Economics of Banking and Finance Markets
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Lecture - 45
Fed fund rate determination-II

Hi everyone, welcome to the session.

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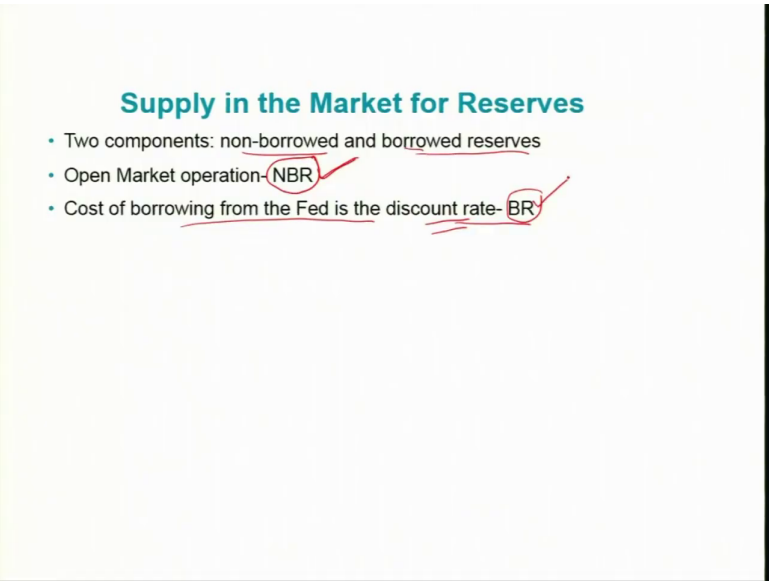

In this session we will continue our discussion on the determination of Fed fund rate. In the previous session, we have discussed the demand curve for reserves, and in this section, we will focus on the supply of reserve in the Fed fund market and the determination of Fed fund rate in the Fed fund market.

So, coming to the supply in the market for reserves you please recall I have mentioned in the one of the previous sessions that supply in the market for reserve is coming directly from the Federal Reserve System. There are two components into it: one is non-borrowed reserve and the other one is borrowed reserves.

And about the non-borrowed reserve part, it is coming through open market operation, that is, through the purchase and sale of government securities by the Federal Reserve System with the banking system. And the second one is through the discount window, that using discount rate changes the Central Bank lend to the member banks. So, that is called borrowed reserve. So, we have also stated that the cost of borrowing from the Fed is the discount rate.

There are two component the total reserve, that the Central Bank is injecting in the economy through the banking system can be classified into two types. One is non-borrowed reserve because this reserve is coming to the member banks not by borrowing from the Federal Reserve System, but by selling their government securities that they are holding, they are selling some part of it to the Federal Reserve System.

So, in that way the resources reserve is coming to the member banks and this reserve is called as a non-borrowed reserve. And second component is borrowed reserve, this depends on the willingness of the member banks to borrow from the Central Bank. So, by making the change in the discount rate, that the rate at which Central Bank lend to the member banks, the member banks will be incentivized to borrow from the Central Bank and utilize this fund for lending and buying government securities. So, this part we are going to say that this is borrowed reserve.

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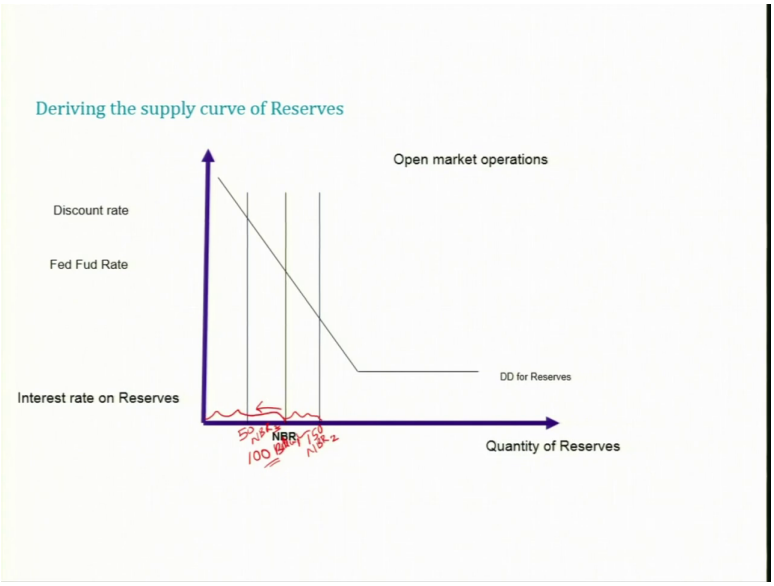

So, in this diagram, let us start with first how Central Bank is supplying reserve in the Fed fund market. Then, as a result, first draw the supply curve and then let us see what is going to happen, when they are making further changes in open market operation, then what is going to happen to this supply curve.

And here, we begin with, the Federal Reserve System is engaging in open market operation and suppose the Fed is injecting, for example, here that this much money, this much, for example, 100 billion.

So, this is coming completely through the banking system by open market operation; that means, the open market purchase by the Central Bank. So, as a result when they are buying 100 billion of government securities from the member banks then you know that, that much reserve is supplied into the market, into the banking system. Then as a result the liquidity of entire banking system increases.

So, in this case, suppose, we are not talking about the other window, that is the borrowed reserve window, that we will discuss immediately after completing this discussion. Suppose here the reserve coming to the Fed fund market, in the banking system, is going to be 100 billion and we are going to call it NBR, that is through the open market purchase.

What if they increase the purchase of more government securities, suppose they make into 150. So, you can see that then the reserve increases further right, the NBR increases further, let us call it NBR 2, this the first one NBR 1 and this will become NBR 2. That means, the because of open market operation you can see that the reserve in the banking system increases.

So, now suppose the Fed want to reduce the NBR, then Fed will carry out open market sale of government securities, then you know that it will be declining this much. For example, then you can say, this is NBR 3 so; that means, instead of open market purchase, the FED will do open market sale, then they will be reducing the reserve with the banking system.

So, in this case, let us see how the rate of interest will be determined. Suppose the initial open market operation they conducted, and as a result assume that they injected 100 billion dollars into the banking system. So, you can see that this is the demand curve. The supply curve is vertical, supply curve is vertical.

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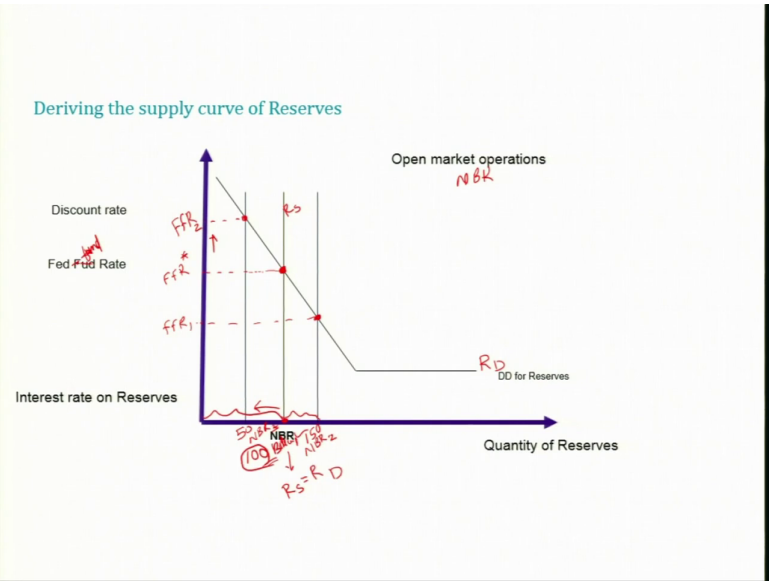

Because this is inelastic to the Fed fund rate, it does not change the supply of reserve by the Fed in the Fed fund market, the supply of reserve is an arbitrary policy decision, it is taken by the federal open market committee, they do not consider the market Fed fund rate. So, this is interest inelastic, and this is a vertical line because this is an exogenous policy decision, it is not response to responsive to Fed fund rate, it is a policy decision.

So, from this we are going to call that this curve as the supply curve, this is a supply of reserve; this one is demand for reserve and this curve is the supply curve.

We are doing only open market operation, let us take some more time before introducing the other window, the discount window. Then we can see that suppose there is only open market operation, then the supply curve intersects the demand curve at this point.

So, at this point you can see that this is the intersection point, and accordingly you can see that this is the Fed fund rate determination. The supply curve of reserve and the demand for reserve curve intersect at this point and this is going to be the Fed fund rate, the equilibrium Fed fund rate.

And this is the quantity supply, this much is the RS and is equal to RD. So, given this open market operation, you can see that the Fed fund rate will be determined at this point.

Now what we can see that if Fed increase the open market purchase; that means, open market purchase by the Federal Reserve System and they inject more money, that is, more reserve

into the banking system. Then this is going to be the new equilibrium point and the Fed fund rate decreases to this point this is going to be a new Fed fund rate. Similarly, what if, instead of open market purchase, what if they do open market sale, and take back the reserve from the banking system then you can say that in this case the Fed fund rate is going to increase, Fed fund rate is going to increase to FFR2.

This is all what we have discussed now, only the open market operation that is the known borrowed reserve component. The Federal Reserve System has more control over the open market operation, that is the NBR then the borrowed reserve; borrowed reserve we have seen that it depends on the banking system's willingness to borrow.

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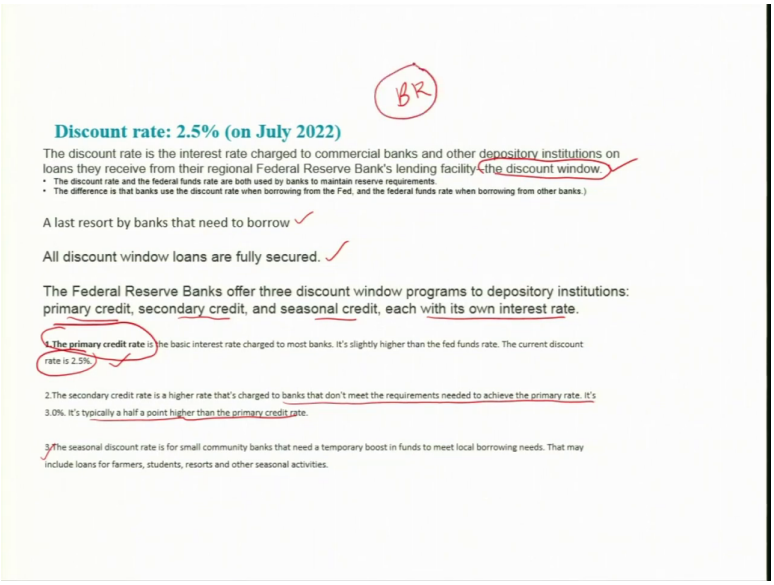

Let us now talk about the second tool, that is the borrowed reserve through the discount window. The discount rate is the interest rate charged to commercial banks and other depository institutions on loans they receive from their regional Federal Reserve Bank's lending facility, that is, through the discount window.

The discount rate and the Fed fund rates are used by banks to maintain reserve requirements. So, the difference is that banks use the discount rate when borrowing from the Fed and the federal fund rate when borrowing from other banks. So, this comes as a tool that means, the Central Bank is the lender of the last resort, so whenever commercial banks need money, they can approach the Central Bank for their fund.

But what the Federal Reserve System can do that, by changing the discount rate, by increasing the discount rate for example, they can discourage the borrowing by the member banks. And if they want to lend more through the discount window, they can reduce the discount rate then the banks will be incentivised to borrow more. So, all discount window loans are fully secured with the collateral.

So, the Federal Reserve Banks offer three discount window program to the depository institutions; one is called primary credit, second one secondary credit and seasonal credit with which each with its own interest rate. For example, coming to the primary credit rate, it is the basic interest rate charged to most banks, and is slightly higher than the Fed fund rate.

So, the discount rate that we are going to discuss in this session is this primary credit rate, then there is secondary credit rate there is a higher rate that is charged to banks that do not meet requirements needed to achieve the primary rate, it is 3 percentage it is typically a half a point higher than the primary credit rate.

In addition, there is seasonal discount rate, that is for small community banks that need a temporary boost in funds to meet local borrowing needs. That may include loans for farmers, students, and other seasonal activities.

Now let us bring the supply of reserve through the discount window that is through the borrowed reserve window, let us bring that one in our diagram.

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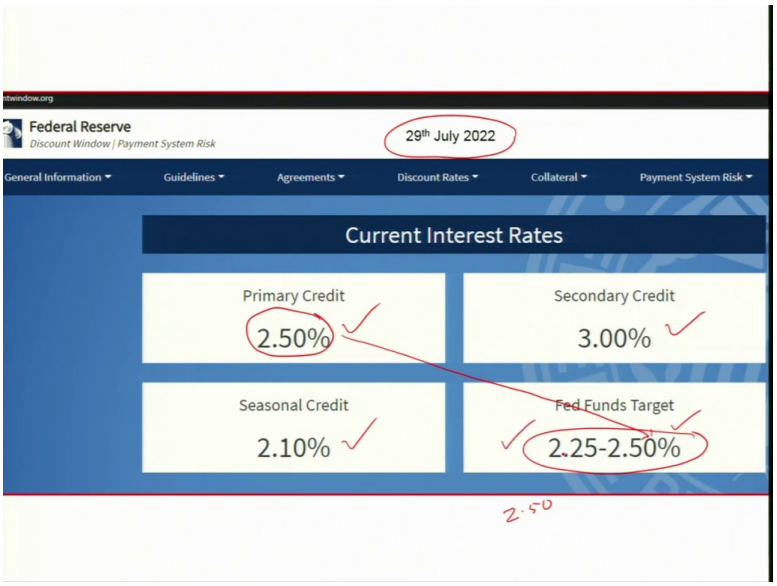

So, before that I am also showing this, I have taken on this date the current primary credit rate, our secondary credit rate, seasonal rate, and the Fed fund target rate. So, importantly you can see that the Fed fund target rate, this one that, the upper limit is 2.5, you can see that the primary credit rate is equal to this point you can see that this is going to be. The discount rate and the upper limit of Fed fund target rate is same, that is 2.5 percentage.

So, that what we are going to see that how the upper limit in the Fed fund target rate can be achieved by changing the discount. We are going to discuss two points; one is, using the discount rate, how the Fed can decide the upper range of the Fed fund rate. And similarly, using the interest rate on reserve, how the Fed can define the lower limit of the Fed fund rate.

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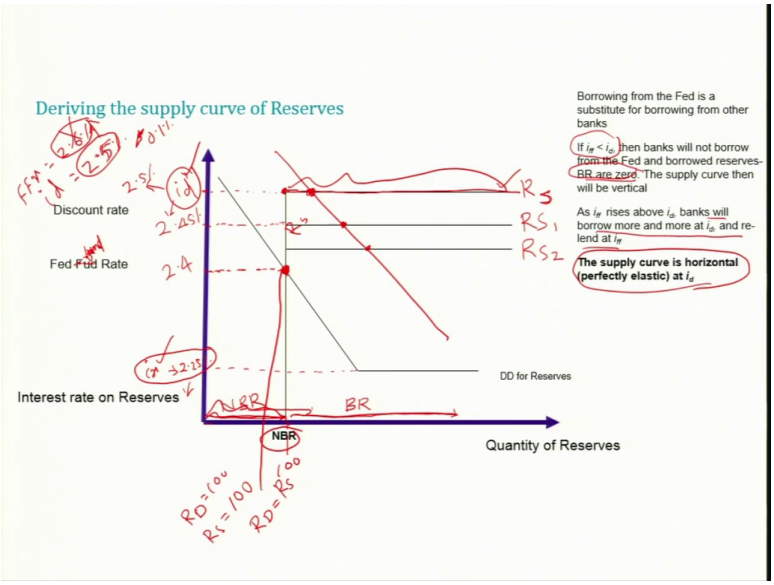

This is the supply curve, when we are supposing the vertical part, this is the non-borrowed component, that the supply of reserve constituted mainly by non-borrowed reserve, this much supply is decided by the NBR component of the reserve. And after that, suppose there is a supply of reserve, then after that whatever they supply is through the discount window by determining the discount rate.

Suppose Fed determines the discount rate for example, here let us call it id for example, let us make it for example, 2.5 percentage. This component if there is demand suppose right now the demand curve the equilibrium is already achieved at this point this is the supply curve vertical component is intersecting at this point.

Then what we can do that we are going to gradually shift the demand curve rightwards then to see how discount rate is going to play a role, but at this moment here we can see that this is the supply curve's vertical part, that is the supply of reserve. So that means, this much part we are going to say this quantity; that means, suppose we say that this one is 100 billion. So, this much is NBR component of the supply of reserve and this part is going to be the borrowed reserve component.

So, when we talk about the supply as a quantity, this much part is the NBR component, and this part is going to be the borrowed reserve component. But when the curve is shifting rightwards, the NBR component of the supply of reserve shifting rightwards then; obviously, you know that the NBR component is increasing like that, and the borrowed reserve component will be declining.

So, what is special with this id? So, in the previous session we have seen that the federal fund rate will never go below the interest rate on reserve, that we have seen 2.25 percentage, the actual Fed fund rate will never go below 2.25 percentage. Because we discussed that it is better for the banks to deposit their money in the federal fund Federal Reserve System and earn interest instead of lending to the Fed fund market at a rate lower than less than the ir.

And another thing we are going to see that the Fed fund rate is never going to be above the interest rate on discount rate, the interest rate on Federal Reserve Systems loan. The Fed fund rate is never going to be above the discount rate, why? The reason here is that suppose the FFR is going to be, for example, 2.6 percentage. Anyway, the Central Bank is going to give loan at 2.5%, that is, the id is 2.5 percentage.

So, the FFR is never going to be above the interest rate on discount rate because what if it is going to be 2.6 percentage, then it is better for all the member banks to borrow from the Federal Reserve System and lend in the Fed fund market.

That means they can borrow from the Federal Reserve System at a rate of 2.5 and they can lend in the Fed fund market at a 2.6 percentage, then the difference that this the difference here is that 0.1 percentage that is going to be their profit. But you know that in that way they can lend, but there is no one is going to borrow of at a 2.6 percentage, because anyway they can borrow at a 2.5 percentage from the Federal Reserve System.

So, because of this reason we can confidently say that federal fund rate is never going to be above the discount rate. So that means, the upper rate of Fed fund rate is going to be the discount rate. So, two things we infer here the lower limit of Fed fund rate can go minimum this much only that 2.25 percentage, it will never become 2.24 or 2.22 like. That is the lower limit. The upper limit can become maximum equal to the interest that the discount rate, it will never go above, it will never go above 2.5 percentage.

So, when the Fed announced the lower limit and upper limit, they are also changing the interest rate on reserve and the discount rate. Then only the Fed can make FFR to fall in the boundary that the lower limit and upper limit, and the effective Fed fund rate will be somewhere between the lower limit and the upper limit.

So, in this example this is going to be the Fed fund rate. Suppose let us see that this is for example, 2.4 percentage. Now let us see what if Federal Reserve System is going to reduce the interest rate. So, here the id1 is, this one, suppose the Fed is going to reduce the discount rate to 2.45 percentage. So that means, then the upper limit is going to be maximum 2.45 percentage, the Fed fund rate will never go above 2.45 percentage, the reason that we discussed just now.

That means, if the Fed fund rate is above 2.5 percentage it is profitable for all banks to borrow from Federal Reserve System and lend in the Fed fund market. But you know that no one will be borrowing there because, why should they borrow at above 2.5 percentage from the Fed fund market, since they can easily get funds at the discount rate from the Central Bank from the Fed reserve system.

So, what we can see that by reducing the discount rate they can limit also reduce the upper bound of the Fed fund rates. So, when they reduce the rate of interest, the supply curve is going to shift like that. So, this is RS1, this is then RS2, this is going to be like this. So, simple explanation I have given here, borrowing from the Fed is a substitute for borrowing from other banks if interest rate on federal Fed fund rate is less than the discount rate, then banks will not borrow from the Fed.

Banks will not borrow from the Fed and the borrowed reserve are going to be 0. So, you can see that in this case, the determined federal rate is 2.4 and when a Fed fund rate is 2.5, that the discount rate is 2.5 you can see that the supply curve the demand curve intersects at this

point. There the member banks are not going to borrow from the Fed; they are not going to go borrow from the Central Bank or the Federal Reserve System.

So, then the BR is going to be zero because here the in this discussion we can say that the demand and supply is going to be RD is equal to 100 here, that we can see here this much only will be demanded. And then accordingly RS is also going to be 100, so that means, RD is equal to RS at this point here right. So, at this equilibrium point you can say that this is the demand and supply of reserve.

So, in this case you can say that the BR though supply curve is there, but the BR is 0 here. So, in this case what we can see that the supply curve, the actual supply curve what we are using is only vertical, that the horizontal part is not taking place here because actual Fed fund rate is lower than the discount rate here.

So, at iff, suppose the Fed fund rate rises above the discount rate, then we discuss this one already bank will borrow more and more at id and lend at a the Fed fund rate. Then at that time, suppose this curve shifting rightwards for example, like this, then you can say that the equilibrium is going to happen here. If this is the initial BR curve, then if they reduce it further, then they will be demanding here, this is the other equilibrium point.

So, here we can say that at this point when the Fed fund rate keep on increasing rises above the discount rate for example, this is the discount rate and iff increases, then you can see that the member banks can borrow from the Federal Reserve System and lend in the Fed fund market. So, here you can see that the supply curve is horizontal, that is at this point right; there is infinite increase in the supply demand for reserve from the Federal Reserve System.

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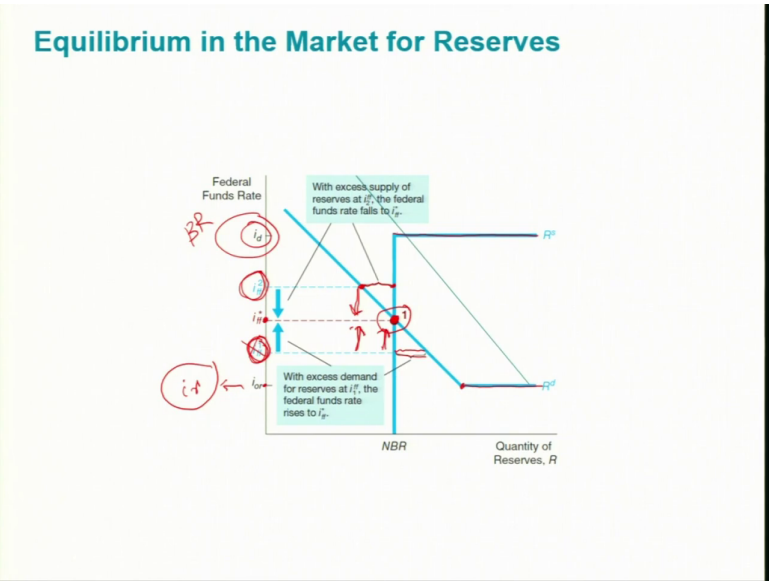

So, this is the diagram that we can use to discuss the equilibrium in the market for reserve. So, already this clear to you, this is the downward sloping demand curve, but at this point that the interest rate on reserve from this point onwards the demand curve will become perfectly elastic.

And we already drawn the vertical NBR reserve curve, the reserve constituted from NBR this is inelastic to interest rate. then this is the elastic part; that means, determined by the discount rate. And the supply curve. given this one, the position of the demand curve. We can see that this is the equilibrium point; that means, this is the equilibrium Fed fund rate in the market.

So, here you can see that the lower limit is the interest rate on interest rate on reserve and the upper limit is interest rate on discount loan that is this one. And is from this discussion, how much open market operation they are doing and what is the position of the demand curve, accordingly we can say this is going to be the new equilibrium point.

So, let us look at what if we are going to say that this is never going to be the equilibrium point, the iff1 is never going to be the equilibrium point, because given this position of demand curve and position of the supply curve, this is never going to be the Fed fund rate, because you can see that there is excess demand for reserve at this position.

Excess demand, because the opportunity cost of holding excess reserve decreases for many large banks, they demand more reserve from the banks instead of lending their money and

buying government securities, to meet the required reserve and excess reserve they will be preferring to borrow from the market. So, there will be excess demand.

Because of the excess demand you know that when the demand increases the rate of interest also increases here. So, as a result there is an upward pressure, more and more banks will prefer to borrow from fed fund market and as a result the Fed fund rate is going to increase.

What if we are also going to say that this is not going to be the equilibrium rate of interest, that iff2, because you can see that there is excess supply of reserve in the market, the demand is only this much at this rate, but supply is this much. So, because of the excess supply there will be pressure to reduce the rate of interest in the market, so as a result the rate of interest will decline to this point.

So, initially it will increase when Fed fund rate is this one iff1, then there will be upward pressure because of excess demand when the Fed fund rate is this one iff2 then there is a downward pressure on interest rate and finally, the equilibrium rate of interest will be attained at iff.

So, in this session, using demand and supply curves, we have completed the discussion on how Fed fund rate are being determined. The two policy tools by Federal Reserve System, one is interest rate on reserves that is ir and other one is the discount rate that is through the BR, the discount window through the borrowed reserve window.

And in the next session let us discuss all the three policy tools that the reserve requirement, discount rate and doing open market operation, how does it affect fed fund rate.

Thank you and see you in the next session.

Keywords: fed fund rate, supply of reserve, lower limit, upper limit, vertical supply curve, discount rate, interest rate on reserve