Economic Environment and Business Strategy
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Central Banking and the Money Supply Process – II

Hello, everyone. Welcome to this session. In the previous session, we saw how a central bank's use of open market operations and the discount window affects the monetary base. Now, we will examine how the money supply changes in today's session. What we will discuss here is the multiple expansion of deposits and its impact on the money supply. I'll start by showing you a motivational picture. What you see here is what I showed you in the previous session, as well. You can see that the money supply includes the currency in circulation plus deposits with the banking system, which are the money base and the monetary base we discussed in the previous session.

Open market operations and discount loans affect the monetary base through the banking system. In this picture, you can see the size of the base. The amount is relatively small compared to the total amount of money in circulation. So, what does it mean if a central bank conducts open market operations or makes discount loans to the banking system? It can either influence the reserves or the currency.

However, what you can see here is that, even though the size is only this much, the total money supply is much larger. From this picture, what you can see is that the money supply is greater than the monetary base, whereas a central bank can only influence the monetary base, which is at the bottom of this figure. Here's how, based on this relatively small monetary base, a large money supply or money stock could be created. This normally happens through the multiple expansion of deposits within the banking system. To explain this, I will clarify the concept.

Let us continue from the previous session, assuming a $100 open-market purchase has been made by the Fed. This was conducted with the First Bank as a starting point; it is one of the commercial banks. In other words, we begin with open market operations, where the central bank purchases a government security from a commercial bank. In return, the central bank credits $100 to the specific commercial bank's account. Then, what is going to happen here? This has been seen earlier as well.

You can observe that on the asset side of the first bank, the commercial banks, there is a decline in securities, but there will be an equivalent increase in reserves. Reserves, as we've seen, are part of the monetary base. To clarify this idea with an example, you can

see that there is an increase in the monetary base, specifically in the form of reserves. In fact, reserves increase by $100. That means the monetary base has increased by $100.

In other words, you can also see that the reserves have increased by $100. Now, the first bank gives these reserves—these $100 reserves—as a $100 loan to a borrower. Suppose this bank wants to sell government securities to the central bank, and in return, it gets currency. Obviously, it wants to use this money for some productive investment. So, here's what happened: this $100 was credited to this bank, and now the bank loans out an equivalent amount of money to a borrower.

When this happens, the first bank's T-account on the balance sheet indicates that the remaining amount remains unchanged. Securities declined; reserves increased. Now, what caused these loans to increase? When the loans increased, you could see that this reserve disappeared. Similarly, you can see the change in checkable deposits there as well. Before that, at First National Bank, you can see that the securities have declined, and reserves have already increased when they make a loan.

A loan to a borrower involves a commercial bank lending money to a customer. Please note that the loan amount will be deposited in the customer's name, meaning it will be credited as a checkable deposit. This is how a commercial bank uses loans. The customer can choose whether to withdraw this money or not. Once the loan is approved, it is immediately deposited into the customer's account.

As a result, the loan amount increases. Similarly, on the liability side, checkable deposits have increased. When we examine this, what you can see is that this reserve will not remain with the first bank for very long. Suppose now that the borrower purchases goods and services from other individuals and corporations by writing checks. Deposited in another bank or simply spent the money, and those who receive it deposit with another bank, so you can choose bank A or bank B.

Then, how does the First National Bank, which we just discussed, experience changes in its balance sheet? It changes in this way: the security has already declined. There is an increase in loans, so on the asset side, it now shifts: securities decrease by 100, and loans increase by 100. Since the customer has withdrawn this amount, it effectively disappears from the liabilities; that money has already been taken by the customer. Now, let's see. There will be multiple expansions of these deposits.

So, for Bank A, which received this money, what happens to its T-account and balance sheet? The story begins with open market operations by the central bank with the First National Bank. Then, the First National Bank loans out the money, which then comes to Bank A. This appears in its bank account. The assets on their live balance sheet increase by 100, and liabilities also rise by 100 if someone deposits this check with the bank. How

will they record it in their T account? Since the money is coming from a cheque, they need to get this money through the central bank.

It will be credited to the commercial bank account by the central bank, and later, the central bank will deduct the amount from the other bank that issued the cheque. On the liability side, checkable deposits increase by $100, which means this amount will be credited to the depositor who submitted the check. Now, suppose this customer does not withdraw the money and keeps it as a checkable deposit. If the required reserve ratio is 10%, then the bank needs to invest or employ this money elsewhere because it must pay interest income to the customer, and it also has surplus funds since it now has $100. Then the commercial bank wants to lend it to another customer.

But it cannot lend the entire amount; it can only lend 90% because the required cash reserve ratio is 10%. So, what does it mean? It means that, of the total deposits received by any bank, whether in the form of demand deposits or time deposits, a certain fraction must be kept with the central bank. Assuming, for simplicity, that this fraction is 10%, it implies that the bank can lend or utilize only 90% of the remaining funds. The remaining 90% of the funds is what the bank is likely to loan out to another individual. Then, a natural question will likely arise for you.

You might be wondering why the First National Bank didn't maintain the 10% required reserve. Because the required reserve ratio is primarily based on the deposits it receives from the public, but the First National Bank received $100 not from any public deposit but by selling government securities to the central bank. That means the money was directly received from the central bank through the sale of government securities, so it wasn't through any deposit; therefore, it doesn't need to keep 10 percent, as the record shows. However, Bank A must maintain a 10% reserve, and the remaining 90% can be loaned out to another individual or firm.

Let's look at how the banking system's liabilities and assets change using a T-account. Initially, you can see Bank A. Initially, reserves increased by $ 100, and checkable deposits increased by $ 100, as we have already discussed. Now, when it lends 90, the asset side changes in this way: 10, which is 10 percent, is reserved with the central bank because that is the required reserve. The remaining 90 is a loan to an individual, which is also an asset. So, you can see that these 100 dollars now count as an asset for this commercial bank. However, it is divided into two parts: one is assets held with the central bank, which are reserves with the central bank, and the second is loans given to individuals. On the liability side, it remains the same. That means $100 is the liability amount. Then, Bank B, suppose this person withdraws the money, and the person who received it makes a transaction with another individual, who then deposits the money in Bank B.

Then, you can immediately see that. Bank B, the third bank in our discussion, saw its reserves increase by 90 because a deposit was made through a check. Its liabilities also increased by 90 immediately, as this amount was credited to the individual's checkable deposits. Then, assume that the money is deposited with bank B. If this customer is not withdrawing the money and prefers to keep it as a checkable deposit, what will the bank do? The bank also needs to lend out this money now.

Assuming it loans out this money, what actions does it have to take? Because it received a deposit of $90, with 10% kept as a reserve. This leaves $81 to be loaned out. Therefore, the total assets remain $90, split between $9 in reserve and $81 in loans. On the liability side, once the deposit is made in the individual's name, it becomes a liability for the bank in the form of a checkable deposit. Now, let's assume that the person who received this $81 loan spends it on goods and services, possibly buying some capital goods or durable goods.

And then this money is transferred to another individual, who then deposits it in a different bank, such as Bank C. If the borrower deposits the loan in Bank B, this bank will only be able to lend an amount exceeding 81, which we have already discussed. What happened is that if this money goes further, the checkable deposits will increase by a total of 271. So, that means Bank A has $100, Bank B has $90, Bank C has $81, Bank D has $72, and then some more money — another bank, Bank E, will come along, but it must keep 10% of its funds as reserves. The remaining ones can be loaned out, and then Bank F comes, Bank G comes, and so on. We can keep adding like that.

If all banks lend out the full amount of their excess reserves, further increases in checkable deposits will continue in this manner, like the 190, 80, 172.90, and others, and it will persist until this money is depleted. So, if you present this in a table, the increase in deposits will show that First National Bank has no increase because it received $100 from an open market sale of its government securities to the central bank. Meanwhile, Bank A's deposit increases by this amount, Bank Bs by that, Bank C's by another, and Bank D's by yet another. It finally increased when the reserve ratio was 10 percent.

From this table, you can see that the total deposit increased by 1,000. Initially, the monetary base was set at 100 through an open market operation. But what you can observe is that the total increase in deposits is 1,000. Here, you can see the increase in loans by $1,000, and the reserve increases by $100. If you analyze this process, the growth of money with Bank B can be understood as the increase being multiple times the reserve—specifically, the reserve times 100, the reserve times 1, and the reserve times this amount.

This, and finally, if you sum up what you are going to see, the sum of an infinite series equals the total increase in delta. This increase in delta is equal to delta r; delta r is the reserve that the banking system received, which is $100. We have seen through the open market operation that $100 has entered the banking system. This is calculated as R times 1 divided by 1 minus R, which simplifies to ΔD being equal to ΔR. That is, $100 times the inverse of the required reserve ratio, which is the inverse of 10 percent.

What you can see here is that the inverse is 10%. The inverse of 10% is obviously 10. You can see that if the cash reserve ratio is 10%, then a central bank conducts an open market operation with a commercial bank. By buying or purchasing a security and depositing an equivalent amount of money in their account as a reserve.

All transactions will be conducted through the reserve here. Injecting that much money in the form of reserves. Then that would lead to this much increase: 1 divided by the reserve ratio times the increase in that reserve. From this, you can see that it will lead to 1000 here. Here, this one is the inverse of the recurrence ratio.

This is considered the symbol for the deposit multiplier. The point here, and in the motivating figure, is that we have seen the figure where the monetary base is small. We have observed that the monetary base (MB) equals C plus R, but the money supply equals C plus D. Mainly, we've seen a multiple expansion of deposits here, not solely by the central bank, but also by the banking system, which participates in this as well. Therefore, the money supply is generally greater than the monetary base. Here, the multiple increase in deposits resulting from an increase in the banking system's reserves is referred to as the simple deposit multiplier. Generally, the simple deposit multiplier equals the reciprocal of the required reserve ratio.

This is the formula for that, and using the illustrative example, we have explained how an open market operation or any monetary policy initiative by the central bank can lead to a larger increase in the money supply within an economy. However, this simple model has faced some criticism because many of the assumptions we made are quite bold. It won't be accurate in real-world situations. For example, holding currency is important. The actual creation of a deposit is much less mechanical than the symbolic model indicates.

What I assume here is that someone took a loan of 100, 90, or 81, and we assume that the person doesn't keep any cash with them; they deposit the entire amount into another bank. That is not true. However, if they keep more currency, then there wouldn't be this much multiple expansion. Similarly, regarding the excess reserve. Our assumption here was that the banks do not hold excess reserves.

In the real world, banks do not lend or buy securities for the full amount of their excess reserves. If banks decide to hold all or part of their excess reserves, then the full

expansion of deposits predicted by this model does not happen. And here, the Fed, the central bank, is not the only player whose actions affect deposit levels and, consequently, the money supply. It's really the depositor's choice. How much they want to deposit and whether they want to deposit.

Do they trust the banking system, or not? If they don't want to keep the money they got from the bank, then that money doesn't matter if they don't want to keep it as a deposit at all. Then the multiple expansion gains stop at that point. The excess resources to hold depend on whether they believe that all the money from the open market operation—the $100—comes to them. If they choose not to loan it out and just want to keep the entire amount as excess reserves, then from that moment on, the multiple expansion of deposits stops.

At that point, there will be no increase in the monetary base, and the money supply will remain unchanged. The factors that determine the money supply include changes in the non-borrowed monetary base. The money supply is positively related to the non-borrowed monetary base, particularly when the central bank conducts open market operations or when more money is deposited into the central bank. From the point we discussed here, the chain we talked about, and multiple deposit expansion through that route, the money supply increases. Similarly, if a commercial bank borrows from the central bank, that is obviously the borrowed reserve.

When the reserves held by the banking system increase, it leads to an expansion of deposits, which in turn causes the money supply to grow. The money supply is also positively related to the level of borrowed reserves from the Fed. However, there are three other factors that are inversely related to the money supply. One of them is the reserve ratio. If the central bank increases the reserve ratio from 10 percent to 20 percent, then you will see the effects.

The money with the deposit multiplier that you will receive, instead of 10, will be 5. Similarly, changes in currency holdings affect the money supply. If the public prefers to hold more currency instead of depositing it in commercial banks, then the deposit multiplier and, consequently, the money supply decline. Similarly, changes in excess reserves relate to the point we discussed because excess reserves normally serve as a cushion or insurance against losses due to deposit outflows. Commercial banks generally prefer to keep a certain fraction of their deposits as excess reserves.

Therefore, if a commercial bank keeps a larger portion of its deposits as excess reserves, it helps protect against potential withdrawals. Additionally, this is negatively related because it will not be included in the banking system or reach the public, resulting in a decline in the money supply. This concept can be better explained using another concept called the money multiplier, which is an expanded form of the deposit multiplier

designed to overcome its limitations. Again, to set the stage, I show this figure here once more.

This one is the monetary base, and this one is the money supply. Using this monetary base, the money supply will expand by this amount. What you can see here is that the expansion in the total money supply is divided by the monetary base. When this monetary base expands to this level, it increases by a multiple known as the multiplier. Therefore, the money multiplier is calculated as the ratio of the money supply to the monetary base. Simply, we can define the money supply as the money multiplied by the monetary base, which a central bank control.

The central bank can influence the money supply through the monetary base, but it has more control over the monetary base itself than over the total money supply. To derive the money multiplier formula, we need to define some factors that affect the money supply besides the monetary base. One is the currency-deposit ratio. The depositor's decision regarding their holdings of currency and checkable deposits is one factor affecting the money multiplier. The second is the reserve requirements imposed by the Fed and the RBI on the banking system.

If it affects the required reserve, we will verify whether it also changes its impact on the money multiplier. Then, the bank's decision about excess reserves, as well as the excess reserves themselves, also affect the money multiplier. To derive this, we can rewrite the currency-deposit ratio. First, we can see that this one is C; the lowercase letter C represents the currency deposit ratio. That means currency, which is the total currency divided by the total deposits in the economy.

This is the reserve requirement ratio. That refers to the total reserve as part of the total deposits. Then, the excess reserve is calculated as the excess reserve divided by total deposits. We can also rewrite it this way: this will be useful in deriving the formula, the multiplier formula. At the beginning, remember that M equals C plus D, MV equals C plus R, and the money multiplier equals M divided by V. MB is R plus C. You can rewrite it this way. Because we have already rewritten the equation specifying RR, ER, and C in this format. Finally, the monetary base can be rewritten as the ratio of the sum of all these ratios times D. Rewriting this in terms of money, the monetary base is expressed like this: then, dividing both sides of the equation by the same term, we find D as the inverse of that, which is. The inverse of R plus E plus C times the monetary base, then using the money supply definition, we can interchange the values. For example, the money supply equals this because C times D plus D equals this.

By substituting the expression for D from equation 2 into this equation, we have M equal to 1 plus C divided by R plus E plus C times MB. That means M corresponds to this, since we have already seen that the money supply is equal to M times MB. Therefore,

this value represents the money multiplier. The money multiplier, denoted as M, is calculated as 1 plus C divided by (R + E). So, here is the induction: let's examine the reasoning behind the money multiplier.

Suppose these are the given values; then, by plugging them into the formula, you will find the money multiplier to be 2.5. The money multiplier of 2.5 tells us that a one-dollar increase in the monetary base (MB) results in a $2.50 increase in the money supply. This means that if a central bank conducts an open market operation (OMO), for example, a $100 increase in the monetary base, it will lead to 2.5 times increase in the money supply, which is $250. Therefore, a $100 open market operation increases the money supply by $250, reflecting a 2.5 times multiplier effect. I also share some insights here. When there are changes in the money supply, how will the money supply change? I have some text here. I'll just show it to you. You can go through this. When R increases from 10% to 15% and you plug these values into the formula, the money multiplier decreases from 2.5 to 2.3. That means it goes down. When C increases, which currency holdings increase? What we have discussed in this session is that a central bank uses open market operations and discount loans to initially influence the reserves in the banking system. Then, through the process of multiple deposit expansion, we observe that deposits in the banking system increase, which, in turn, leads to an expansion of the money supply. Regarding the increase in the money supply, to improve clarity, we have elaborated on this and expanded the simple deposit multiplier formula to derive a more comprehensive money multiplier formula. At that time, we observed that if the central bank reduces, for example, the reserve ratio, then the money supply declines. The money supply declines, which is another monetary policy tool in addition to open market operations and discount loans.

Here, the central bank uses the reserve requirement as an additional method to influence the money supply. Therefore, if it wants to increase the money supply, it can adjust the reserve requirement. Then they reduce the required reserve, and if they want to decrease the money supply, they increase the required reserve. Thank you for watching this session. See you at the next one. Thank you.