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**RICARDO CABALLERO:** All right, let's start. So today I want to talk about interest rates. If you have followed the news, there is a lot of debate on these days on where will the interest rate in the US end at the end of this tightening cycle. And so I'll show you.

There has been a very aggressive monetary policy trying to fight the inflationary episode we're going through. And that's done through interest rates. And the question that I want to address today is well, how is it that the interest rate is determined? So when a central bank decides to hike interest rates, how do they do that?

And obviously this is about financial markets. Interest rates are set in financial markets. And financial markets are very, very complicated. So we're going to keep it very, very simple. We're going to introduce more complexity later on in the course. But still, we're going to keep it pretty simple because our main objective in studying financial markets is really to achieve some sort of understanding of how the interest rate policy that the central bank controls is determined.

So before I get into specifics, let's see some trivia here. Who knows who that person is? OK. You, sir.

**AUDIENCE:** Jerome Powell.

**RICARDO CABALLERO:** Jerome Powell, exactly. And who is Jerome Powell?

**AUDIENCE:** The chair of the Federal Reserve.

**RICARDO CABALLERO:** The chair of the Federal Reserve System in the US, which is the central bank of the US. OK, so that was an easy one. And if you are into financial markets, everyone is worried about what this guy is thinking and his friends are thinking at this moment because they determine the interest rate. How do they do that? Well, that's what we're going to talk about later on.

A little trickier. Who is this? No, no. That's cheating. Katsuo Ueda. He's the next president of the Bank of Japan, the central bank of Japan. And an interesting-- there are many interesting things of him, about him-- but he's a he's a graduate from our program, the PhD program, which actually is an incredibly successful program at producing major central bankers.

Ben Bernanke is our alumnus. He was the chairman of the central bank, the chair of the central bank of the Fed during the financial crisis. Mario Draghi is one of our graduates. Mario Draghi was the most successful central banker in Europe. He was the president of the ECB, European Central Bank, for many years, and in particular, during the global financial crisis and the European crisis, which followed the global financial crisis. But you name it-- Stan Fisher in the past of the Bank of Israel. And nowadays, Phil Lowe of the chair of the Reserve Bank of Australia.

In Chile we have had two or three presidents and so on. So if this is your career, this is a good program. You should join our program. You may end up in a good place. But that's the next one for Japan. And Japan is a very interesting place from the point of view of monetary policy, precisely because they haven't had much space to do conventional monetary policy. So they have had to do lots of unconventional things from the point of view of what a central bank typically does.

But today, we're going to study conventional things. And we'll talk a little bit more about unconventional things later in the course. Now, some institutional knowledge-- this is, again, in the US, the central bank of the US is called the Federal Reserve System. And it's a system, really.

It has the Board of Governors which sits in Washington DC. And there are seven governors. And the governors are nominated by the president and then confirmed by the Senate. And the president of that board is-- so the president of the Fed will be one of those members.

Now, in addition to that, the US has a Federal Reserve bank system. There are 12 regional banks. There is one in Boston. In fact, if you look at the skyline near the waterfront, there is a building built out of recycled aluminum. Well, that's the Reserve Bank of Boston. And of those 12 regional banks, they rotate. So the policy, the policy interest rate, is set in a committee, which is called the FOMC, Federal Open Market Committee.

And the member of that, the voting members of that committee are the seven governors plus 4 out of the 12. And they rotate. Most of them rotate. The only one I think does not rotate is the president of the New York Fed, because they are so important, because that's the financial heart of the US that you certainly want that president to be involved in interest rate decisions. And it's really the Fed that is in charge of communication with financial markets, which is a huge thing for the Fed. They are in New York and they're crucial for that.

OK so those are the people that-- and in most places around the world you're going to have at least something equivalent to the 7 governors out there-- most places. Obviously, the ECB is different because it's multiple countries. So each country sends one member. But otherwise, it tends to be like the US without the regional banks.

So why do we care about monetary policy? Well, because the thing is one of the main policy tools you have in the short run remember in this part of the course, we're trying to understand output in the short term. And one of the main policy levers-- I mean, how can you affect output-- is monetary policy. Which one is the other one? There are two major ones.

**AUDIENCE:** Fiscal policy.

**RICARDO** Fiscal policy. Exactly. And fiscal policy we did look at in the previous lecture. Remember, we said an  
**CABALLERO:** expansionary fiscal policy is an increasing  $G$  while a decline in  $T$  would lead to an expansion in aggregate demand. Equilibrium output would go up. So fiscal policy is something you always use in deep recessions.

But monetary policy is much more nimble. I mean, it's a bunch of people that need to meet and just change the interest rate. Anything that is fiscal, there are some automatic stabilizers, by the way. So automatically, fiscal policy becomes more expansionary during recessions and stuff like that.

But any deviation from the typical automatic stabilizers require Congress to approve things. It's a long process. And so it's not something that can react as quickly as monetary policy can. And so that's what we're going to do. That's the reason why monetary policy is important for us at this point.

Then there are medium and long run issues. Fiscal policy still affects equilibrium output in the medium and long run. Monetary policy is much less effective at that. It's very difficult to change sort of equilibrium growth or things like that with monetary policy. It's very pretty minor. Most of the impact of monetary policy in the medium and long run is really on the price level and inflation more than on real activity. But in the short run it's very powerful for reasons that we're going to discuss in this and the next lecture.

OK, so as I said, monetary policy acts through financial markets. I think it's a very interesting part of my research agenda is about that. I think the central bank is a very strange institution because most of its mandates are in terms of what happens in the goods market. It says try not to get into recession. Try to get us out of a recession, and so on.

But unlike fiscal policy, which has tools that are directly aimed at the goods market, remember, is a purchases by the government of goods. So if there is insufficient demand for goods, the fiscal policy, the fiscal authority can go out there and buy goods. That creates more demand.

The central bank is given the same mandate aside from price stability and things like that we want to worry about later. But it doesn't have any tools. The central bank, if there is insufficient demand, the central bank cannot go out there and buy hamburgers. Fiscal policy can do that and expand the demand for hamburgers, but not monetary policy.

What monetary policy can do is buy bonds, buy instruments in the financial markets. And through that, affects real activity. So it's the fastest policy tool but it's the most indirect, in a sense, because it has to go through financial markets. And those channels can be very complex. But obviously, we're not in the business of complicating things in this course. So we're going to make it very, very simple.

We're going to assume that financial markets only have two instruments. Obviously a huge simplification. There are millions of financial instruments out there. But I'm going to isolate only two instruments because this happens to be the instrument where the central banks typically participate. They affect all asset prices around. But the direct interventions typically-- recently has been a little different-- but typically it's only in these kind of instruments. And so we're going to focus all of our analysis on those two instruments for now.

Later on, we're going to talk about equity and stuff like that. But just to isolate how monetary policy works, it's sufficient to just focus on two financial instruments. So we're going to assume that people have their wealth in only two forms, in two financial assets. One, we're going to call it money. And the other one we want to call it bonds.

Money, the characteristic of money, what we call money, there are many definitions of money, and 1, and 2, and 3, and 4. But let's keep it very simple. Money essentially means something that you can use very easily for transactions.

So for example, the most important example of money-- not the largest, but the most important one-- is cash, currency. You can buy anything with cash. It's no problem whatsoever. Now the characteristics of the money typically does not have, it doesn't give you any return. You don't invest in cash. You have cash because you need to do transactions. But it's not the way you get a return.

And so money, that's what it's going to mean for us, is something that is used in transactions. But it pays no interest rate, no interest. There's no interest on that.

A bond is going to be the polar opposite. It's going to be something that pays a positive interest rate. So if you buy a bond for 100, for 95, you're going to get \$100 a year from now. So you get something out of that bond. But it's not very useful for transactions. I mean, you cannot go and buy your lunch with a bond. You get the piece of bond for that.

And many things cannot be-- even within financial markets-- you cannot buy assets with asset. You have to go through some process in which you can sell something, get cash, and with cash you pay for that stuff-- not necessarily cash. It could be other forms of money. But typically, financial instruments need to be sold before you can buy something else. You don't swap them. It's not a barter.

But this is what it means for us. So this, whenever you see something like this, is always interesting for an economist. Why? Any economists, microeconomists or whatever. What have I done there that makes-- Economics is about decisions. And then it's about the equilibrium-- decisions and equilibrium.

**AUDIENCE:** What makes people decide how much [INAUDIBLE]?

**RICARDO**  
**CABALLERO:** There's a decision to be made here. There's a trade off. If I need to do lots of transactions, I better bias my portfolio towards cash, towards money. If I don't need to do lots of transaction and the interest rate is very high, particularly, then this is an issue today. Today interest rates are very high. Nobody cares about bonds or anything two years ago when the interest rate was 0.

But today interest rate is 5%. So it's an issue. If you want to keep it in cash, you're going to give up a lot of return. So this is a decision to be made. It's a portfolio decision. And that's always interesting for economists.

So let's talk about that decision. And we're going to talk-- you can describe this decision either from the side of bonds or from the side of money. We're going to describe from the side of money. Because there is a total amount of wealth and you have to decide what to allocate it to.

It suffices, if I tell you there's a total amount of wealth and if I tell you how much you allocate to money, then I'm telling you implicitly how much you are allocating to bonds. It's a complement of that. So I cannot do an analysis either way. But I'm going to do it through money, which is the way it's normally done.

So money demand, if I plot it in the space of  $m$ , money, and the interest rate, it's a downward sloping curve. Why is it a downward sloping curve?

**AUDIENCE:** The interest rate is higher. It pays off more to get bonds, your utility shifted.

**RICARDO**  
**CABALLERO:** Exactly. Your decision, if the interest rate is very high, is to go more towards bond. The interest is very low, I don't care too much about bonds. I'd rather keep the thing that helps me transact, which is money.

And it's interesting because for most of your adult life, you have lived in a world in which that was not a very interesting decision, actually. Because interest rates were very close to zero. Now you're living in a different environment. Interest, for the first time, sort of high for you. For you, there may be a bigger decision between investing in equities and cash. But bonds-- and these are safe bonds, by the way, US treasuries and things like that. And money is not something you have to worry about.

OK, good. What I'm saying is interest rates were around here. So you were all in cash one way or the other. And now interest rates are a lot higher. The other thing that-- so that's a movement along the curve. I'm plotting something in the space of interest rate, money and interest rate. Then when I tell you what happens when the interest rate rises, I'm asking you for a movement along the curve. So if I raise interest rate, I move along the curve up.

So the second thing that we have there, argument we have is something that shifts the curve, because it's not part of my axis. So it will shift the curve. It's a parameter for each of these curves. And that's nominal income.

So in particular, if nominal income goes up, I'm showing you there, that money demand goes out. Meaning for any given level of interest rate, you're going to demand more money. Why do you think that's the case? And again, I'm looking here at the aggregate. But it applies to an individual, as well. So for the same level of wealth, now nominal GDP is higher.

Remember that nominal GDP is the same as nominal expenditure here. So if nominal GDP is higher, then that means there's going to be more transactions because there's going to be more expenditure. and therefore, you need more of the thing that is useful for transactions. Money demand goes up.

The second point to highlight is that while, in most places, we use  $Y$ , here I'm using dollar  $y$ , nominal  $y$ . Why do you think is that? Why don't I just put there real GDP rather than nominal GDP? Is it a typo?

Let's go into steps. Suppose that prices are totally fixed and real GDP goes up. That means that this economy needs more transactions because it's going to be more expenditure. So that explains that yeah, when real output goes up, then money demand goes up. When I say money demand goes up, I said for any given interest rate we have more money demand.

Now fix real output. And I tell you, suppose that the price of goods doubles. Do you think you need more money to transact? Of course, because it's the same. It's equivalent. Money is dollars. I have \$10. And now prices are twice what they used to be. Well, I'm going to need more dollars to transact. So that's the reason we have nominal GDP here rather than real GDP.

Let's now determine the interest rate. And I'm to do it in the simplest possible model first. And by simplest, I mean here in particular, no banks. No intermediaries. OK, so there's only a central bank and people.

OK, so suppose that the central bank decides that it wants to-- this is the way monetary policy used to be conducted. Suppose the size that it wants to offer  $m$  dollars to the economy. And the central bank is the one that produces at-- this moment in which I have no intermediaries, money is really currency. The only one that can produce currency-- forget Bitcoin-- only one that can produce currency is the central bank. I mean dollars. No one else can produce dollars.

Watch out when we talk about banks later on. In this economy I'm describing, there are no banks. The only one that can produce dollars, currency, is the central bank. Any other one that produces dollars, that's illegal. So it's a central bank. So the central bank can decide how much money to supply.

And suppose it decides to supply  $m$ . That's it. It's a decision. Well, what is now? For the first time I can answer the question is, well, what is the interest rate in this environment? Why do I know that? Because I have a money supply. I have a money demand. The intersection at this level of money supply, the equilibrium interest rate, that is the interest rate is consistent with money demand equal to money supply, is that one.

Is it clear? So I have my money demand. And I'm saying the central bank, suppose the central bank decides to supply  $m$ . Well, in equilibrium, that will be the interest rate. That's the way the interest rate is determined. Now, suppose that the central bank increases. Remember, the goal of this lecture is that we get to understand how is it that the interest rate is determined. How is it that the Fed, the central bank, determines the interest rate?

Here, we said, look, the central bank decides on certain amount of money. And then the market determines what the interest rate is. And this is the way monetary policy used to be conducted. The central banks would typically decide the amount of money in the system. It was called monetary aggregates. The amount of money in the system and then the market would determine the interest rate.

It turned out that was a nightmare. And so now that's not what central banks do. And it was a nightmare because this money demand that looked so peaceful here, in practice is moving around all the time for a variety of reasons. Even holidays affect the money demand and all that. So if you fix the monetary aggregates, and money is moving all over the place, what happens?

Suppose that the central bank says I'm going to offer this amount of  $m$ , that's it. And now I tell you the money is moving all over the place. There are weeks that have three days of weekend that have no vacations in between, or there is a Super Bowl and lots of people decide to buy tickets or whatever, or beer, so whatever.

**AUDIENCE:** [INAUDIBLE]

**RICARDO CABALLERO:** Well, no. Because when you say shortage-- I mean, it depends what you mean by shortage. So you could be right with that part of the answer. But when you say excess demand, then I have a problem. Because that's true only if the interest rate doesn't move.

But in a situation in which a central bank fix  $m$ . And let the market do its thing, then the interest rate will not be fixed. And that's exactly the problem, that the interest rate becomes very, very volatile. If you do it only through monetary aggregates because this guy is moving all over the place. And so imagine what happens. If this demand shift up, then an equilibrium interest rate goes up, precisely to avoid your excess demand. Because if this thing goes up, I have an excess demand at that interest rate. But what will happen in equilibrium is the interest rate will go up until the excess demand disappears.

Now in central banks like the US, central bank the Fed, they can control this stuff fairly well. Many of the central banks don't have that. If you look at the Bank of China, for example, they have lots of high frequency movements in interest rates because they are not very good at doing this stuff. It's not that easy to control an interest rate, for example, to keep it fixed.

But the central bank used to do that. That's what I'm saying. It used to do that. I'm saying in practice this system wasn't very good because in practice, the money is moving around for a lot of idiosyncratic reasons. Some of them are using credit. Some of them are very predictable.

There was a lot of panic around the shift of the year 2000 that the ATMs would stop working and stuff like that. So there was a massive increase in money demand because people wanted to have cash just in case ATMs stopped working. and so there are some things that are predictable and some. But you can get very large fluctuations.

So in practice, what central banks do nowadays is really is they tell you what the interest rate is. And then they offer whatever  $m$  the market needs for that interest rate. That's the way modern monetary policy works. OK, I'll tell you a little bit more about that. So let's see what happens here if-- suppose the Fed, for reasons that you will understand better in the next lecture, suppose the Fed decides that they want to have an expansionary monetary policy. Expansionary monetary policy means it's going to expand  $m$ . It was offering a certain amount of  $m$ . And now it decides to offer more of that  $m$ .

So what happens in equilibrium? Well, we start from an equilibrium here. If the interest rate remains at that level, now we have an excess supply of money. And the only way to restore that equilibrium is by people demanding more money. And when will people demand more money? Well, when the interest rate is lower. So excess demand, the interest rates are declining. Then the demand for money starts catching up with the new hire supply of money.

And you end up with a lower interest rate. So that's an expansionary monetary policy, an increase in  $m$  that leads to a decline in the interest rate. Again, modern central banks don't tell you we're going to increase  $m$  by 20%. What they tell you is we're going to cut interest rate by, say, 50 basis points. When they tell you that they're going to cut interest by 50 basis points, they're reading you this axis.

But behind that operation there must have been an increase in money supply. And then it comes all the fine tuning that they have to do now so the interest remains there when the money is vibrating around that thing there. But when we say an expansionary monetary policy, we really mean cutting interest rates. How is that the interest rate is cut effectively? By an increase in the money supply. But they don't tell you that they are doing that. But that's what they're doing.

Good. So nowadays, we're in the opposite process. We're moving that way, up. But you seen, in every single meeting now for the last seven meetings or so, we have seen a hike in interest rates. Well, they don't tell you that. But they're saying, we're going to cut money supply and moving in that direction. Because if they move in that direction, then interest rate go up. It's clear. Good.

What else shifts? This is a different kind of shift. Suppose that nominal income goes up. And this is happening all the time. Nominal income is growing in most economies most of the time. Unless you're in a recession, nominal income is growing. It's growing for two reasons-- one, because you have inflation. And the other one is because of real output is growing.

That means that typically in an average year, money demand is shifting to the right. So if money demand shift to the right and money supply does not change, then what happens to the interest rate? Money demand goes up, money supplies doesn't change. What happens to the interest rate?

Increases because at this interest rate here, we have an excess demand for money. So we have to reduce the money demand. How do we reduce money demand? By increasing the interest rate. That's the way we get there. So that's yet another reason why it's not a good idea to be targeting monetary aggregates.

The Fed tells you we want the interest rate at 5%, say. And then the economy will be growing and so on. And what the Fed will be doing is if they want to maintain the interest rate at 5%, well, they keep expanding  $m$  so the interest rate doesn't go up. That's the way it's normally conducted.

But if the Fed stays sleepy and they have an increase in money demand. Then the interest rate will tend to go up. So I told you that the central bank is moving  $m$ , increasing  $m$ , reducing  $m$ , or whatever. So how do they do that. I mean, it's not that they-- although that policy has been advocated. It's not that they go in a helicopter and sort of fly builds on top of all of us. They don't do that. Although, again, it has been advocated in extreme cases of recessions, and so on. And it's called helicopter money. Just give money away.

But that's not the way it's normally done. For normal operations, is not done that way. So how is it done? Remember that we have a financial system that is very simple for now. We have money and bonds. So what the central bank does, the central bank wants to change the portfolio of people. They want people to have less bonds, say, and more money. That's to raise the interest rate.

So what the central bank does is goes out there and expansionary open market operation. Open market is because they go into the open market to buy bonds, the as opposed to an operation that happens behind doors. If the Fed went directly to the Treasury and bought bonds, that would not be an open market operation.

But what they do is they go to the financial system and they go with a big bag of money and say, OK, we want bonds. And so the public sells bonds to them in exchange for money. That's an expansionary market.

So what we saw before when  $m$  shift to the right, what the central bank really did is went out there and bought bonds from the public. The public sold the bonds and got the cash at some price. When I show you equilibrium in the money market, that means also an equilibrium in the bond market necessarily. So it has to be the price is right for the portfolio of individuals.

A contractionary open market operation is the opposite. It's a central bank goes out there and sells bonds to the market and takes the cash back. That's a contractionary monetary policy. So when the Fed wants to-- Yeah, let me finish. When the Fed wants to cut interest rates, what the Fed does is an expansionary monetary policy, which means it goes out there and buys bonds from the market and gives cash to the market. OK, yeah.

**AUDIENCE:** How can a central bank, in this instance, guarantee that someone's going to buy their bonds? If their government didn't have the financial stability, I guess, the United States has, how would they guarantee that these bonds will be worth anything in the long run?

**RICARDO CABALLERO:** Well, I mean, you're talking about risk premium. And that's an additional issue. Typically central banks intervene in very short duration bonds. So it's not the typical bond that is risky in many sense. It's very, very, very short duration bonds, treasuries, very short duration. In fact, it's even less.



Nowadays central banks really intervene in the overnight market. But you're that countries that don't have a bond market, a well-developed bond market, have problems with the management of monetary policy and so on because they have a credit spread that is moving around, as well. But they tend to focus on the type of instruments.

That thing becomes very important. I mean, for Japan, even big guys, very big guys, now they have an issue because they have been buying bonds, very long duration bonds-- so 10 year bonds and stuff like that. And there it's a little trickier. Market needs to trust you a lot more if you're dealing with 10 years things and you're dealing with three month horizons and so on.

In other instances, for example, Chile has a situation like that, the central bank itself can issue bonds. And so those are bonds issued by central banks. And they tend to be very reliable bonds because these are bonds that are issuing your same currency. So you have the currency to always pay them. You can always print money and pay for those bonds. So it rarely happens that there is default on bonds of that kind.

The typical bonds, government bond, that defaults is a bond that is issuing a currency different from the one you have because then you may not have the currency to pay for the stuff. And that's the reason emerging markets run into trouble and things of that kind.

So in terms of the balance sheet of the central bank, how does an open market operation look? So if you look at the balance sheet, this is an incredibly simplified version of the balance sheet of the Fed. They have lots of things, more assets, gold, and all sorts of stuff.

But in our simple economy, the government, the Fed, the assets of the Fed, they have some bonds. It has already some bonds out there. And the liabilities is the money they issue. They owe that to people. I mean, they issue currency. But that's a liability. People can do things with and buy things with that money and so on. It's a liability.

So that's the way the balance sheet looks. So when the Fed decides to do an expansionary open market operation, then what it does is it goes out there. It issues, say, a \$1 million expansionary open market operation. They do it in much bigger tickets on this. But let's make it simple. \$1 million of an expansionary operation. When they go there, they print \$1 million and they buy \$1 million from the market.

And so at the end, the balance sheet ends like it used to be. There is an extra \$1 million of liabilities because now there's a million more of dollars circulating out there. But against that, the central bank also has a million more of bonds holdings. So that's what happens.

With an expansionary monetary policy, the balance sheet of the central bank expands. Both sides expand by the same amount, but expands. And one of the big themes of recent years, starting from the global financial crisis, is that these balance sheets used to be small peanuts type things, for \$1 trillion or something like that for something like the US, the size.

Nowadays they're much, much larger than that because they have done so many operations to first get us out of the global financial crisis and then to get us out of COVID and so on, that these balance sheets are now an order or two orders of magnitude larger than they used to be. But in other words, they have had to do lots of expansionary monetary policy over the last couple of decades.

So let me talk a little bit about interest rate and bond prices because that's the other side of this thing. So what is the connection-- because sometimes it's easier to understand things in terms of prices and in terms of bonds? So suppose a bond pays \$100 a year from now and no coupon in between. So if you buy a bond now for some price  $P_B$ , you get \$100 a year from now. So what is the interest rate of that bond? That is, what is the excess return that you get out of that, or the return you get out of buying that bond?

Well, it's going to be \$100 minus whatever you pay today-- say you pay \$95, then \$5-- divided by your investment, initial investment, which was 95. So that's a bond that gives you a little bit more than 5%. OK, that's the return. That's the interest.

So that's the connection between interest rate and prices. And notice that this is an inverse relation. When the price of a bond goes up, the interest rate goes down because you're paying more for the same principal. You're going to get 100. But now you're paying more for it. Well, that means the interest rate, the return on that bond, went down.

Conversely, you can say that I went around. The high is the interest rate, the lower is the price of bond. So for example, today the interest rate is 5%. If I want to issue a bond that doesn't pay any coupon and I'm completely safe, so I'm the US Treasury, I'm going to be able to sell that bond for 95.

Two years ago, when the interest rate was 0, the Fed would have been able to sell that bond for 100. So there is an inverse relationship between the interest rate and the price of bonds. And now I can take you back to my open market operations.

So remember what I said. There's another way of remembering which way these signs go. Remember when you have an expansionary monetary operation, I said the Fed goes out there with a bag of money and buys bonds from the market. When bonds, when you buy something, when there is an enormous increase in demand for something, what do you think happens to the price of that something?

Goes up for anything-- cars, whatever it is. It's a lot more demand, then prices will go up. And the Fed has a lot of cash. So he can really buy large amounts of bonds. And so when the Fed goes out there and does an expansionary open market operation, means it goes out there and buys a lot of bonds. The price of those bonds goes up. And by that formula, that means the interest rate is going down.

So that's another way of understanding how is it an expansion open market operation lowers the interest rate, because it raises the price of the bonds that it's demanding. And when you raise the price of the bonds, then the interest rate goes down.

So really, the only thing I really-- I want you to understand what I just said well because we're going to use it. I want you to understand what comes next ideally well, but it's OK if you don't understand it too well. And I'm going to tell you when you have to start understanding very well again. For now, this is a piece in which, what I'm doing here is making things a little bit more realistic. The message will be similar. But it's a little bit more complicated.

That's the reason, substantively, I already told you what I wanted to tell you. What I'm going to tell you now will give you a little bit more realism, and therefore will allow you to understand a little bit better a technical description of monetary policy or something like that. So in practice in the economy I just described, you had sort of households and firms and the central bank.

But in practice, there are lots of financial intermediaries. And in financial intermediaries, the most prominent of them, for especially for monetary policy, are the banks. And there are certain banks, actually, that are even more important than others. But banks are financial intermediaries. They take money from someone or they post it from someone and lend it to someone else, or buy some instruments. So they intermediate the funds of somebody that wants to save in the bank, a deposit and a deposit account or something, and they lend that money, effectively in the name of the other person, to someone else.

So banks do two things to the model I just described. The first is that they produce money, as well. Because money is made of currency, which is issued by the central bank. But it's also made of checkable deposits. If you have a checking account, something you can have a debit card against or something like that, then that's money for you.

If you deposit in a bank in a checking account, that's money. And so banks, the liabilities of banks, the deposits is part of money, is something you can use for transactions. You can write checks. You can use your debit card and stuff like that. So that's the first thing that banks do.

The other thing the banks do is they, themselves, have a deposit account at the central bank. So they, themselves, take part of this deposit. They take the deposit. Part of the deposit they lend to other people. Another part they buy financial instruments, bonds, and stuff like that. In this economy would be only bonds. And the other part, smaller part, 10% or something like that, they deposit at the central bank.

That deposit at the central bank is called reserves. So when you hear the word reserves or the banking sector, this is the deposits of the banks at the central bank. And that's also a liability for the central bank. The central bank is holding that deposit of the banks. It's not the central bank's money. It's the bank's money.

And they're holding it there. It's a liability, as well. So now, if you look at how the balance sheets look, our central bank now has more things. It has assets. It's going to be bonds. In this economy, it's the only thing you can have. But now it will have the currency that it had before and in the liabilities, but also will have the reserves, the deposits of the banks themselves.

OK, and this is called-- this stuff here is called central bank money. In contrast, it's called central bank-- has so many names-- it's called central bank money, high power money, some other name. They have it some. But it has several names. And what is it?

I like the name central bank money because that's in contrast with this kind of money. It's the money that the banking sector produces, the checkable deposits. So this is the money produced by the central bank. And then through deposits, the financial system, the banks themselves produce more money.

So the total money in the system is much more than the central bank money because deposits is a big thing. This is much larger than that in practice. Good. So how does this change our model? Not really much. And so that's the reason I don't care too much if you understand this last two slides.

So let me rederive what we had with this approach, with this extension. So money, the money is the same as it used to be. What happens is you're going to demand it in the form of currency or checking accounts or something like that. But the total money demand is exactly as it used to be.

Banks typically hold a share. And assume for now that there is no currency. So everything is in deposit, otherwise you get a more complicated formula. So no one holds cash, which is probably quite realistic nowadays. So everyone has a checking account, and that's it.

So the banks typically hold, for regulatory reasons, a share of their deposit. They have a minimum for regulatory reasons, a minimum share of the deposit they have that they need to hold in the form of reserves. And I'm going to call that a fixed fraction,  $\theta$ .

So if all the money is held in the form of deposits, then  $\theta$ , which is a number like 0.1, say, times the deposit, which is money demand, is equal to the reserves, is equal to the demand for central bank money. This is the demand for central bank money because these are the reserves that the banks want to have at the central bank.

So the demand, they want to have this amount of deposits at the central bank. This we'll call  $H_d$ . It's  $\theta$  times  $M_d$ . And so now, rather than  $M$ , what the central bank controls really-- because it's the only thing you can really control-- is the money that it issues, which is the central bank money. Supplying  $M$ , which used to be currency. Now  $M$  is a bigger thing because of deposits and all sort of stuff. But the central bank is the one that controls how much high power money, how much central bank money, it issues. And we're going to call that  $H$ .

So if you go back to my balance sheet here, the central bank cannot control total money because it cannot control the amount of checkable deposits in the economy. But it can control this money here. And since we have no currency in my example, it really can control how much supply of reserves it can do.

And so now we have a demand for reserves, which is just proportional to money demand, equal to some fixed amount,  $H$ , which is the supply of high powered money by the central bank. And then the equilibrium looks exactly like before. It's going to be some-- remember, before we have  $M$  equal to dollar  $Y_L$ .

Now we're saying it's not  $M$ . It's  $\theta$  times  $M$ , really, because it's a fraction only of total money. Has to be equal to money demand. It's not total money demand. It's the money that ends up being demand for central bank money. Because total money demand is the checking account.

That leads to demand for central bank money by the banks, which is  $\theta$  times those deposits, not the full deposits. They don't take all the deposits and deposit the central bank. They say only 10% of those deposits will keep them at the central bank.

So \$100 in deposit, if  $\theta$  is 0.1, \$100 in deposit leads to a demand for reserves, that is for deposits by the bank and the central bank, of \$10. And that is the thing that the central bank can control very well.

It's the demand that comes to me. The central bank is \$10. And I decide whether we do \$10 or not. We can do 5 and then we're going to have the interest rate sort out 5 to be an equilibrium. So if the banking sector wanted 10 and I'm only going to supply 5, then something, the interest rate is going to have to rise so that the deposits decline, less demand for money, and the final demand that gets to me is 5, not 10.

But the mechanism is exactly the same. I know this can be a little confusing. But the mechanism is exactly the same. This just illustrates-- I mean, this is important because it's institutionally important, more than conceptually important. Because this is the market where really the interest rate is set. Okay?

That market, the market for reserves, really, because what the banks do is they want reserves, deposit at the central bank. That market for reserves, the interest rate in that market for reserves, is called the Federal Funds Rate. And it's called the Federal Funds Rate because the federal reserves controls that rate. So when there is a meeting by the Fed or a policy announcement and it tell you that the Fed has increased the rate by 50 basis points, it means it has increased the interest rate in that market by 50 basis points.

So the interest rate that the central bank controls directly is called the Federal Funds Rate. And the Federal Funds Rate is that market, is the market for reserve for high powered money. So all the operations happen there. They don't participate in the deposit market, anything like that. They participate in that market, which every night is a huge number of transactions.

Every night because I put all the banks together. But what happens every night is some banks have more reserves than they need. Some other banks have less reserves than they need. So the supply and demand within the banking sector for reserves, and there is an interest rate that tends to equilibrate, if too many banks are short reserves, then there is going to be lots of demand for reserves and the interest rates are going to tend to go up. If the Fed doesn't want that interest rate to go up, then what it will do overnight, it will go there and inject reserves into the system, high power money. So the interest rate in that market comes down.

And that's the way the Fed operates. That's the way it controls it. Participates in that market. Controls the amount of high power money, which regulates the rate in the reserves market. And here it's only-- and then so here you have the major banks participating here.

And then this leaks into the other interest rates in the economy, into the deposit rates, to bond rates, and so on. But the real rate they control, the rate that they control most directly, is that right here. And that's the reason I wanted to give you a little bit of institutional-- I mean, to add complexity, so you could get to this word, Federal Funds Rate because that's what you want to read in the newspapers.

The Fed increased the federal funds target, it's going to say. Because they target. They cannot guarantee there's going to be a target in an interest rate. And typically, they give you a range. It's a very narrow range.

Let me just conclude by showing you how that rate has looked in the US recently. And I finish here. So here is before COVID. The interest rate, the Fed was already hiking interest rates. It had overdone it there so it was beginning to lower interest rates. And then COVID came and they cut interest rate very aggressively.

This is the maximum they can cut it to. And we're going to talk about that briefly in the next, to zero. You cannot go below zero. You cannot pay negative interest rate because then I don't demand money. I don't demand bonds. Why should I hold a bond that pays me a negative interest rate when cash pays 0, always 0? I can keep it under the mattress and I don't pay anything negative. So the interest rate, the lowest can be 0.

And you see that they did the maximum they could in terms of cutting interest rate. They went to 0, effectively 0. And now they have been trying to catch up because inflation is very high. And so they're trying to hike interest rates. And you see what they're doing.

Well, all those interventions happen in the reserve market. That's what this is. That's the rate, is in that market over there. OK, so I think we're meeting on Tuesday next week. I think that's the plan.