Microfoundations of Macroeconomics
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Lecture – 21
Sticky Prices 1

Let us start. So, we are talking about the rational expectation model and we have understood some basic ideas about and we were discussing the basic framework of the equations that we are going to solve.

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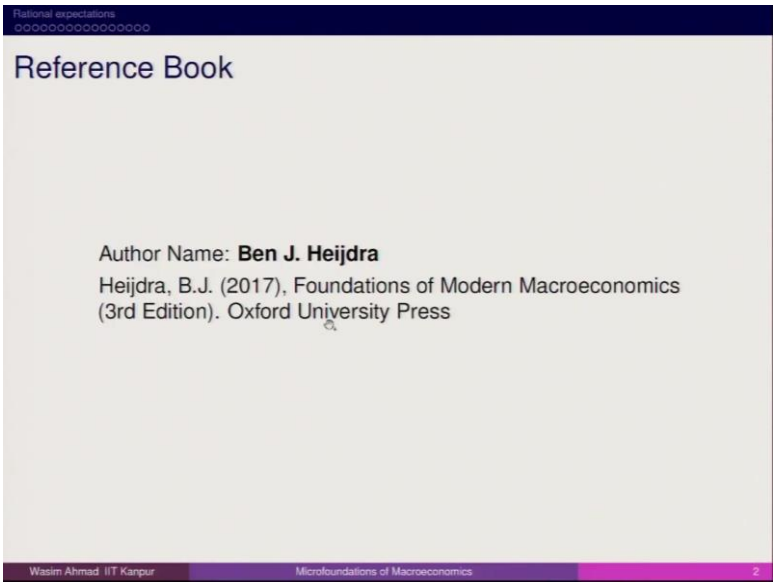

So, the reference of this particular session remains same Ben. J. Heidra chapter 5 and these things we have already explained. So, let us not get back to these things.

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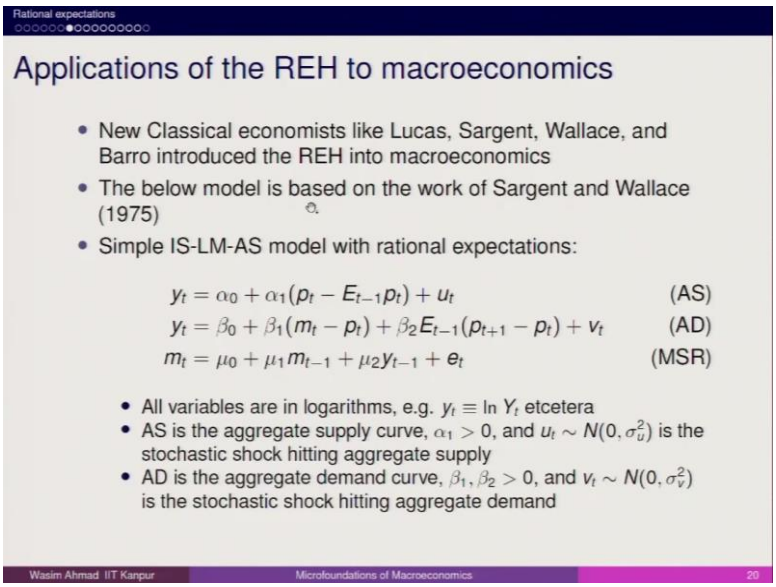

And now we were discussing here. So, we were talking about the new classical argument that how certain frameworks that were used at that time by the Keynesian and new Keynesian school of school, how this was not very well accepted and later it was challenged also. So, here we have three set of equations so here y_t it is dependent upon the deviations actual minus the expected. So, this is the objective that we have expectation.

So, here we have the p t which is actual so deviation of this it is measured by the alpha 1 and here you have the error term and if p_t is greater than of $E_{t-1}p_t$ it means that people are not able to predict about the future and if you have a p_t less than $E_{t-1}p_t$ these all has to deal with the labour supply in the economy. So, here you have and once you have labour supply then it also creates more output in the economy and that helps a lot.

Here you have y_t is equal to $\beta_0 + \beta_1 (m_t - p_t) + \beta_2 E_{t-1}(p_{t+1} - p_t) + v_t$ this is what we have. So, if I am saying here we have y t so this is the money supply minus the price that you have the current price and here you have the role of expectation. So, this is linked with how the price changes also augments in investment in the economy that in turn further creates the growth scenarios for the economy.

So it mentions about here it mentions about the real balance effect. Now here you have the money supply so $m_t = u_0 + u_1 m_{t-1} + u_2 y_{t-1} + e_t$. So, here also we are introducing. Now unlike the previous example where we had only the aggregate supply having the error term in this setup we have all three equations having the error term and this makes the model really interesting.

So, here you have a u_t and here we have v_t and then here we have the e_t. All variables are in logarithms which mean that if I am taking about GDP so it is also in log. So, here all are the log models so you can say if I am having money supply it is not actually in thousands, it is the log of those 1,000 so you have to keep in mind. Aggregate supply curve a 1 is greater than 0.

And here you have the u_t it is normally distributed with sigma square u stochastic shock hitting the aggregate supply. So as long as this is 0, this become deterministic, but the moment you add u t it become stochastic; so those things you have to add. AD is the aggregate shock demand

curve and here we have beta 1 and beta 2 all greater than 0 and here you have error term again normally distributed stochastic hitting.

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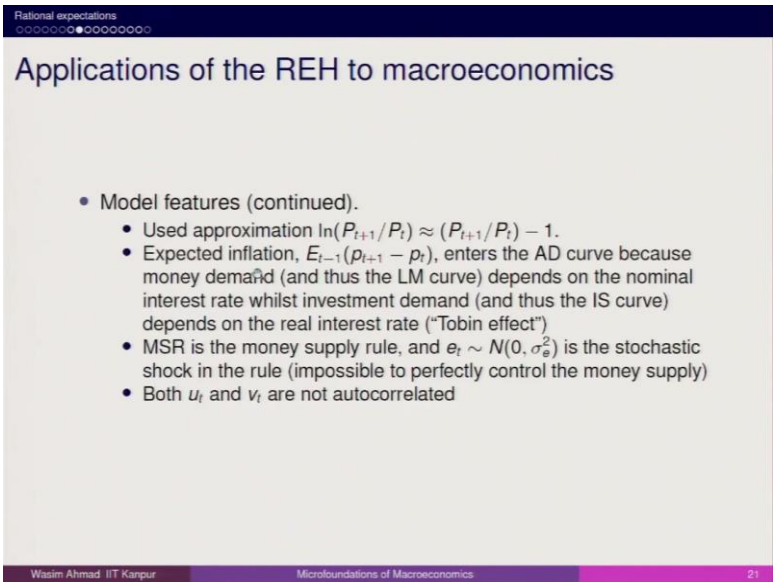

And then here you have the expectation of inflation. So, this is more like I have already mentioned. The money supply rule that you have it is also having the error term e_t and this is also having the N (0, σ_a^2). Here we are saying that u_t and v t are not autocorrelated which means that v t expectation of v_t, v_{t-1} is equal to 0 and here u_{t-1} = 0 so that is what we call the autocorrelation, the multi collinearity system is different when the explanatory variables are correlated that we say.

When your error term is correlated with the explanatory variables then we call it the term it will impact the variance. So, we deal with the hetero stochastic.

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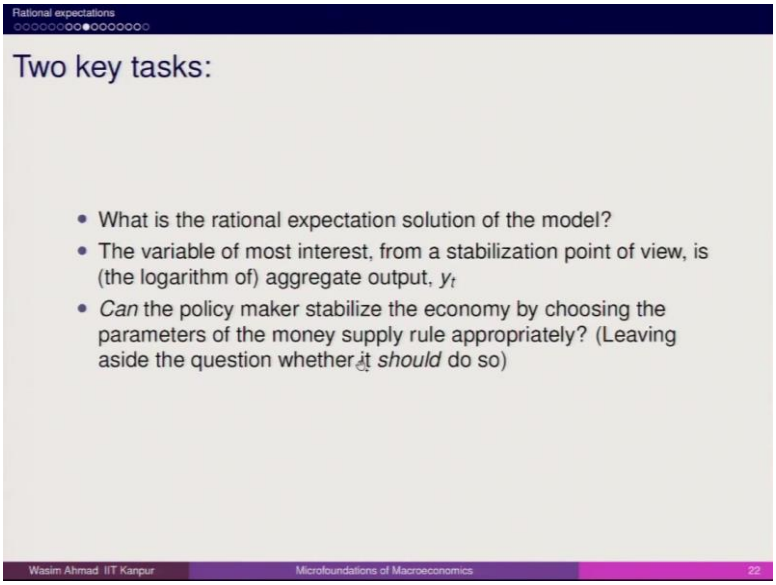

Now we are going to understand the rational expectation solution model. We are trying to understand how we can think about some kind of macroeconomic stabilizer kind of scenario, stabilization scenarios and how we can understand whether the policy stance was taken by the government or the Central Bank and whether it is going to play a role in stabilizing the economy.

Here we are talking about the Central Bank because directly we are introducing the money supply here.

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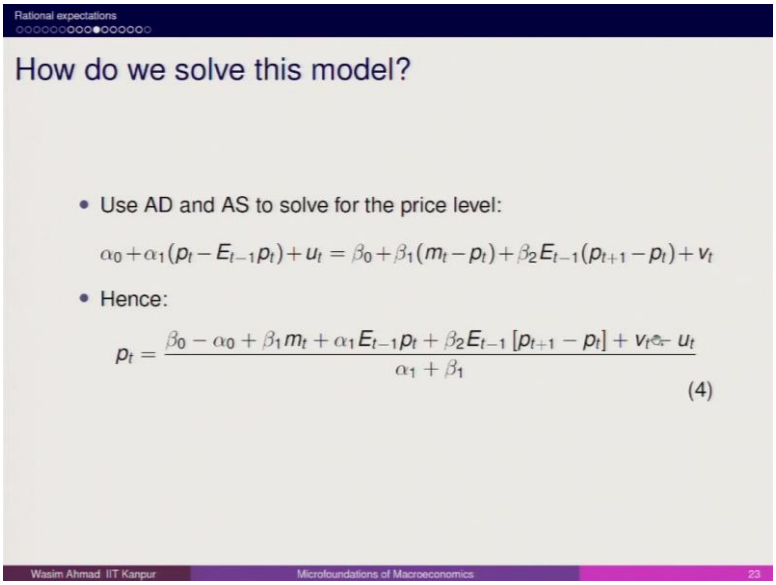

So, here we have or if we solve or go for the reduced firm solution. So, here it looks like once we go for the aggregate demand, aggregate supply equilibrium. So, here we have α_0 +

$\alpha_1 (p_t - E_{t-1} p_t) + u_t$ and then here you have again so this is coming from the aggregate supply and this is coming from the aggregate demand. So this is what we have $\beta_0 + \beta_1$.

Now once I solve for p t so this is the p t equation. Here you will be knowing that here we have a error terms of both, aggregate demand and aggregate supply and divided by the coefficients of the aggregate demand and aggregate supply this is what we have beta 1.

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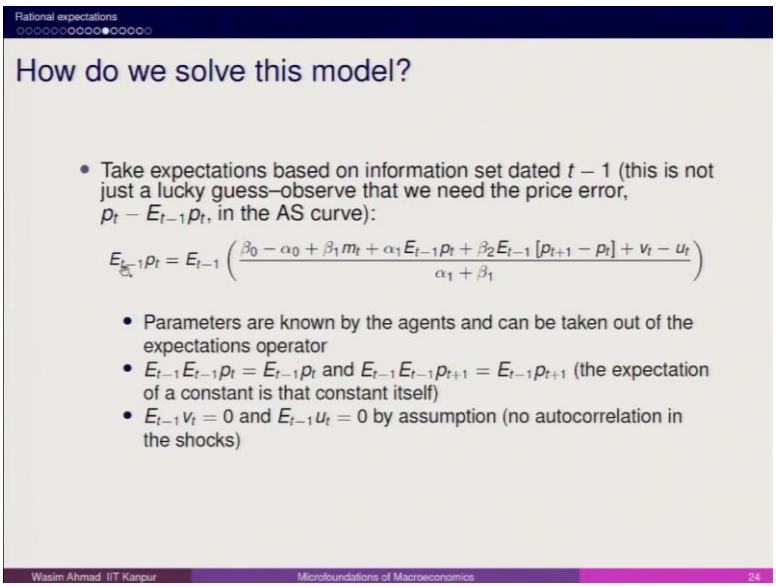

Now in order to form the objective expectation. So, let us work out so if we are going to think about the adjustment with price. So taking expectation both information set dated t – 1 so we can think about since we already have this scenario $p_t - E_{t-1} p_t$ in the aggregate supply let us find out first that. So, if you are having the $E_{t-1} p_t$we introduce the expectation operator to this particular equation.

So, it is bound that particular term will be 0 and this particular term will be 0 because we have assumed that the mean is 0 and variance is constant. We are going to have the similar kind of scenario. Now here we are also introducing that once we are going for expectation then E_{t-1} $E_{t-1} p_t = E_{t-1} p_t$.

$E_{t-1}E_{t-1} p_{t+1} = E_{t-1} p_{t+1}$. So, this is how we have and $E_{t-1} v_t$ = 0 and $E_{t-1}u_2$ = 0. So, how come this is linked once I bring this expectation operator inside. So, once I am bringing this inside then this is going to be 0.

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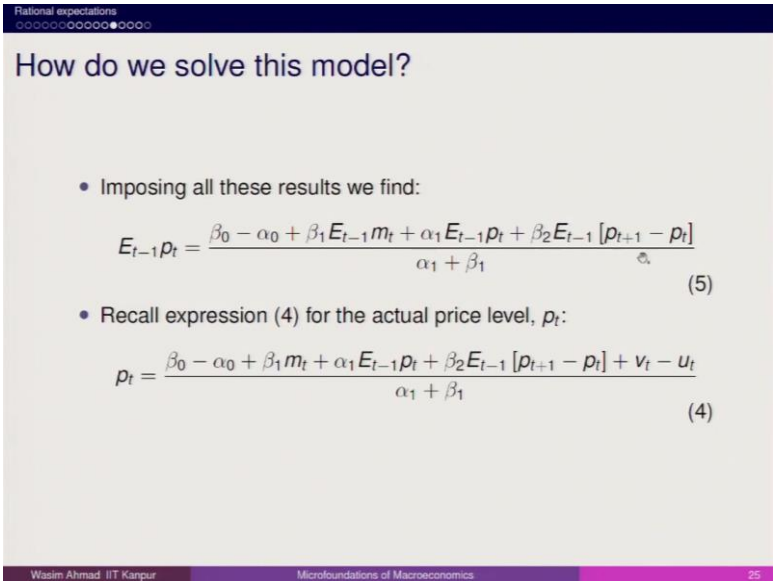

So, here it is; once I go for calculating this then it becomes $E_{t-1}\ p_t$ this particular part where all the error terms are 0 now. This is the actual price level that we had calculated if I go for the subtraction.

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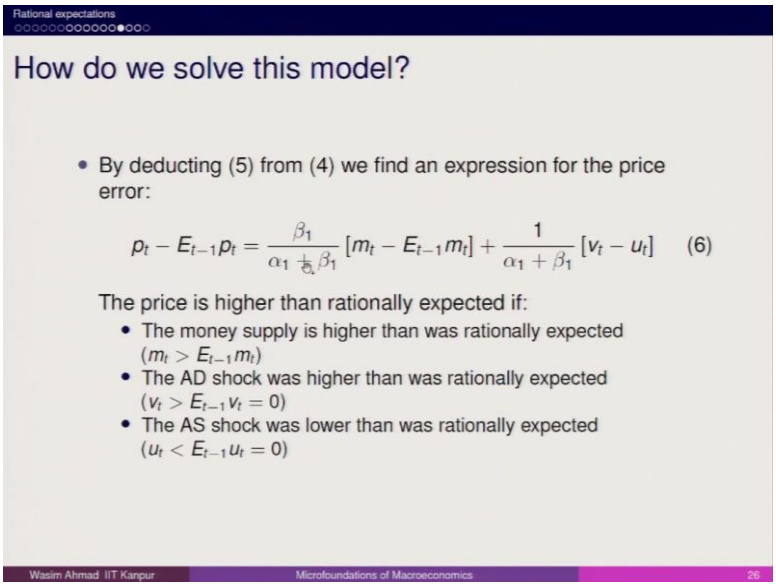

So$p_t - E_{t-1}\ p_t$ if I subtract this from here this then I have this particular expression which is nothing,$\frac{\beta_1}{\alpha_1+\beta 1}\ (m_t - E_{t-1}m_t) + \frac{1}{\alpha_1+\beta 1}(v_t - u_t)$. Now these random term differences are having lot of meaning in macroeconomics because as long as you have the positive values coming odd differences then it will create problem in the model which means that it will deviate from the objective function.

So there you have the role twice is higher than rationally expected if we have such type of thing that if it is greater than $E_{t-1}\ v_t$ and then here we have u_t less than. So these are; the scenarios

that gives even if you are not taking in account these things it may not matter much because it is clearly revealed here. Now the deviation of $m_t - E_{t-1}m_t$ will also matter because there also you have the stochastic term attached. So, let us understand the further solution of this.

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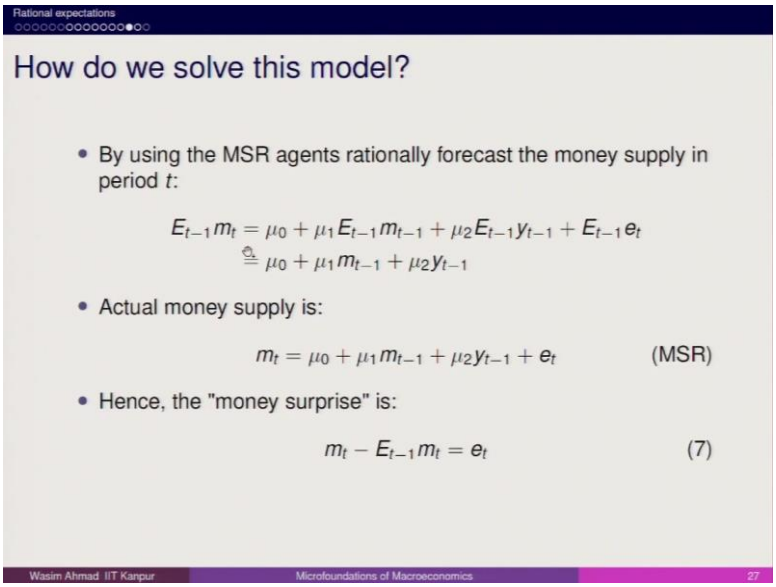

Since, I have the $E_{t-1}m_t$ so I can bring this the $E_{t-1}m_t$ to equation 3 of the money supply rule MSR. MSR is here is here that we have so I am introducing $E_{t-1}m_t$ here. If I am introducing it here then here you have the values introduced. So, here you have $E_{t-1}m_t = u_0 + u_1\ E_{t-1}m_{t-1} + u_2\ E_{t-1}y_{t-1}\ \ E_{t-1}e_t$.

Now here we have $u_0 + u_1\ m_{t-1} + u_2\ y_{t-1}$. So the actual money supply is nothing this, but this is what we have in equation. Can I get this particular expression I can get this particular expression here. So, here it becomes $m_t - E_{t-1}m_t$ = error term which means that now this e_t can be substituted back here. How does it look like?

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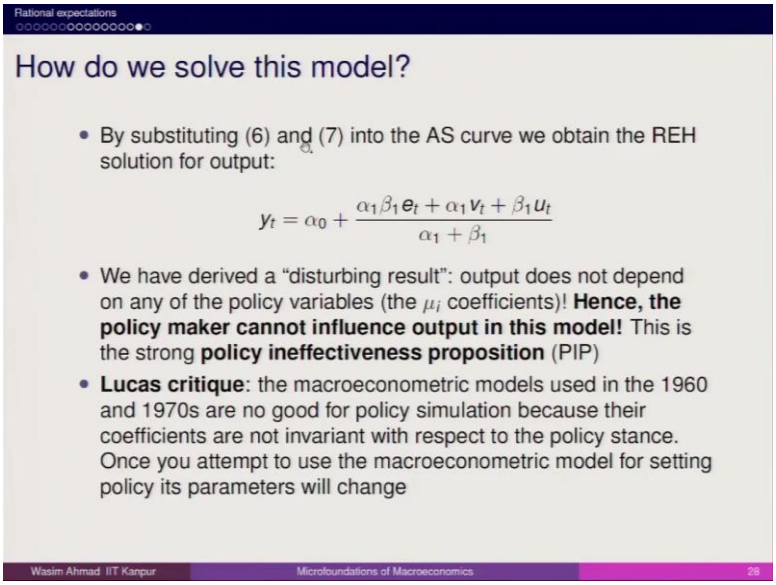

So, if I just go for the substitution of those things. So, here if I just go 6 into 7 so by substituting 6 and 7 into the aggregate supply so if I substitute 7 6 into your aggregate supply equation that we have here then how does it look like. So, here we can easily solve for it. So, once I go for substituting this then we have $y_t = \alpha_0 + \frac{\alpha_1 \beta_1 e_t + \alpha_2 v_t + \beta_1 u_t}{\alpha_1 + \beta_1}$.

Now you will be surprised to see that we have none of the variables of policy variables coming here. We have what? We have the error term of the money supply rule not the money supply as such and then here we have v_t and $u_t$which means that even if the money supply is going to be increased by the Central Bank it is not going to have a much impact on the y_t because it is not coming explicitly or revealing explicitly into the final output equation.

So, here what we say that the output does not depend on any of the policy variables that we have the u_i coefficient which are policy coefficient. So, the policy coefficients are this u_1 , u_2, $u_0$so these are this. So, once I have this then we cannot have the similar kind of expectation formed here. So, this is what we are. Hence the policy maker cannot influence output in this model and this is strong policy ineffectiveness.

So, here what Lucas criticize the policy makers that you are formulating the policy, you have the long set of equation explaining the economy, but ultimately it is not helping you to get the ultimate objective because you may be increasing the money supply, people will have different expectation the random shocks will play a role which means that people are expecting.

But also they have a some linkage with or some expectations about the other variables also they maybe more relying on the information available in the US market about India then within India. So, in that kind of scenario even if you think about the money supply increase this is not going to change the output and rest of the variables may also have a limited impact. So, if you understanding the macroeconomic picture so there is a literature called Central Bank commitment.

So, commitment in the sense that once you have the Central Bank commitment that it has to reduce the inflation by decreasing the money supply then they will be acting, but at the same time the Central Bank credibility also matter, how credible is the Central Bank in managing the inflation. So, as long as you do not have any kind of policy variable impacting the output y t then we do not see any kind of impact here.

Hence the policy maker cannot influence output in this model and this is the strong policy in effectiveness proposition. The Lucas during 1970s he criticize this idea he said that simple accepting or going for policy formulation based on certain policy parameters may not be sufficient it is always good to have some kind of microanalysis and there they started working certain types of general equilibrium kind of models.

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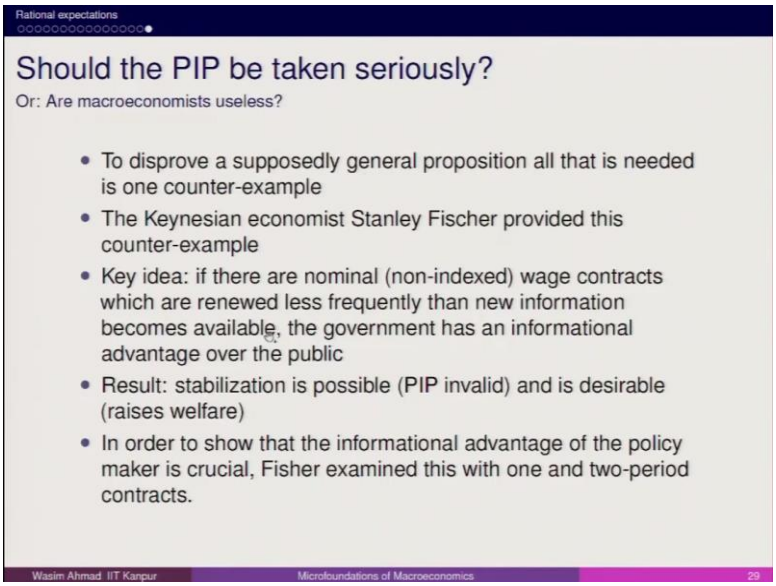

Here what it was envisaged so the Stanley Fischer the Keynesian economist Stanley Fischer he started understanding the role of this and Fischer introduced the idea that as long as you are having the understanding about the economy and you are working in an environment where there is role of rigidity so wage rigidity or price rigidity so there you have the understanding

about, there it may happen that even if you go by such type of operation then the policy variable will appear in the.

So, they had gone by some kind of one period contract and two period contract and they try to make that policy ineffectiveness proposition is invalid. So under that they introduced the concept of what happens if the individual is employed by the firm for only one period, what happens if the individual is employed for two periods where he is already knowing that this is going to be my wage in the next period.

So, in that scenario policy ineffectiveness proposition becomes invalid and they also launch and attack on the neo classical idea that the government intervention is not at all acceptable. This is the underlying idea behind the; I would say the rational expectation hypothesis. I hope this particular idea helped you to understand the model in a much better way and we will be now moving towards the monetary economic part we will be trying to understand the monetary models.

But I hope such type of basic analysis has made you understand or helps you understand the macroeconomic understanding or macroeconomic concepts better. So, this is what we try to understand from this particular model. So, in a nutshell I would say that when you are trying to understand when you are trying to formulate the model you should always try to add some dimensions of the macro where you will have the definitions of different agents operating in the economy.

And then you can think about adding, understanding the efficiency, inefficiency characteristics and finally with some calibrations you will be able to arrive at some kind of scenarios based analysis which will further give you the idea that whether particular policy is impacting and then you can have the closed view scenarios where you will be interacting one variable with another keeping all other constant.

So, in recent literature when you read in macroeconomics than in most of the good general then you will find that you will have lot of people talking about the role of macrofoundations. So that is why I thought it is good to add a course on this topic and I hope it has helped you understand the idea of policy formulation in a much better way and where macroeconomics commits mistake.

And where they have the; scope of expanding the learning by adding the behavioural aspect. So, I will be stopping this topic here and I will be starting the new topic and new topic will be based on the monetary intertemporal model. So, monetary intertemporal model is important to understand. So, here we are going to talk about the microfoundations of macroeconomis here from the perspective of intertemporal monetary models.

Now from the hardcore macroeconomics we are moving towards the area where you will have to understand the role of money in the economy, when you have a cash in your pocket and when you have a money in your pocket what are the roles that you have you can understand and what are the roles you can define of this money. So, we will have some brief idea and then we will move to explaining the model in a much better way.

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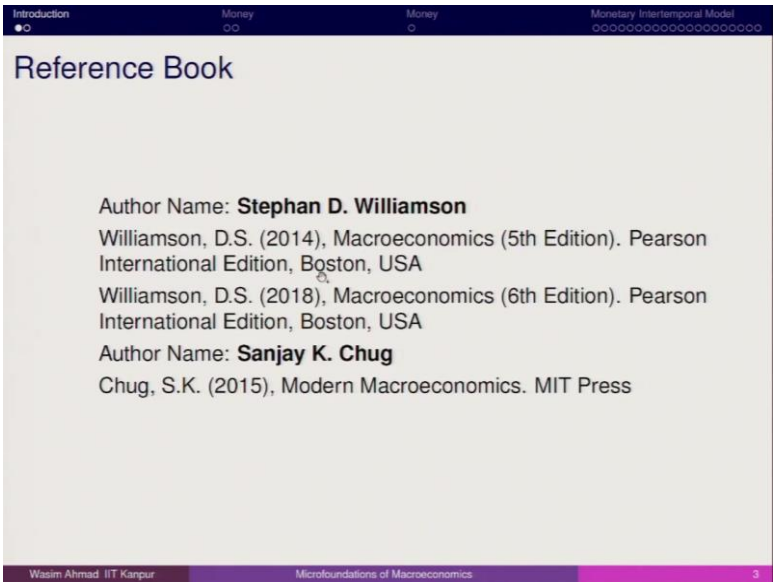

So, the book of Stephen D. Williamson remains same and Sanjay K Chug and these two books are important to understand, but I would say that I am referring more of the Williamson here.

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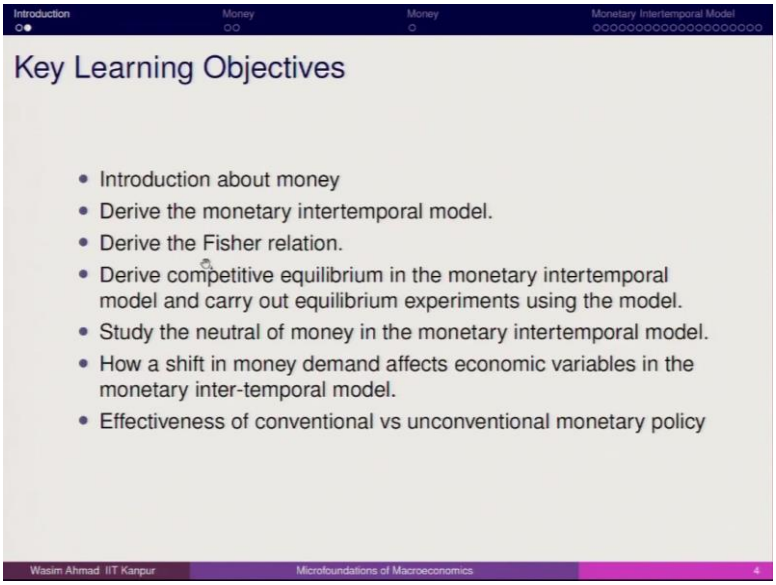

So, here we have the objective, objective is that how can we think about the monetary inter temporal model, Fisher relation which means that the real interest rate scenario, how we can arrive the competitive equilibrium with the monetary intertemporal model. So, when I talk about multi-intertemporal model it helps you understand that given the two period scenario that you have can you understand a situation or can you derive a situation where the individual is indifferent about using cash and credit card.

So, you have the credit card and credit card is having the beauty that it gives you a free I would say interest free period and if you are not paying after the free interest period then you will be penalized or you will be charged interest on the outstanding. So, credit card has become a new or alternative form of money where people are just having an arbitrage opportunity that whether they should be relying more in cash or card.

So, under the competitive equilibrium we will try to understand then you have the neutrality of money is one area where we focus more on monetary intertemporal model, how a shift in money demand affect the economic variables in the monetary intertemporal model then we talk about effectiveness of conventional and unconventional monetary policy that conventional we have money supply increase or decrease.

Unconventional when we have a special packages or we have zero lower bound, liquidity trap all those kind of situations we will be examining.

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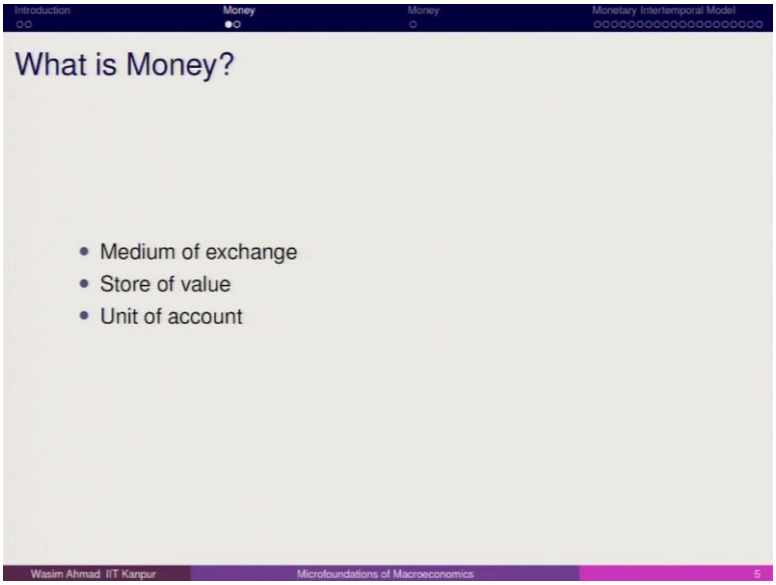

So, money is the medium of exchange we all know and in the medium of exchange when I talk about. So, here it has facilitated the transaction in a much better way. So, earlier when we had the barter system then we had the coincidence of wants if you want to sell some amount of wheat or rice then you have to find somebody who is willing to exchange for the good that you are interested so it has become really difficult.

Then you have the store of value in the sense that if you keep your money or hold the money certain period it is going to give you extra value. It is also the unit of account the prices are expressed in money terms not in the commodity terms or under barter system when we used to deal with there you had the coincidence of wants, the double coincidence of wants those things which means that if I am selling the wheat and by selling wheat I want carrot.

So, somebody should be selling the carrot then only I can exchange from wheat otherwise it is not possible. During earlier days when people had a limited knowledge about the usage of money they were relying more of the physical transaction, so physical transaction since the carrying cost became difficult. So, money facilitated those kinds of transactions in a big way and that is what we always mention about.

Then here you have the store of value you can think about the time value of money if you are keeping your money in your bank account for certain period of time you may be rewarded. The unit of account that it has become really, really easy, but with the development of technology or advancement in technology it has become much easier to transact and even the transfer money from one place to another.

Second thing is that you have different alternative forms of money which means that I can use cheque, I can use debit card, I can use credit cards. So, credit card has become a major source of alternative payments, but with credit card you have the advantage and disadvantage. The advantage is that it gives you immediate flexibility to buy anything and then you can repay back after some period.

So maybe the bank will be giving you 20 days or 25 days of the free interest period if you are transacting two day you are supposed to pay by the 20th of that month. If you are not paying then the interest rate will be accrued by the bank or financial institution. What is the cost with the bank? The cost with the bank is that they provide the services of credit card at some fixed price.

So, some fixed price you can say A, B, C whatever is the fixed price. Now with this fixed price why they are charging this fixed price because they also have to invest in certain infrastructure for maintaining the history of the consumer or also keeping record. So, in case of default this record will be used by the bank to monitor the progress of certain transactions. So, for the bank also it incur some cost, but if you think about the usage then usage fee or user fee it gives extra money to run the business and remain liquid into the business and how and this is how banks operate.

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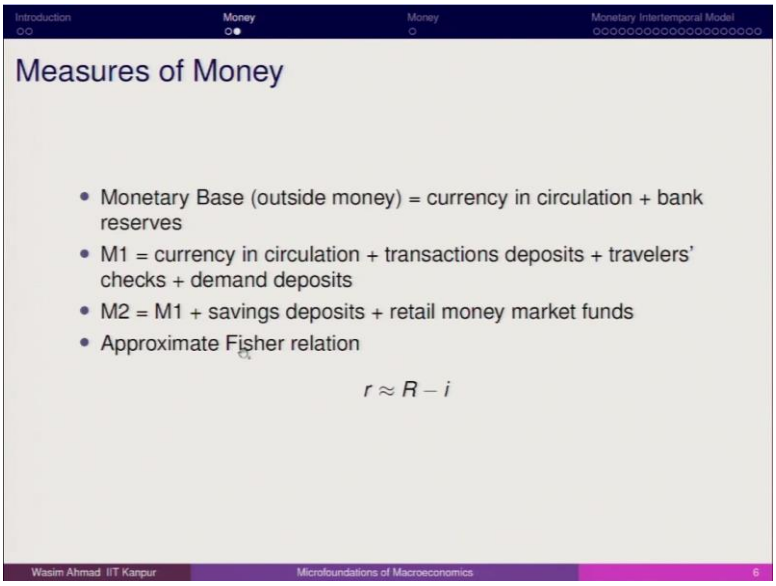

So, different types of measures of money we have so this is for the case of US where we have the Fisher relation so here we have r = R – i which means that real interest rate is nothing, but

the nominal interest rate – inflation so that is what we have the interest rate. I will be talking more in terms of Indian case that how we have.

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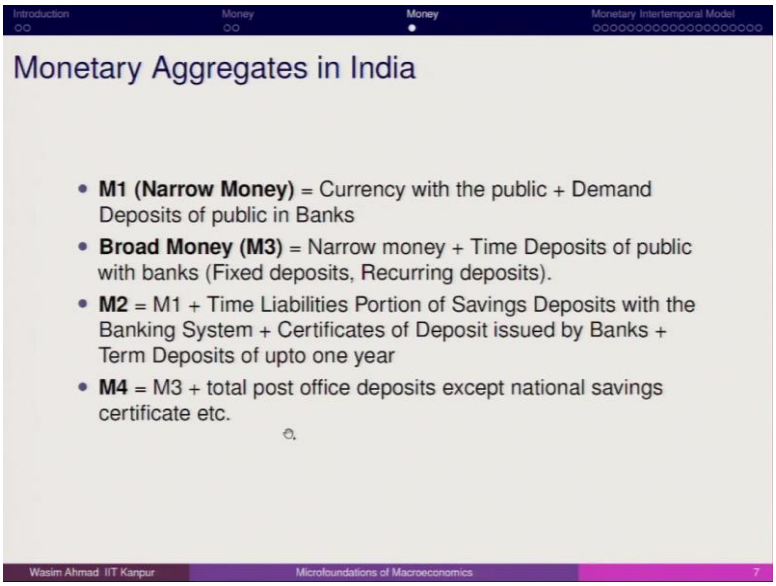

So, in case of M 1 in India you have these kinds of monetary aggregates in India so here you have M 1 which is narrow money. Narrow money in the sense that it is just about the currency public demand deposit and it does not have any multiplier effect. So, the moment it does not consist of any multiplier effect that we call it as the in terms of liquidity it is very high, easy to transact.

But there is no multiplier of it as such because it is just the money held with the bank. Broad money is having multiplier effect because it includes a narrow money plus the time deposit of public with banks fixed deposits, recurring deposits. If you have recurring deposits with the bank than this also gives the flexibility to the bank that they will keep certain amount and then they can lend it to someone else.

So, you have something called credit creation so the term that we attach often with the money supply or the banking system is called credit creation where if you are depositing Rs. 100 in a bank then out of this Rs. 100 as per the requirement of the Central Bank, banks will be keeping aside some amount of money and rest of the money they will be using it for lending and with that they create extra money while you are charging a higher interest rate.

So, in credit market imperfections we have already understood about that, what is the role of limited commitment and further you have the collateral. M 2 is also called the high powered

money and this high powered money is basically dealing with the monetary base that how much you can simple lend it and how much you have you can use it for the credit creation framework and how much this can be expanded.

M 4 so in most of the government reports if you are reading the economic survey or any document you will be seeing that they will be mentioning about narrow money and the broad money. Here M 4 it includes the total post office deposits except holding of the government bond what we call it as the National Saving Certificate. It also has the durations of 7 to 8 years earlier it used to be 6 years now it is I think 8 years and it also offers you coupon rate.

So, the time of maturity will have principle plus whatever is the coupon rate attached so that you get, but it includes the deposits the total post office deposits here it is M 4 so here you have M 3 plus whatever money that you save in the economy.

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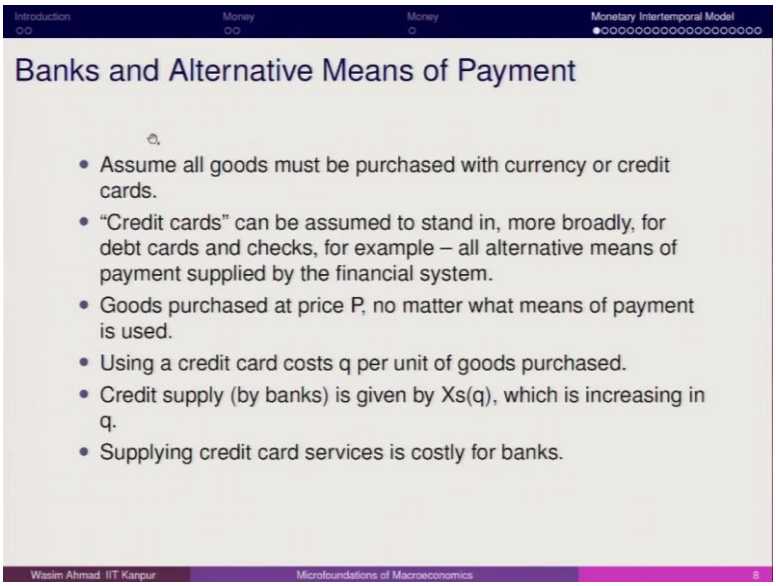

Now I will be starting with this in the next class and I will be giving you some background that here in this particular model when I talk about the monetary intertemporal model as such. In this particular model we are trying to understand that how we can create a scenario in which our representative agent who is rational and who has well defined preference about money.

He holds a cash and credit card so in the inter temporal setup if he has been given the scenario that if the rate of interest is going to be higher whether he should be using credit card or cash. If the rate of interest is high then it is highly likely that this representative consumer will be

using more of credit card less of cash because then this money that he has he can lend it to somebody whatever is the rate of interest he gets back.

And then after paying the money as long as the benefit that is driving from the credit card it is or if it is higher than the rate of interest or the interest earnings I would say. Let us think about the interest earning so if the rate of interest is higher which means that this representative agent is going to get more interest income and this will create extra cushion for this particular person to use more of credit card.

So, as long as the earnings is higher you do not mind using credit card. So, I will be explaining further details about this in next session and we will have the further explanation of this particular model with certain comparative statistics in the next session about the monetary intertemporal model and then we will be also looking at certain characteristics of the conventional and nonconventional monetary policy. I am stopping it here. Thank you so much.