipliers, so we are going into multipliers. So, let me do one by one, there are quite a few and there is a new multiplier that will come the money, monetary policy multiplier m changes which was not there. Earlier, there was no money market in Keynesian cross model, now we have a money market. So, money supply can change and the earlier multipliers the two important ones, one was g change, the other one was tax rate change, two multipliers we did t g, now we will add m and a few things.

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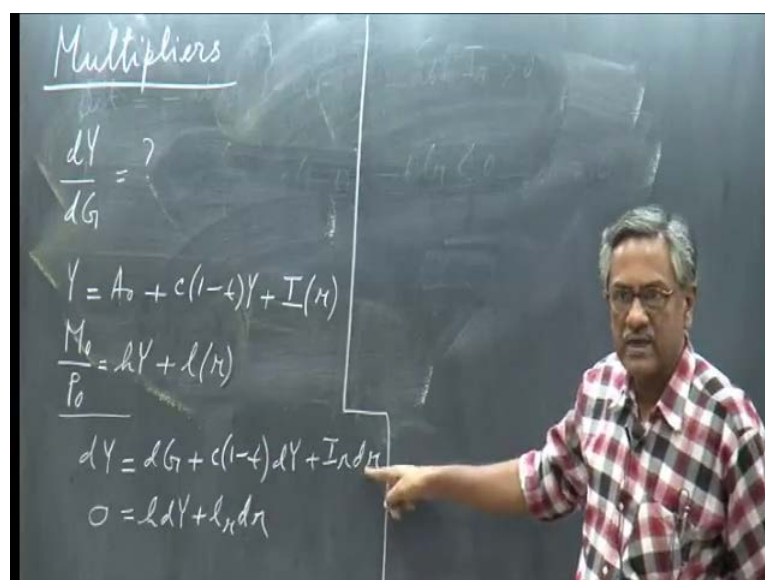
So, we would talk about these multipliers, we will talk about the multipliers, the first multiplier I would focus upon will be d y d g, so it is government expenditure changes, what will happen? This is the first multiplier, now algebraically speaking, we have y is

equal to a not plus c into 1 minus t y plus I r. Then m not over p not h y plus l r, these two equations, so how do I get d y d g, I totally differentiate this, then substitutes for d r from this equation then I d r is eliminated and then I can get d y d g.

So, you totally differentiate this, what you have is d y in a not, I am going to make one variable change, g nothing else. So, I will have d g plus c into 1 minus t d y plus I r d r from the second equation m not over p not is 0, it is a constant. So, I have 0 is equal to h d y plus l r d r, now you can see from d r from this second equation, you can solve d r, d r will be minus h d y over l r which you can substitute here for d r, d r. Then I can solve for d y d g, it is d y d g, you can see from the second equation, you can get d r is equal to minus h d y over l r to substitute here.

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So, what you get if you do that then d y becomes d g plus c into 1 minus t d y plus I r into here I r it will be minus h over l r d y I r into minus h over l r into d y. Then if you arrange terms d y into i minus c plus h a whole bunch of terms will d y will come on left hand side and d g there. So, this will give you this multiplier d y over d g, 1 over 1 minus c into 1 minus t plus 1 minus c into 1 minus t plus I r h over l r this is the multiplier you will get.

Now, this is the multiplier and what was the earlier multiplier, you did not have this bunch of terms. It was 1 over 1 minus c into 1 minus t, but this bunch have come you can see what other parameters investment functions I r liquidity preference curve or

speculative demand for money l r h was there. So, this is the multiplier, now you can see one thing I r is negative a l r is negative sign, so this becomes positive into h. So, essentially this is a plus term this term is a plus term this term is a plus term greater than 0. This is greater than 0, this one, so has the multiplier become stronger or weaker, my goodness weaker plus term in the denominator the strength has fallen.

So, what you notice is the government expenditure multiplier is becoming weaker and weaker. The more realistic we are making the macro model, in the first macro model when government multiplier came as autonomous expenditure multiplier or government expenditure multiplier in the Keynesian cross model without taxes. It was simple 1 over 1 minus c, when taxes came proportional tax system, it become 1 over 1 minus c into 1 minus t.

Now, I bring in the money market and the investment function two things in the k IS LM model, it has even it has become even more weak. So, it is a huge problem, the expenditure multiplier is becoming weaker and weaker, now let me talk about why is it weaker. Then we will go over to various prospects of this multiplier at A, you understand what is happening? Let us look over the diagram.

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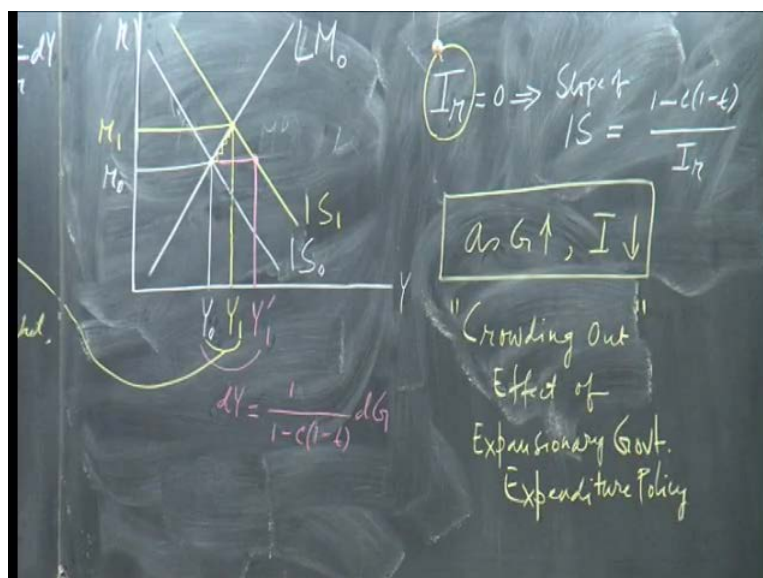
Now, this is the IS LM diagram rate of interest this is IS curve, this is LM curve, this is the initial equilibrium point, say these are the initial equilibrium points y not r not. Now, what you are saying government expenditures increased, so IS curve will be shifting to

the right. So, the IS curve has become this yellow line call that is 1 and call these initial lines is not and LM naught. So, the economy has moved from one equilibrium point to another equilibrium point, economy has moved from one equilibrium point to another equilibrium point.

The output has increased to Y 1, but rate of interest has also increased to r 1, output has increased to Y 1 and rate of interest has also increased to Y 1. You are saying the multiplier has become weaker, you can see a bunch of terms here. Now, I can see one thing if I r is 0, investment does not respond to r, this whole bunch of term would disappear, but if I r is 0. Then I have the old multiplier 1 over 1 minus c into 1 minus t, but I r 0 means what if I r is 0, it implies that the IS slope, slope of IS has also changed which was how much, 1 minus c into 1 minus t over I r, slope of IS if you check.

So, if I r is 0, what happens to the slope IS becomes vertical IS curve becomes vertical and vertical it shifts. So, the IS curve, when it vertically shifts, you have a multiplier which is ignoring this part which entered through the money market etcetera. The IS LM model and you had the old multiplier this is number 1, so the multiplier becomes stronger. So, the thing is I r, this seems to be a very critical parameter, which makes investment expenditure multiplier government expenditure multiplier weaker, what is the weakness, the weakness is as follows, why it has become weaker as output increase.

As output increases slowly, this increases, you are off the money market LM curve, let us assume the money market adjusts quickly rate of interest adjustments are quick. So, a little bit of increase in output increases the transaction demand for money and when the transaction demand for money increases demand for money increases. So, demand for money is more than supply of money, so rate of interest would increase when demand is more than supply price rises. So, rate of interest would increase, so the rate of interest would increase and you climb up to the LM curve, again since the demand is more again output increases a little bit companies are adjusting demand has gone up to there.

So, happens and the rate of interest again increase to clear the money market, so LM equilibrium, but as rate of interest is going up, what is happening here as r increases. I can put it here as r increase to clear the money market as r increases to clear the money market private investment, I falls in the economy r and I are inversely related. So, demand for goods are also falling from I r side, although there has been an initial

increase in demand for goods from g has pulled up. Demand for goods companies are producing more because there is more demand, but there is a negative thing going on in the economy.

Slowly, it starts happening that the rate of interest starts increasing which affects according to our assumptions private investment. So, one component of demand starts falling private investment, whereas the government component of expenditure goes up. So, this step y, step y may be reaching the equilibrium to the new equilibrium through clearance of the money market. You keep on clearing the money market via rate of interest adjustments, when output in economy starts slowing increasing in response to extra demand, but the extra demand from g that has come through this variable. It is now countered by shrinkage in demand through falling I, why this falling I happens because rate of interest increases, so I falls.

So, what you notice, therefore as g increases, government starts increasing more expenditure, pumps in more money, infrastructure projects, roads, highways, bridges etcetera, if rate of interest starts increasing, private investments starts shrinking. So, it is like government is increasing its expenditure and trying to improve the economy at the cost of private investment. So, there is a battle going on between you, government and me for private investment, it is a tussle going on because of this negative impact, the multiplier. The meaning of the multiplier is because of the negative impact on private investment that the multiplier has become weaker.

The net effect of increase in output is becoming smaller, it is not that much [FL] output income private investment expenditure shrinkages reductions are lowering it. This is what is coming out as a message from the model and therefore, what you see here the multiplier in the algebraic terms. It has become weaker which I told you in the beginning when I drew, when I obtained the multiplier for you on board that this has become weaker. It means that why it is weak, now this weakness will go as soon as investment is not a function of interest rate, you can see that if I r is 0, r changes do not effect I.

You can see that from the algebra here if I r is 0, what happens to the multiplier, it becomes the older multiplier. Then there is no negative impact on private investment, only government expenditure I r is 0, essentially means it is vertical. So, the IS curve would be vertical here and when IS increases you get a new level of output whatever that

increase in IS is this much if you go. It will be somewhere here, which is a same way of saying if rate of interest does not change if r does not change d r is equal to 0. What happens if d r is equal to 0, if d r is equal to 0, d y is equal to d y, d g is 1 over 1 minus c into 1 minus t and here d r is equal to 0.

Essentially, you have a d y value which is solved from the first equation, d r is equal to 0, if rate of interest does not change, you get the same result which I am trying to talk about. Earlier, result d r is equal to 0 means the multiplier will not have these components, it will be 1 over 1 minus c into 1 minus t which is essentially what I am saying is if d r is equal to 0. If I use a colored chalk, then r does not change means I go up from here to here, economy moves from here to here and you get a output level which is y time 1. This output level y time 1, the d y this d y or delta y whatever you call that this d y is essentially 1 minus c into 1 minus t into d g that means d y over d g is 1 over 1 minus c into 1 minus t.

This fellow here, this little bit of increase is our multiplier, this fellow here, it will be d y over 1 I r h l r into d g smaller impact for output the larger impact on output would be this. If rate of interest does not change, this is the same thing as I am saying that investment does not respond to rate of interest change same thing. So, the disturbing story here, therefore message coming out that with taxes you have created leakages in the system, where increase in output and income cannot be enjoyed by the households. So, much because government takes away tax revenue, now with the money market and investment being sensitive to rate of interest changes.

We have created another very negative thing, which is realistic may be government any time wants to increase output or expenditure by spending more g increase does not have a good impact. It is dampened by private investment reduction the reason is rate of interest would increase. So, if private investment does not reduce, it is alright it does not fall this private investment reduction this private investment reduction that I r falls as g increases I falls. This famous message is known as crowding out effect, crowding out effect of expansionary government expenditure expansionary government expenditure policy this crowding out effect is very important thing that the private investment is crowded out.

So, what I am saying, suppose this room is full of students, now if I invite Kanpur university students, there will be a crowding out effect as that those people come some of IIT Kanpur students will have to leave the room because there is no space for them. So, crowding out effect of inviting Kanpur university students to my macro course on IIT Kanpur students as government is trying to push in into the economy and start doing things the private investments gets a dampener it discouraged, it falls. This is very important result, the crowding out effect which in parametric terms is essentially is I r.

If you make I r 0 somehow, either investment not respond to the interest rate or interest rate does not change r is constant as I have done with the pink line here. Then no crowding out effect even if I r is not 0, d r is 0, two ways you can do it, I r is 0 or d r is 0 if d r is 0, government restricts in interest rate. There would not be any crowding out because interest rate is not changing, how investment respond or investment can is not responsive. The rate of interest changes even if government allows rate of interest to be free interest rate investment does not change. Therefore, you will have no leakages, otherwise you have this thing coming out it is a very important risk, a little bit.

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Now, I would like to talk about a few more things in this model, what would be the tax rate multiplier, you tell me you people tell me what will be the tax rate multiplier d y d t, d y d t what will it be the d y d t multiplier in this model. So, from the first equation IS

equation what you have is d y no d g terms 0 c into 1 minus t d y minus c y d t plus I r d r from the second equation LM equation what you have is 0 is equal to h d y plus l r, d r.

Again, you get the d r value from you substitute it there what essentially you will have if you club terms is that you will get d y over d t is equal to minus c y divided by 1 minus c into 1 minus t plus I r h over l r I r h over l r. The problem you remains what is the value of y and what is the value of t here there are two y values two t values, now you remember we did substitution method for the Keynesian cross model tax multiplier.

This y will be y not initial y and this t will be the later t post change t, so this multiplier if you write with the proper notations will be minus c into y not divided by 1 minus c into 1 minus t 1 1 I r l over l r this the multiplier. Now, if a tax rate cut is there, how would the equilibrium diagram show can anybody have any idea if taxes are cut IS LM diagram, how will it look like if taxes are cut what, will be the effect in IS LM diagram, slope changes are there. So, which curve LM or IS, so it will become steeper or flatter taxes are cut reduced cut means reduced look at the slope of the IS, the IS curve will become steeper or flatter if taxes are cut if taxes are cut will IS curve become steeper or flatter.

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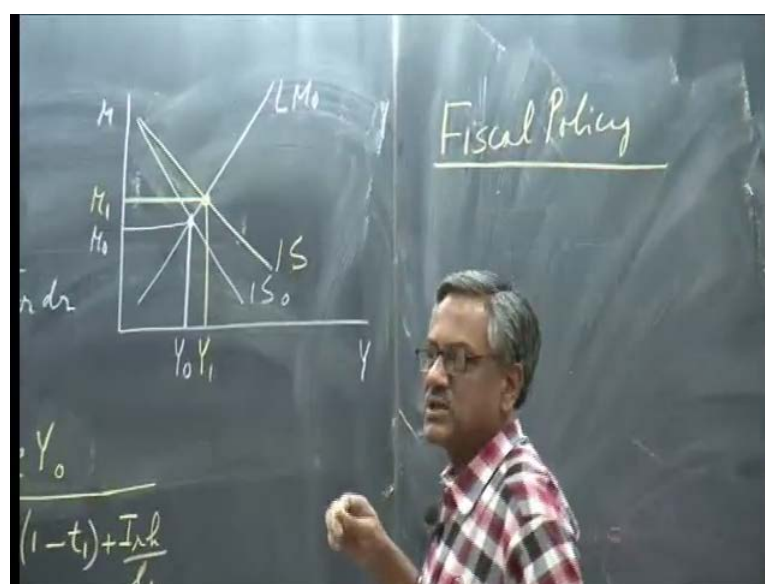
So, the diagram will be, I can draw small diagram here, what you have here is the following this is the IS, say IS not this is the LM naught and then if there is a tax cut, then the IS curve will become flatter to IS 1. So, you reach a new equilibrium point where higher output is there and you can have the higher output y not and the tax cut

here will be Y 1. In this case, also we can see that the rate of interest will increase from r not to r 1, there will be some crowding out effect.

There will be some crowding out effect because rate of interest increases without increase because the tax cut multiplier in the Keynesian cross model did not have I r h over l r. So, you can see the multiplier has become weaker, both ways it has become weaker, tax increased, tax cut. So, it was only c y naught over 1 minus c into 1 minus c 1, now plus I r h over l r is there, so there is a some crowding out also here in case of a tax cut policy. Now, before I go further, let me tell you because you are new students of economics and you do not pay attention to economics just the way I do not pay attention to all that is happening in physics, chemistry and mathematics. Who knows all these engineering disciplines, we are very popular, we are very used to with these terms.

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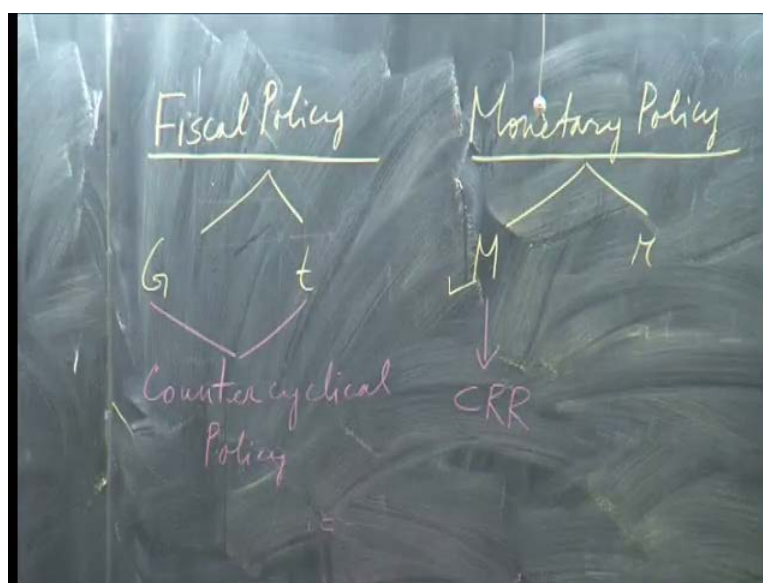
The discussions that I had so far come under something called fiscal policy of the government. So, government's fiscal policy is the finance ministry's job and the finance minister like Mr. Pranav Mukherjee will be doing while I have been busy with fiscal policy finance ministry does that.

So, the fiscal policy I have talked about one, the g policy, the other one is the tax rate policy, so two fiscal policy that I have talked about today which I did earlier also, but the heading is called fiscal policy. Now, I have talked about d y, d g I have talked about d y, d t, these are common two fiscal policy instruments g and t which are used for fiscal

policy purposes like suppose economy is going up earning a lot. So, it does not climb up too quickly like a very over excited child who starts jumping on the bed does not realize the ceiling is very low and hit the ceiling and has an injury, then hospitalized.

So, here business side of economy finance ministers have this job if economy is in a recovery path if it is going up too quickly like a bubble etcetera, they were asking me in the break. So, that there is no much bubble falls kind of a impression and the expectation that the economy is doing too well. So, it can try to check that the movement through what you can call contraction in fiscal policy the contraction in fiscal policy will be in reduce g increases or increase taxes. So, people do not overspend they spend, but taxes are also collected, so the multipliers are becoming weaker, you reduce the economy counter cyclical policies.

So, fiscal policies can be used as counter cyclical policies as counter cyclical policy counter trying to prevent it to run, so quickly countering the speed putting out barrier, putting out hurdle. So, counter cyclical policy can be used with this fiscal policy, they can all be used as a counter cyclical policy, so in case of a recovery what will be the case g will reduced. So, the output shrinkage is there a little bit although the private sector output is growing too quickly and taxes can be increased. So, IS can be made steeper and restrict output increases, these are all counter cyclical policies that can be used that can be used by the finance minister.

Now, in the recession, what counter cyclical policies finance minister should in a recession today in India according to this kind of a fiscal issue. We are discussing what should be the ideal counter policy prescription for the government based on this limited knowledge that you have in recession reduced you need. Already, output is reducing, you need expansion in government expenditure to boost demand and you require tax cuts. So, the people spend more the counter cyclical policy in recession will be just the opposite increase g reduce t in a boom time you require reduce g increase t.

So, the counter cyclical policy that one would require this has other consequences I am not going to talk about that now. The common sense says in IS LM framework that the counter cyclical policies that the finance minister should adopt in a current environment is where there is a recession output is falling demand is falling is to increase g and lower t. So, people spend more if you if the lower money taxes, the income I get from IIT when

I go home, I can spend more, I spend more means I buy goods and the company see more demand is there for their goods.

So, they would produce more, there will be more income generated multiplier would operate in a positive direction more employment etcetera, this kind of a counter cyclical policy. So, fiscal policy is what the one I need to add which I will bring in today, but I will conclude it tomorrow and that will be the last thing that is very important money market and government can pump in more money, how it will pump in more money. They have various ways one in a country like India, there is something called cash reserve ratio, what is a cash reserve ratio CRR, I am going to talk about monetary policy.

Next, I am going to talk about monetary policy and I am going to talk about one monetary policy there can be various kinds of monetary policies. Usually, there are two fold, one is to effect m and another one is to effect r, I am going to talk about the monetary policy m, how it can be increased if government wants to increase it. There is something called CRR, the simplest example that I can give you something called CRR something called CRR. This is called cash reserve ratio when banks accepts deposits from us from the public they deposits go where they go into savings accounts, fixed deposit accounts, current accounts, various accounts bank has.

Here, we open accounts and money goes there, these are called from banks point of view commercial banks, I am talking about banks point of view. These are deposits public money public deposits since it is public money government has made rules which started in fact after 1930s that the central bank says you have to keep a cash reserve ratio with us. What does it mean that these deposits, you do not have entire freedom to use them for loan purposes for any other investment purposes. You do not have enough freedom a part of that cash every week on Friday, you will have to tell us how much deposits you have.

Given the CRR percentage number 7 percent, 8 percent whatever 8 percent of that cash 7 percent of that cash. You will have to deposit with us literally cash from bank goes to RBI office and in a locker, State Bank CRR, Bank of Baroda CRR, Canara Bank CRR, Punjab National Bank CRR every Friday cash reserve ratio. That money stays there and gets on adjusting on CRR and deposits, CRR is already there. Now, this CRR money is essentially precautionary money in case banks mismanage the money that they collected

from the depositors by giving out too many loans where the money was not returned called bad loan.

In formal language, banks call them nonperforming assets to banks loans are like assets because of loans they make money. It is not important, so these assets are they have become nonperforming assets means the loans have not been returned interest payments they are called bad loans also. Now, money was given out of the deposits of you and me, so tomorrow when we go and if the bank says, sorry it happens bank is closed or something, so the central bank keeps CRR money, it can be used that cash to bail out the banks. They start some monitoring, more serious sincere monitoring of the bank what the bank is doing may be the bank manager is corrupt is a nephew of that or a friend.

So, these go on in India, I have once upon a time have heard that the largest defaulters, defaulters means who did not took a loan did not return the money to banks are the big companies. I felt extremely good, India is on the right path the largest defaulters are not the small borrowers are the large borrowers who got the big companies who are the safer, who make more money. That means that they have deliberately defaulted and government even cannot do anything about the system. So, the corrupt government even does not do anything about it, so these are that data available, there are not jokes, I am saying is just not cooked up stories. I am telling you this is actual numbers I am talking about the largest defaulters in Indian banks are the big companies.

Now, then you have the farmers issues etcetera, you know that they borrow money, they eat up their capital their there is no monsoon. They cannot produce anything and the harvest goes and they lose everything, so what I am trying to say is that the monetary policy can operate through CRR where money supply can increase. Now, if RBI reduced the CRR number, what will happen with banks more money, they can give out more loans more money will be inside the economy again pumped CRR.

So, this is one simple way I am talking about one simple route through which money supply can affect the economy. So, suppose money supply increases we can talk about a simple monetary policy in this multiplier what will happen, now to d y d m. So, we can get the algebra done, this is the last thing we will do today d y, d m a little bit of monetary policy.

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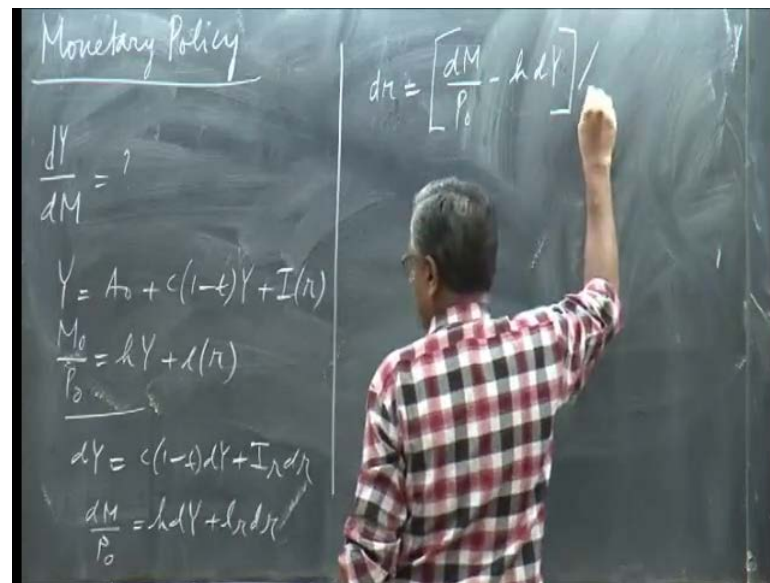
Now, I am going to talk about monetary policy and it is a very simple Monetary policy, it can be much more complex, the monetary policy that I am going to talk about is d y d m, how much it is. Now, you can work that out IS function is I r and this is m not over p not is equal to h y plus l r, now if you do the algebra here, the first equation will give you d y is equal to d n naught is 0.

Now, I am talking about monetary policy no g increases is c into 1 minus t d y plus I r d r the second equation will have d m over p not because monetary policy money supply is increasing d m or decreasing. Whatever it is increasing or decreasing, d m means it can positive or negative, so d m over p not is equal to h d y plus l r d r. Now, you need to substitute for d r, so you can get the d r number from here which is d m over p not minus h d y over l r.

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The second equation is d r is equal to d m over p not minus h d y divided by l r that is what you have d r, d r is d m over p not minus h d y over l r. Now, substitute that there therefore, d y in the IS function will be c into 1 minus t d Y 1 minus t d y plus I r over l r into this bracketed term. This entire bracketed term d m over p naught minus h d y which means what you have there is the d y term that will come minus h d y put I r, l r, h t y would go. What you have this term c into one minus t plus I r h over l r is equal to now you have d m p not here into I r over l r. So, you have I r over l r d m over p naught, so what you have d y over d m in the numerator.

You have I r over l r and into p naught, p naught can come downstairs, you have p naught into 1 minus c into 1 minus t plus I r h over l r I r l r over p naught into 1 minus c into 1 minus c plus I r h over l r this one. Now, is can you sign is the positive multiplier or a negative multiplier denominator is positive numerator is positive, so it is a positive multiplier.
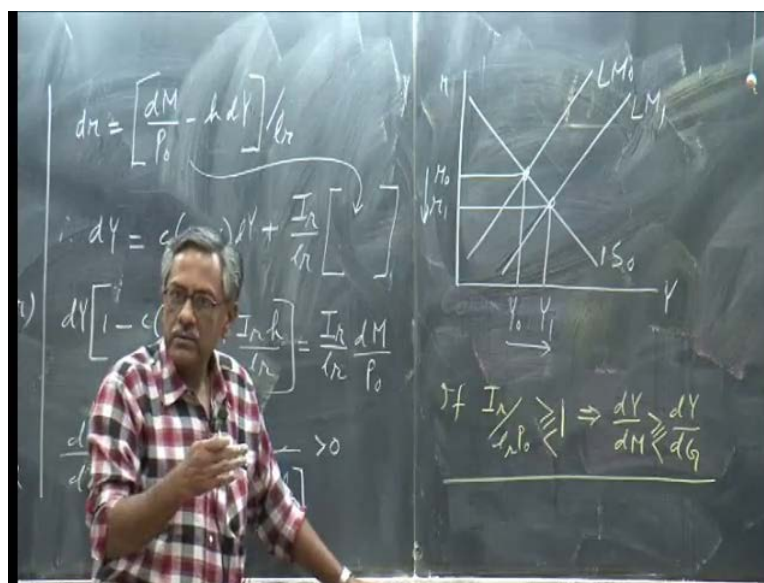
So, in very simple words what you have is this diagram that we required very simple words what you have is you have an IS LM diagram y r you have IS curve IS naught you have LM curve. Now, money supply is increased in the economy, so it will shift parallel to the right, so you have LM 1, it will shift parallel to the right LM 1 and what you have is output in the economy will increase y naught to Y 1. The rate of interest will also be the rate of interest will fall rate of interest will fall, now the question is this I r over l r into p not whether term this term is greater than 1 or not. If it is a greater than 1, then this multiplier is stronger than the d y d g because d y d g you had only this bracket term, third bracket.

Now, the terms are I r over l r into p naught, if this is strong, you can say that if I r over l r into p not if this term is greater than 1, then you can conclude that d y d m greater than d y or greater that d y d g this is easily this is important conclusion. The monetary policy can be more effective than government expenditure policy monetary policy can be more effective than government expenditure policy provided I r over l r p naught. This parameter value is greater than 1 if it is equal to 1 too much it has the same if it is less than 1. Then the monetary policy is less effective than government policy, so you can put a few more properties here equal to or less than 1.

You can put it this way will be equal to less than d y d g I can do that, nobody stops me, I can compare the expansion in fiscal, in fiscal with expansion in monetary policy

expansionary means increasing contractionary means decreasing fiscal policy. So, I can compare them an expansion in fiscal policy course for India to do that to judge that I need the parameter values whether to use g or whether to use m because one good thing is happening here. We can see with m increased rate of interest falls no crowding out, so there is no negative impact on government on private investment, but if you have expansionary government expenditure policy where IS shifts upwards rightwards.

Rate of interest will go up because LM is upward sloping, so rate of interest will go up and rate of interest going up means private investment is crowded out bad news, but with expansionary monetary policy there is no crowding out. In fact, it helps private investment more because rate of interest falls and more private investment activities. So, the transmission channel of output increased from money supply increases, essentially this because if money supply increases banks can lower the interest rates and give more loans because bank has more cash more loans for companies. So, companies can come can take more loans at the lower interest rate and invest more, more output is produced opposite of crowding out.

This is how monetary policy is working why m increase increasing output is; you have to ask this question diagrammatically m increase means LM shifting new equilibrium output increase. What is the intuition because m increase means banks have more cash government r b i has lowered the CRR, so banks wants to do something with the cash, so they lower the interest rate and tell companies. Now, we are going to give you more loans companies are attracted by lower interest costs, they take more loans more private investments so more output.

So, some people may argue that expansionary monetary policy is perhaps the better counter cyclical policy when you are coming out of recession than expansionary government expenditure policy. So, you can tell the finance minister humbly you can tell him he knows so much which one will be better. Now, you know this more government expenditure policy or expansionary monetary policy economy is in recession which one will be better because you have some model here which you can use.

I am doing this you learn some practical things; some of you will enjoy this at some point most of you will forget. Now, you have other courses to do your department courses your major subject's civil engineering, chemical engineering, metrology, so

many things, but this has a practical side. What I am trying to say is that is that for today enough for today, but I will continue this tomorrow.