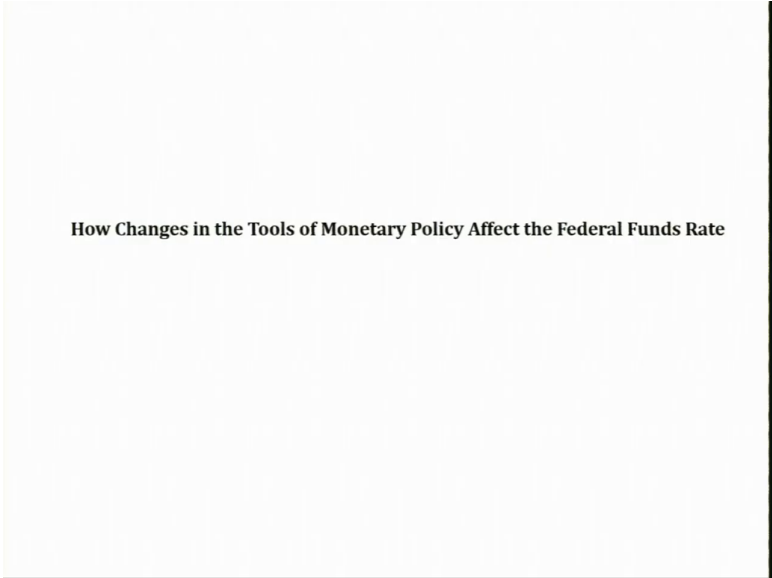


Economics of Banking and Finance Markets
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Lecture - 46
Fed fund rate determination - III

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How Changes in the Tools of Monetary Policy Affect the Federal Funds Rate

Hi everyone, welcome to this session. In the previous sessions we discussed the mechanism of Fed fund rate determination and how federal reserve system announce the target fed fund rate, and to attain that how they also fix the discount rate and the interest rate on reserves. And after that and how do they conduct the open market operation using the open market operation and the discount window, how do they attain the target fed fund rate.

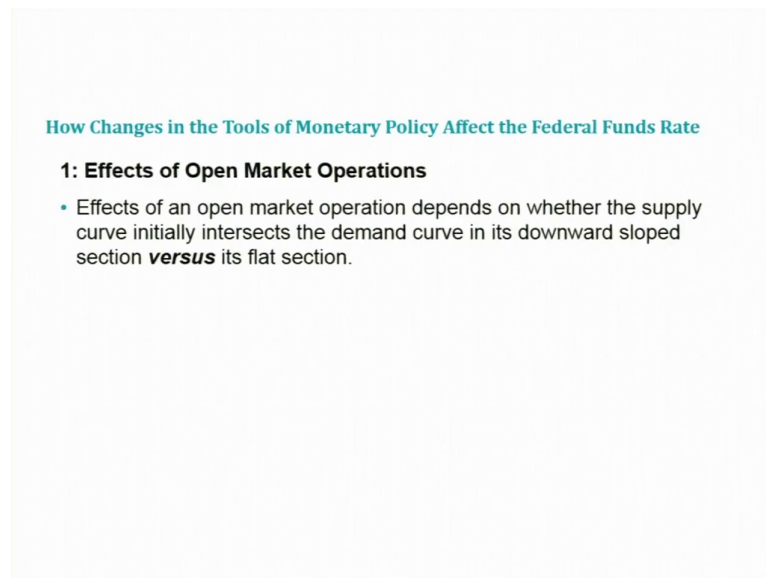
And then we found that the market will be determining the fed funds rate. And the finally, what we are going to get the average of the equilibrium fed fund rate, we call it as effective fed fund rate. In this session, we are going to see how fed is using the three major tools of monetary policy to affect the fed fund rate.

Here we are going to discuss, for example, how the federal reserve system, using open market operation, can fix the fed fund rate.

And subsequently we are going to discuss how changes in the discount rate, that the borrowed reserve, using the discount window, how does the Fed affect the fed fund rate. And

after that, we are going to discuss how changes in reserve requirement and as well as the changes in the interest rate on reserve requirement affect fed fund rate.

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How Changes in the Tools of Monetary Policy Affect the Federal Funds Rate

1: Effects of Open Market Operations

- Effects of an open market operation depends on whether the supply curve initially intersects the demand curve in its downward sloped section **versus** its flat section.

So, let us start with the first one, that is the changes in the open market operations; so, how changes in the open market operations affect fed fund rate. So, here the effects of an open market operation depend on whether the supply of reserve curve initially intersects with the demand curve in its downward sloped section, vis-a-vis, its flat section.

So, we have seen that the demand curve has the downward slope section as well as it has the flat section. So, we are going to see that when the supply curve initially intersects with the demand curve in its downward slope section, how does it affect the fed fund rate.

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This is the graphical representation, here our assumption is that intersection occurs at the downward sloped section of the demand curve. That means, looking at this, what we are

going to show here is an open market purchase causes fed fund rate to fall; whereas an open market sale causes the federal fund rate to rise.

So, the initial equilibrium position is this, that you can see, the demand curve intersects the supply curve at this point, and accordingly we can see that this is the federal fund rate equilibrium ffr. And at this point, the quantity demanded, and quantity supplied in the market is going to be this much, this is the quantity supplied and as well as the quantity demanded in the market. So, this is the equilibrium quantity, that is the equilibrium where the demand is equal to supply.

Now, you can also see here, on the flat section of the demand curve, we know that this is the interest rate on reserve. And this one, the upper part, this one is the discount rate that is the rate at which the banks can borrow from the federal reserve system. Now, let us see when we saw that the Fed engages in open markets purchase.

So, when they make open market purchase; that means, they are purchasing the government securities from the banking system. And as a result, the net proceeds of the purchase will be credited into the account of the banks who sold their securities to the Fed. And then, in this process, we can see that it becomes NBR; that means, the fed injects some more reserve into the banking system through open market operations, which we call here a non-borrowed reserve.

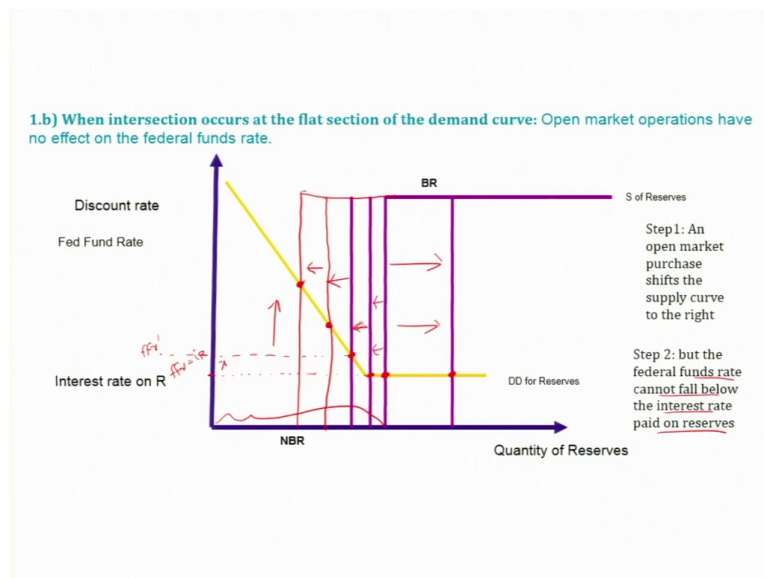
So, finally, the new intersection point is this one; so, what we can see that when the Fed is purchasing government securities, step 1, we can say that the supply curve shift to the right. So, this is what we are seeing here, the supply curve is shifting rightwards. And the initial equilibrium point let us call it initial position number 1 and the new equilibrium point is 2.

And the new equilibrium rate of interest, that the new fed fund rate is going to be this one, this is the fed fund rate is this point. So, at this rate, obviously, we know that there is a downward sloping demand curve. So, when the fed fund rate declines, there is more reserve in the banking system, then as a result when there is more reserve in the banking system.

And then the member banks who are borrowing from the fed fund market move along the demand curve, like this, they move along. And they will be demanding more when the price (fed fund rate) declines. Then the new quantity demanded and supply; this is going to be the new demand for reserve and the new supply of reserve.

So, this is the new equilibrium point, and accordingly we can say that an open market purchase by fed leads to a fall in federal funds rate. So, this is one of the impacts, suppose given that the intersection of the supply curve happens at the downward sloped section of the demand curve; so, this is scenario 1.

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Then let us see what is going to happen when the intersection occurs at the flat section of the demand curve. Suppose this is the initial intersection point where you can see the open market operations have no effect on the federal fund rate. So, initially if this is the intersection point, we know that the ffr is equal to the interest rate on reserve, then the intersection happens at the horizontal position section, the flat section, of the demand curve.

At this point we can see that this is the NBR, this much is the NBR, and this is the equilibrium position. Now, let us see when there is an open market purchase, when there is an open market purchase you can see that there is no change. What the outcome you can say that because of the open market purchase the supply curve shift to the right.

Then, however, we can see that there is no change in the fed funds rate, because we have seen that in the previous classes sessions that fed fund rate will never go below the interest rate on reserves. If the fed fund rate is below the interest rate on reserve, then no one will lend there. Because it is better to keep all reserve as excess reserve in the fed account and then they will be getting the interest rate on reserve. So, no point in lending in the fed fund market at a lower rate, lower than the interest rate on reserve.

So, that means, the fed fund rate will never go below the interest rate on reserves. So, what is the likely impact; because of open market purchase, the supply curve that the NBR curve shift rightwards. But the fed fund rate cannot fall below the interest rate paid on reserve, as a result there is no change in the fed fund rate.

And what if the Fed engage in an open market sale. That means, selling government securities to the banking system and getting the net proceeds, that is collecting that net proceeds from them. When the banking system purchase government securities from the fed, the immediate impact is that the reserve in the banking system declines, then the reserve in the banking system will be declining. So, as a result, if still the intersection happened at the horizontal part of the demand curve, then there is no change in the fed fund rate. In contrast to that, further suppose if the objective of the fed is to increase the fed fund rate, then they must reduce the reserve with the banking system.

Then the option here is that open market sale; that means, keep on selling more and more government securities to the banking system. Then, that means, the supply curve is shifting leftwards, then you can see that now the intersection is happening at the downward section of the demand curve.

So, now you can see that this is the new fed fund rate, this is the new fed fund rate; that means, it is greater than the initial fed fund rate; that means, fed fund rate increases if the intersection happens at this point. So, we can see that if the Fed would like to increase the fed funds rate, then the option is to conduct more and more open market sale, then you can see that the equilibrium fed fund rate is increasing. If the objective of the Fed is to increase the fed fund rate, then the option is to do more and more open market sale, that is selling government securities to the banking system.

Then as a result, reduce the reserve with the banking system, then you can see that the new intersection is going to be here; so, the curve is going to be like this. So, this is the way using the open market operation, the Fed influence the fed fund rate, this is one of the tools.

So, now, we are going to discuss how changes in the using another tool, using the tool of discount window, how the Fed is going to affect the fed fund rate.

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How Changes in the Tools of Monetary Policy Affect the Federal Funds Rate

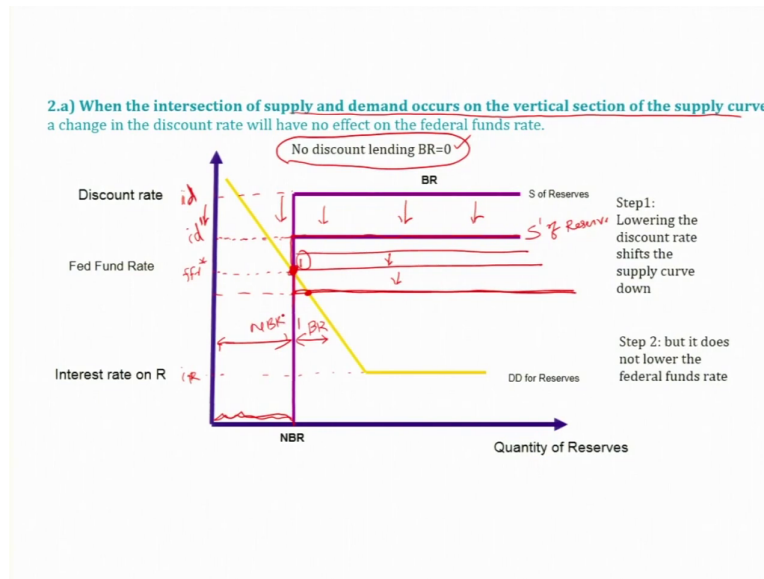
2: Effects of Discount rate cut

- If the intersection of supply and demand occurs on the vertical section of the supply curve.

Again, to discuss here we need to again consider the position of the supply curve and as well as the demand curve; so, that is important, very important. The actual effect of any policy depends on what is the position of a demand curve and what is the position of the supply curve; moreover, especially the intersection the position of supply and demand curve, whether is at the vertical section or at the horizontal section. Again, we need to think about the horizontal section of the demand curve, horizontal section of the supply curve as well as about the vertical part of both curves.

So, here we are going to see that if the intersection of supply and demand occurs on the vertical section of the supply curve, that is one scenario. We can visualize multiple scenarios, but for the sake of simplicity, to manage our discussion, let us make a few reasonable scenarios and then see what is the likely impact of fed fund rate.

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Here, our first scenario is that when the intersection of the demand curve occurs at the vertical section of the supply curve. So, the interaction of the demand and supply, it occurs at the vertical section of the supply curve, this is the intersection point. Again, we can say that this is the equilibrium interest rate, and this is the quantity demanded and quantity supplied, that is, the quantity of reserve demand and supply is equal to this much.

So, this is the initial equilibrium position, and this one anyway you are clear that this is the interest rate on reserve, this is the discount rate. Let us see what happens here, suppose there is a change in the discount rate.

So, this is going to be the new supply curve, new supply curves of reserves. So, you can see that now the supply curve is going to be like this way, this is the new supply curve. The supply curve shifts down, this is the new supply curve. So, what happened that initially this is the interest rate on discount.

Now, what we have seen here is that Fed has reduced the discount rate. When fed is reducing the discount rate, obviously, you know that the supply curve is shifting downwards. Since the intersection happened at the downward sloping position of the demand curve, we are going to see that there is no change in the fed fund rate.

Because intersection is still at this point, though the supply curve shifted downwards, we are going to see that no discount lending happens here. That means, the borrowed reserve, that is

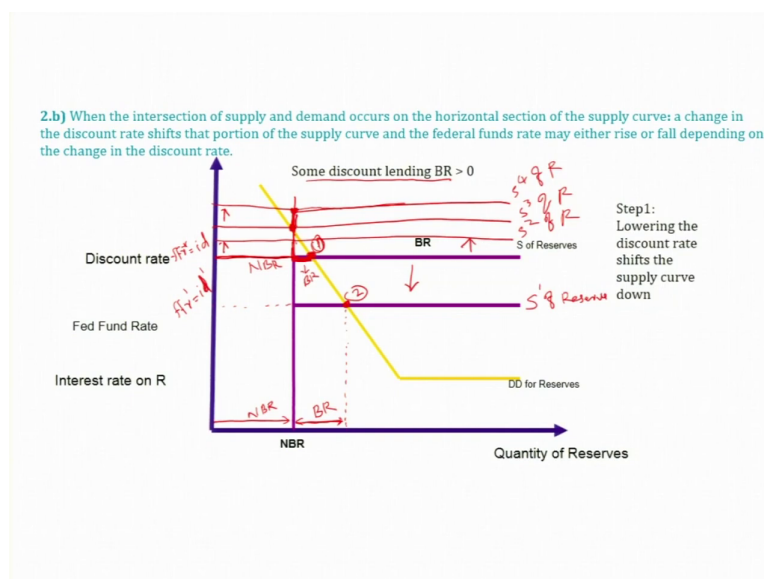
through the discount window is still zero here. That means, the supply in this market consists fully of the non-borrowed reserve; that means, this much is the supply in the market.

So, no discount lending here, then as a result the intersection is here. Because always for us, the equilibrium fed fund rate will be at a opposite point where a supply of reserve is equal to demand for reserve; so, our intersection point is this one. So, we see that there is no effect even when they reduce the discount rate.

But if the Fed keep on reducing the discount rate, then we are going to see there are some changes happening. Suppose if they reduce further, if the Fed keeps on reducing like that, then the supply curve is going to intersect with the demand curve at this point; so, you can keep on see that it will be equal to here, then after that the new intersection will be here, then the ffr will be declining.

When the fed keeps on reducing the discount rate; then we can see that the curve will be shifting downwards, downwards, further, and further. This is the supply curve; this is the supply of reserve that is coming from the BR component. This much is this much from NBR, after this is whatever is coming due to the change in the discount rate, that is coming from BR part, the borrowed reserve.

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So, let us now see another scenario when the intersection of supply and demand occurs at the horizontal section of the supply curve. So, here a change in the discount rate shift the portion

of the supply curve, and the fed fund rate may either rise or fall depending on the change in the discount rate.

So, here the initial equilibrium point is here, you can see that the equilibrium ffr is equal to the discount rate. The equilibrium happens at this point, at the BR part of section of the supply curve; that means, here there are some discount lending.

So, this distance; this much is I am marking in red color; this much is coming from the BR component, this much is the BR component, and this much is supply in the market coming from the NBR component, that is through the open market operation right.

So, this is the total quantity demanded and supplied, and of this is the first part is NBR and second part is BR. This is the initial equilibrium position where we can see that the fed fund rate is equal to the discount rate, the equilibrium fed fund rate is equal to the discount rate.

Let us now visualize what if the fed is going to reduce the discount rate? When the fed is going to reduce the discount rate, you know that at this position, suppose initial equilibrium is at this position, then lowering the discount rate shift the supply curve down. Then you know that this is the new supply curve, and you can see the new equilibrium position is this one. Here you can see the fed fund rate is going to be this, that is, this is going to be the new fed fund rate.

And here the new quantity demanded and supplied is this much, and of this you know that this part this much part i is going to be the borrowed reserve component. And this much is the NBR component that is from open market operation, and this BR part through the discount window. So, what we have seen here is that when the intersection of the supply and demand curve occurs on the horizontal section of the supply curve, then at that point of time, the discount window is going to make an impact on the in the fed fund market. That means, if the intersection is happening at this section, that the slope that what we mentioned here, then you can see that a reduction in discount rate is going to make an impact.

Similarly, we can also see that what if Fed increases the discount rate, if they increase the discount rate, then you know that the curve will be shifting upwards. So, when the Fed keeps on increasing discount rate, we can say that this one is S2 of R, S3 of R, S4 of R.

It means, Fed is increasing the id, the discount rate. When they keep on increasing the discount rate then you can see that this point, the new intersection is happening here; so, it is not making any impact. That means, the demand and supply curve intersect at this point, then you can see that the fed fund rate increases.

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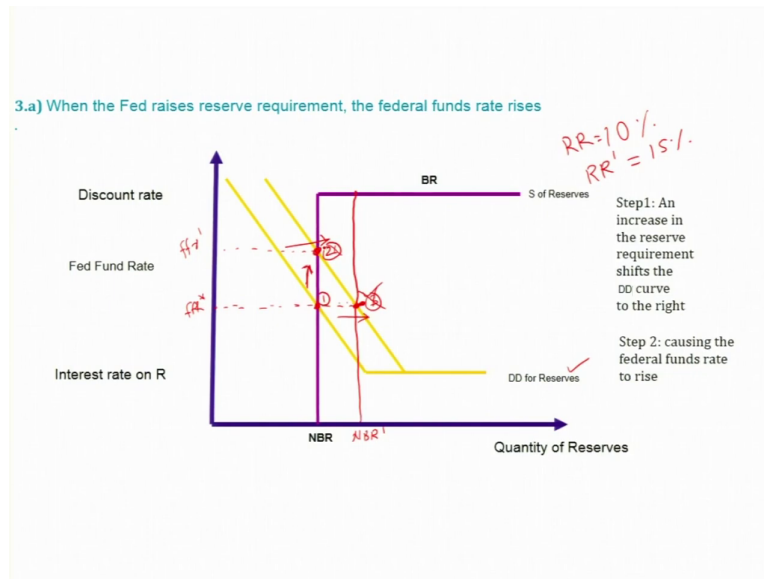
How Changes in the Tools of Monetary Policy Affect the Federal Funds Rate

3: Effects of changes in reserve requirement

- When the Fed raises reserve requirement, the federal funds rate rises
- when the Fed decreases reserve requirement, the federal funds rate falls.

Now, let us see how changes in another monetary policy tool, that is changes in reserve requirement, how does it affect the fed fund rate. So, here we are again visualizing two scenario what if fed raises reserve requirement, that is one, another one is what if when fed reduces the discount rate. So, we are going to see that when the fed raises reserve requirement, we are going to see that the fed fund rate rises. So, in contrast when the Fed decreases reserve requirement, the federal fund rate falls.

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Let us see both scenario, this is our initial equilibrium position where we can say this is the equilibrium ffr. Now, see what is going to happen when the Fed increases the reserve requirement. So, we can see that when the Fed is increasing the reserve requirement, keeping other thing constants; that means, there is no change in even the fed fund rate. You know that the banking system, the borrowing banks will be forced to borrow more to meet the increased reserve requirement.

And at the same rate, they are willing to borrow more, because they need to meet the reserve requirement. Suppose initially, it was 10 percentage, that is, this demand curve is when initial RR is equal to 10 percentage. What if the new RR is going to be 15 percentage. Then you know that the curve will be shifting rightwards, because the banks are willing to borrow more.

The increase in the reserve requirement shifts the demand to the right. The banks are forced to borrow more and as a result this is the new intersection point. This is the initial equilibrium position, and now this is the new equilibrium position, you can see that this is the new fed fund rate at the new equilibrium position.

So, what we have seen here is that when the Fed increases the reserve requirement, the demand for reserve will be increasing in the market and it will put an upward pressure in the fed fund rate. Note that when the Fed increasing the reserve requirement, we are assuming

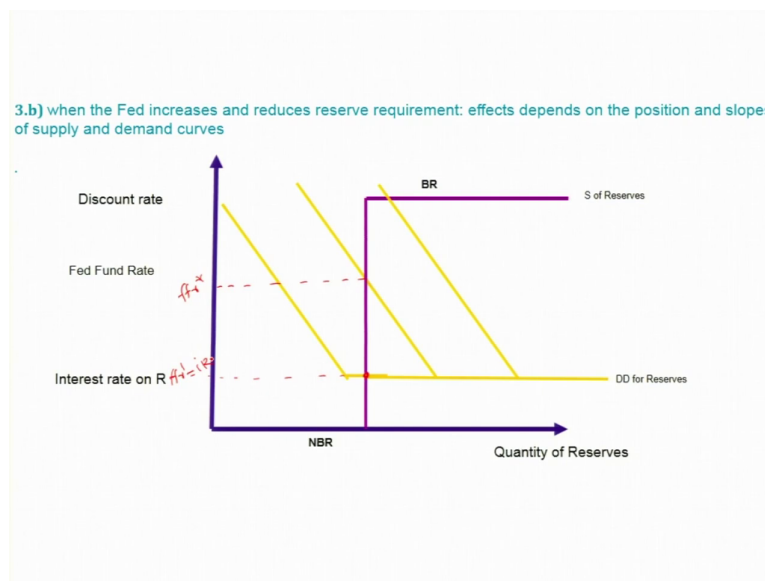
that there is no change in the reserve, we assume that in this diagram, there is no increase in the NBR or BR; that means, there is no open market purchase or open market purchase,

In this scenario, to keep the same ffr, for example, the Fed is increasing the reserve requirement. But if the Fed does not want to see the ffr is increasing, then one option is to increase the NBR; increase the NBR this much.

That means, open market purchase, then the equilibrium same equilibrium position happens, this would not happen, and this will be happening provided that there is a open market purchase. But in this diagram, we are just assuming that there is no open market purchase by the Fed. The Fed just want to increase the fed fund rate by using the reserve requirement, then they can do in this way.

That means, increase the reserve requirement and as a result you can see that the fed fund rate will be increasing.

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What if they reduce the reserve requirement, here initial equilibrium position is this ffr equilibrium position. And if they reduce the reserve requirement, we can see that the new equilibrium position is going to be here, the fed fund rate is going to decline. The new fed fund rate is going to be this, this is equal to the interest rate on reserve.

In this session, we have discussed three tools: the open market operations, discount window and as well as changing in the reserve requirement. And in the next session, we will continue

this discussion and see what if they change the interest rate on reserve and what are the likely impact.

Thank you, see you in the next session.

Keywords: fed fund rate, Fed, reserve, discount rate, reserve requirement, NBR, BR