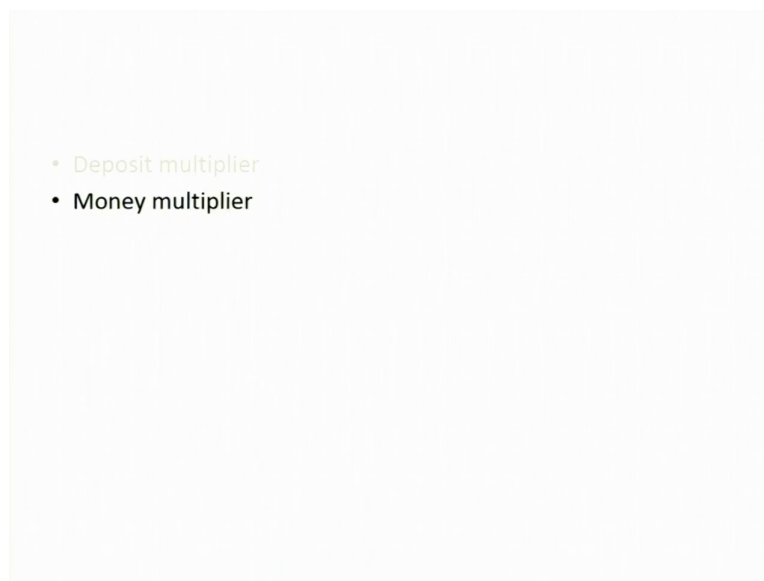


**Economics of Banking and Finance Markets**  
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**Lecture - 41**  
**Money multiplier**

Hi everyone, welcome to this session. In this session, we will discuss the concept called Money Multiplier. This is an extended version of deposit multiplier.

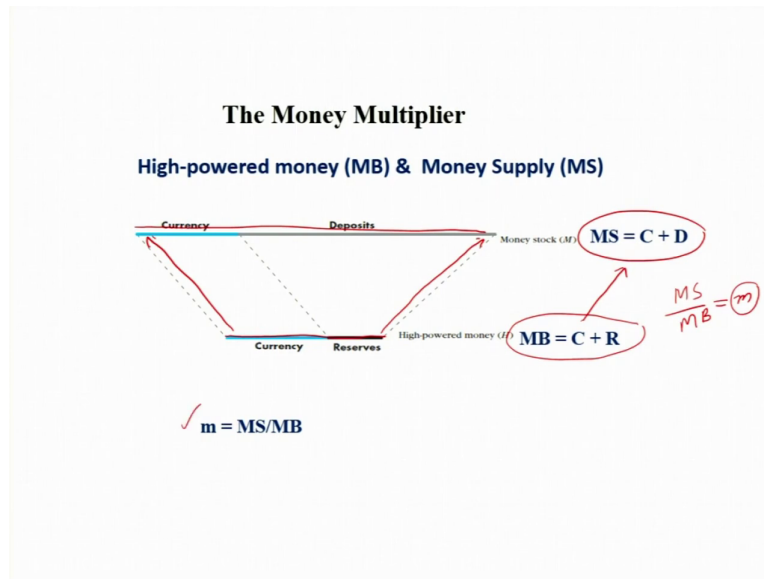
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So, as we saw, the deposit multiplier is a simple multiplier, very simple concept. In the deposit multiplier, we take that is equal to 1 by the reciprocal of required reserve ratio.

So, it does not consider the behavior of the banking system, the behavior of the depositors or the behavior of the borrowers, that the public. So, what we are going to do in this session by discussing money multiplier is that we are extending, we are including other factors because of this reason money multiplier is also called extended multiplier or also called as complex multiplier, because we are considering other factors, other complex aspects, of an economy.

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So, coming to money multiplier, we have seen in the previous session that the monetary base which the central bank can influence; we have seen that monetary base is equal to currency plus reserve.

This MB, this one, this distance, this much is the MB; that means, C plus R; from this the money supply is going to expand, is going to expand this much, that means, this distance is going to be there. So, that is the money supply. From this, MB is the high-powered money, from this it increases to money supply to this much, that the MS is equal to C plus D.

The MB increases to MS some multiple times; that means, MS divided by MB. So, it increases by some multiple times. So, MS divided by MB, that we get the extent, that what multiple of MB is transformed into the MS. So, this m this division tells us that what multiple of MB is transformed into the MS.

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## The Money Multiplier

- Because the CB can control the monetary base better than it can control reserves, it makes sense to link the money supply  $MS$  to the monetary base  $MB$  through a relationship such as the following:

$$MS = \underline{m} \times MB \quad (1)$$

- The money multiplier ( $m$ ) tells us how much the money supply changes for a given change in the monetary base  $MB$ .

So, let us now derive this  $m$ . So, to derive this, we include all the stakeholders that means, all the other players, not only the central bank, but also the banking system as the banking system decide how much excess reserve they want to keep.

And the public, they decide their desired amount of the total deposit, what is the desired amount of currency holdings, all we need to bring here. Because the CB can control the monetary base better than it can control reserves, it makes sense to link the money supply to the monetary base through a relationship such as the following: that is  $MS$  is equal to  $m$  times monetary base. So, the money multiplier tells us how much the money supply changes for a given change in the monetary base.

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## The Money Multiplier

The money multiplier reflects the effect on the money supply of other factors, besides the monetary base.

- 1) Currency-Deposit Ratio:** Depositors' decisions about their holdings of currency and checkable deposits are one set of factors affecting the money multiplier. ✓
- 2) RR:** It also involves the reserve requirements imposed by the Fed on the banking system.
- 3) ER:** Banks' decisions about excess reserves also affect the money multiplier

So, the money multiplier reflects the effect of other factors on the money supply, besides the monetary base. The first one is the currency deposit ratio. So, currency deposit ratio means, the depositors' decision about their holdings of currency and checkable deposits, this is one set of factors affecting money multiplier. Second one is the required reserve ratio, it involves the reserve requirements imposed by the Fed on the banking system, whether they increase the required reserve ratio: whether they make it 10%, whether it is increased to 15% or whether it is reduced to 5%.

So, that also affects the money multiplier, that we are going to discuss here, then comes the excess reserves. Excess reserve means the banks decisions to keep excess reserve, it also affects the money multiplier.

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**Deriving the Money Multiplier**

Assumptions:  
The desired level of currency  $C$  and excess reserves  $ER$  grows proportionally with checkable deposits  $D$ ; in other words, we assume that the ratios of these items to checkable deposits are constants in equilibrium:

$c = \{C/D\}$ = currency-deposit ratio	( $C = c \cdot D$ )
$r = \{RR/D\}$ = required reserves ratio	( $RR = r \cdot D$ )
$e = \{ER/D\}$ = excess reserves ratio	( $ER = e \cdot D$ )

So, let us formally derive the money multiplier formula here. The assumptions here is that the desired level of currency  $C$ , the desired level of currency  $C$  and excess reserve  $ER$  grows proportionally with checkable deposits  $D$ . In other words, we assume that the ratios of these items to the checkable deposits are constants in equilibrium. So, that means, assume the desired holdings of currency  $C$  and  $ER$  grows proportionally with the checkable deposits  $D$ .

It means, we assume that ratios of these items are constants in equilibrium. The one, we can see that, one ratio that is small letter  $c$ , the total currency holding divided by the total deposit, we are going to call it currency deposit ratio. So, the currency deposit ratio  $c$  small letter  $c$  is going to be  $C$  by  $D$ . We can also rewrite for simplification, which we also use later while deriving this money multiple formula; that means,  $c$  is equal to  $C$  times  $D$ ; that means, small letter  $c$  is equal to  $C$  by  $D$ .

This is another way of rewriting. This will help us an easy derivation of this formula. Second one is small letters  $r$ , we are going to write it as required reserve ratio, require reserve ratio of the total deposit, that the fraction of the total deposit that must be kept with the central bank as required reserve, that means, required reserve.

The  $RR$ , we can also rewrite it small letter  $r$  times  $D$ , that is a required reserve. So, then another factor is called excess reserve ratio, that is small letter  $e$ , we can say that  $ER$  by  $D$ ; that means, of the total deposit, what fraction is kept as excess reserve? Excess reserve in the

form of a vault cash with the banking system itself or deposit with the central bank beyond the required reserve with the central bank by the bank.

So, this is the excess reserve ratio, that is, ER divided by D. So, we can rewrite it like that ER is equal to E times D. So, let us derive a formula that describe how the currency ratio desired by depositors, that is this one. Currency ratio desired by the depositors and the excess ratio desired by the banking system and the desired cash reserve ratio by the central bank affect the money supply in an economy.

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**Deriving the Money Multiplier**

We begin the derivation of the model of the money supply with the equation:

$$MB = R + C$$

; where  $R = RR + ER$

$$MB = R + C = RR + ER + C$$

we rewrite the equation, specifying

- RR as  $(r \times D)$ ,
- ER as  $(e \times D)$ ,
- C as  $(c \times D)$

$$MB = (r \times D) + (e \times D) + (c \times D)$$

$$MB = (r + e + c) \times D$$

So, we are going to write it like, begin the derivation of the model of money supply with the equation, that is MB is equal to R plus C, where the R we are going to expand. R is equal to required reserve ratio plus excess reserve ratio. So, that means, R is equal to RR plus ER. So, in that way we are going to expand this definition of MB; MB is equal to R plus C. Now, we are going to rewrite it as: MB is equal to R plus C, where R means RR plus ER; that means, RR plus ER plus C. This is the expanded form of MB.

So, we rewrite the equation specifying each of them that RR, ER and C, we are expanding this MB equation identity like RR as R into D, we already specified in the previous slide as ER is equal to E into D, C currency means total currency means the ratio that the currency deposit ratio times total deposit. So, the MB, the expanded form of MB is equal to R into D plus E into D plus C into D which we can write that R plus E plus C times D that is MB, right. MB means this is MB.

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**Deriving the Money Multiplier**

$MB = (r + e + c) \times D$

Divide both sides of the equation by the term inside the parentheses to get an expression linking D to the MB

$$D = \frac{1}{r+e+c} \times MB$$

Now, using the money supply definition:  $MS = C + D$

$$MS = (c \times D) + D = (1 + c) \times D$$

Substituting in this equation the expression for D from the equation 2, we have:

$$MS = \frac{1+c}{r+e+c} \times MB$$

The money multiplier m is thus:  $\frac{1+c}{r+e+c}$  (4)

$MB = C + R$   
 $MS = C + D$   
 $m = \frac{MS}{MB}$

$MS = m \times MB$

So, since we have expanded MB as the ratios; that means, cash reserve ratio, excess reserve ratio and currency ratio, currency deposit ratio times D, that is MB. Now, dividing both side of the equation by the term inside the parenthesis to get an expression linking D to MB we can write that D is equal to inverse that 1 by R plus E plus C times MB right, the monetary base.

Now, using the money supply definition, we have seen that MS is equal to C plus D. So, for this easy derivation of this formula, always remember that MB is equal to C plus D and MS. Now, MB is equal to C plus R, and MS is equal to C plus D, right, always remember this. So, to derive this, we let us also take into what is MS because ultimately what we are going to do that our multiplier is equal to m is equal to MS divided by MB.

That is what we are trying to achieve here find out here is that using the money supply definition MS is equal to C plus D. Let us expand again this one, because MS is equal to C times D plus D is going to be 1 plus C times D. So, substituting in this equation the expression for D from equation above we have MS is equal to 1 plus C divided by R plus E plus C times MB. So, this is the money supply is going to be 1 plus C divided by R plus E plus C times MB times MB is the total money supply.

So, we know that MS means multiple times, this is nothing but multiplier multiple times MB. So, we already seen that MS is equal to multiple times MB, that is C plus R multiple times C plus R, that is money supply. So, the money supply formula here is going to be 1 plus C

divided by R plus E plus C. So, here what we have done is, the MS we have this MS, we have expanded it like this.

And then this D, we have substituted with this, this D we substituted here. Then we got it. So, accordingly, we substituted this D, this one we substituted, then MS we got in this way. So, accordingly we derived this money multiplier formula here.

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**Intuition Behind the Money Multiplier**

Given the following information

$r = \text{required reserve ratio} = 0.10$  ✓

$C = \text{currency in circulation} = \$400 \text{ billion}$  ✓

$D = \text{checkable deposits} = \$800 \text{ billion}$  ✓

$ER = \text{excess reserves} = \$0.8 \text{ billion}$  ✓

•  $c = \$400 \text{ billion} / \$800 \text{ billion} = 0.5$

•  $r = 0.1$  ✓

•  $e = \$0.8 \text{ billion} / \$800 \text{ billion} = 0.001$

• The resulting value of the money multiplier is:

$$m = (1 + 0.5) / (0.1 + 0.001 + 0.5)$$

$$= 1.5 / 0.601 = 2.5 \rightarrow 2.5$$

• The money multiplier of 2.5 tells us that, a \$1 increase in the monetary base leads to a \$2.50 increase in the money supply (M1).

$$m = \frac{1+c}{r+e+c}$$

$c \neq e$

$D \cdot M = 10$   
 $m = 2.5$

So, what is the intuition behind the money multiplier formula here? So, this is the extended formula and the complex multiplier formula. So, here let us discuss the intuition behind money multiplier formula here by taking one illustrative example. Suppose the required reserve ratio is 10 percentage, let us write it as 0.1. And currency in circulation is 400 billion, and checkable deposit D is going to be 800 billion.

And we assume here that banks decide to hold some amount of excess reserve, that we suppose it as 0.8 billion. So, what we are going to calculate? Now, to calculate the money multiplier, we need this value because the formula that we found here is that the money multiplier formula is our money multiplier formula is 1 plus C divided by R plus E plus C.

So, we need to calculate all these ratios. So, we need to have the ratio C, we need to have that the small letter, we also need to have this one, this already given we need to calculate this E excess reserve ratio. Then, we plug these values in this formula and then we are going to get the money multiplier. So, let us proceed with that, C here is the currency total currency in



circulation divided by the total deposit; that means, 400 divided by 800, we are going to get small c is equal to 0.5.

The required reserve ratio is already given here, it is 0.1. And how about the excess reserve? Excess reserve we can see here the excess reserve is going to be 0.8 billion divided by 800 billion. This is the excess reserve that the E a ratio the e the ratio E is going to be 0.001. So, plugging this, the resulting value of the money multiplier is going to be this.

So, we can see that this divided by this plus this plus this. And finally, we are going to get money multiplier is going to be 2.5, that is the money multiplier we got. So, compare this one with the deposit multiplier. We before we expand this one multiplier compare this one with the simple 1 deposit multiplier. If he had used only the simple deposit multiplier, we would have got the simple deposit multiplier is going to be 10.

But here that is the deposit multiplier that we got is 10, but the money multiplier we got here is 2.5 because it is very clear to you that we have incorporated the currency required reserve ratio, that is the central banks desired ration, Currency in circulation, that is the desired holding of currency by the public, it is the liquidity preference which can change over time.

But here we assume that it is remaining constant, similarly the excess reserve, it also a function of the banking system. So, because of this, we can see that it became 2.5. So, what does this tell? The money multiplier of 2.5 tells us that a one dollar increases in the monetary base leads to 2.50 times increase in the money supply, that is the M1 money supply definition we have used.

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**Money Supply Responses to Changes in the Factors**

**Changes in  $r$ .**

If  $r$  increases banks must contract their loans, causing a decline in deposits and hence in the money supply. The reduced money supply relative to MB, indicates that the money multiplier has declined as well.

when  $r$  increases from 10% to 15%,  $m$  becomes:

$$m = (1 + 0.5) / (0.15 + 0.001 + 0.5) = 2.3$$

The money multiplier and the money supply are negatively related to the required reserve ratio  $r$ .

$10\% \rightarrow 100 \text{ D}$   
 $\downarrow$   
 $90 \rightarrow L$   
 $20\% \rightarrow 80 \rightarrow$   
 $r \uparrow$

What are the responses of money supply due to changes in the factors? The changes in  $R$ , the required reserve ratio, which is set by the central bank, is part of monetary policy. As part of monetary policy, central bank decides how much is the required reserve ratio. So, if central bank increases the required reserve ratio; that means, bank must contract their loans, that is, they cannot give large amount of loans.

Suppose initially when we said that ten percentage is the required reserve ratio. When a bank gets 100 as the deposit, they can lend only 90 as the loan. They can give 90 as the loan. Suppose the central bank increases this reserve ratio, for example, 20 percentage. So, instead of 90, banks can now give only 80 as the loan.

It means a decline in the deposits, and hence the money supply. So, the reduced money supply related to MB indicates that money multiplier has declined as well. Suppose if central bank sees that economy is in a good condition, there is sufficient investment in the economy, and, they see that the economy is confronting with the inflation. In this context, the aim of the central bank is to reduce the money supply in the economy.

And at that time if the central bank decides that they are going to follow a contractionary monetary policy instead of an expansionary monetary policy. So, accordingly one of the tools of monetary policy here is to change  $R$ , they will be increasing the  $R$  as a part of contractionary monetary policy. Then from the money multiplier formula, you can see that the money supply has declined when they increase the reserve ratio required reserve ratio.

Suppose if you put a new value of R as 15 percentage instead of 10 percentage, we can see that the money multiplier is going to become 2.3 from 2.5. So, from this illustration we can see that money multiplier and the money supply are negatively related to the required reserve ratio.

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**Money Supply Responses to Changes in the Factors**

**Changes in  $c$**   
what happens to  $m$  when depositor behavior causes  $c$  to increase?  
When checkable deposits are being converted into currency, there is a switch from a component of the money supply that undergoes multiple expansion to one that does not.

Suppose that  $c$  rises from 0.50 to 0.75. The money multiplier then falls from 2.5 to:

$$m = (1 + 0.75) / (0.1 + 0.001 + 0.75) = 2.06$$

The money multiplier and the money supply are negatively related to the currency ratio  $c$ .

Then moving to another factor that we found in our formula, that is changes in R, what happens to  $m$  money multiplier when the depositors' behavior causes  $c$  to increase? That is, when checkable deposits are being converted into currency and there is a switch from a component of the money supply that that does not undergoes a multiple expansion. So, here taking an illustrative example suppose that  $c$  rises from 0.50 to 0.75.

From this, we can see that the money multiplier falls from 2.5 to 2.06. So, from this what we can see the money multiplier and the money supply are again negatively related to the currency ratio. So, here we have seen that from our illustrative example, we have written here that it has increased from 0.5 to 0.75.

And this is possible if there is an increase uncertainty in the economy. For example, a country expecting anticipating that crisis or a kind of war is going to happen. Or there is an increase in uncertainty in the economy, people lose trust with the banking system.

Suppose there is a banking crisis as well, there is some multiple bank failures; and as a result, what we can see that people withdraw their deposits, the demand for money increases, the liquidity preference increases.

When the liquidity preference increases, maybe due to several factors including a fear of war, uncertainty, problem with the banking system, some external factors and all; because of all these when the  $c$  increases then we can say that the multiple expansion of the money multiplier value also decreases. And as a result, the multiple expansion of money supply also negatively gets affected.

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**Money Supply Responses to Changes in the Factors**

**Changes in  $e$ .**  
When banks increase their holdings of excess reserves relative to checkable deposits, banks will contract their loans, causing a decline in the level of checkable deposits and a decline in the money supply, and the money multiplier will fall.

Suppose that  $e$  rises from 0.001 to 0.005.

$$m = (1 + 0.5) / (0.1 + 0.005 + 0.5) = 2.48$$

The money multiplier and the money supply are negatively related to the excess reserves ratio  $e$ .



Then the third factor, that is the excess reserve. When bank increase their holdings of excess reserves related to checkable deposits, banks will contract their loans causing a decline in the level of checkable deposit and then a decline in the money supply, and the money multiplier will fall here. So, again putting some values suppose  $e$  rises from 0.001 to 0.005, we can say that there is an increase in excess reserve. And, accordingly plugging these values in our formula, the money multiplier is going to be 2.48. It means, the money multiplier and the money supply are negatively related to the excess reserve ratio  $e$ .

What we can see that if a central bank wants to increase the money supply, it cannot simply rely on the required reserve ratio alone, instead they also need to look at what is the general economic condition, what is the trust of public, what is the liquidity preference. What is their trust with the banking system or whether how much currency they prefer to keep with

themselves. In addition, they also need to investigate the banking conditions; that means, how much excess reserve the banking system would like to hold. So, about the excess reserve, you know that it also depends on the liquidity management in the of their respective banking system.

If banks anticipate that a banking crisis is going to happen, maybe a rumor, that banks are going to fail and they expect anticipate that a bank run is going to happen, then what they are going to do? They will increase the excess reserve.

If the asymmetric information problem is very high in an economy or the uncertainty is very high, then accordingly we can see that the bank management is going to keep more excess reserve with them; that is one. Plus, if they find that there is a limited use their resources, that is, they are not finding good investment opportunities, then also they will be keeping excess reserves with them. So, accordingly we can say that increase in excess reserve also affect the money multiplier.

To summarize in this session, we have discussed how to derive money multiplier formula and then discussed what are the factors affecting money multiplier formula.

In the next session, we are going to expand whatever we have discussed in the previous sessions by discussing the monetary policy. We are going to discuss in the next session what are the tools of monetary policy, and what are the target variables etcetera.

Thank you so much for watching this video and see you in the next session.

Thank you.

**Keywords:** money multiplier, monetary base, money multiplier, currency-deposit ratio, required reserve ratio, excess reserve ratio