

As we now know, changes in AD have real effects on the economy in the short run. We also know that aggregate demand is determined by M, the money supply, and k, money demand. We will next take a closer look at exactly how M is determined.

### Money Supply

There are several definitions of money, depending on what you consider as money.

$M1 = \text{currency} + \text{demand deposits} + \text{other checkable deposits and travelers checks}$

$M2 = M1 + \text{balances in savings accounts} + \text{money market mutual funds} + \dots$

There are definitions of M3, M4, etc.

As far as we will be concerned,

### Definition of M

$M = C + D$  (basically M1)

C = currency, currency in the hands of the non-bank public (paper \$ and coins)

D = demand deposits (checkable deposits) in the hands of the non-bank public

### Behavioral Relationship

$M = B * \mu$

B = monetary base

$\mu$  = money multiplier

$B = C + R$

C = currency in the hands of non-bank public

R = reserves of the banking system

Reserves are:

Vault cash, cash in tellers drawers

Deposits at the Fed

Reserves are dollar bills the bank has that have not been loaned out. They are cash and coins in the hands of bank. We'll ignore deposits at the Fed.

### An aside on money creation by banks (and people)

C = currency

D = demand deposits,

M = money supply ( $M = C + D$ )

RRR = the required reserve ratio – the % of deposits that banks must legally hold as reserves (e.g. 10%)

RR = required reserves ( $RR = RRR * D$ )

R = reserves

ER = excess reserves ( $ER = R - RR$ )

We will assume in this example that  $RRR = 0.1$  (10%) and that the banks loan out all excess reserves.

Action	C	D	M	R	RR	ER
\$100 floats down from the sky	\$100	0	\$100	0	0	0
Chuck deposits the \$100	\$0	\$100	\$100	\$100	\$10	\$90
Loan out the \$90 to Derek	\$90	\$100	\$190	\$10	\$10	\$0
Derek deposits \$90	\$0	\$190	\$190	\$100	\$19	\$81
Loan out \$81 to Dave	\$81	\$190	\$271	\$19	\$19	\$0
Repeat an infinite # of times						
In the end	\$0	\$1000	\$1000	\$100	\$100	\$0

Remember that C is currency in the hands of non-bank public. When money is deposited at the bank, it is no longer counted as C, as the money is now in the hands of the bank. In fact, when the bank gets a hold of it, we call it R. (Notice however, that the monetary base,  $B = C + R$  is always \$100. This is the number of dollar bills that have been printed up. While this process creates money, the amount of paper money in circulation stays the same. This is what the base measures.)

Notice, while we originally started with a \$100 increase in currency, we find that in the end the money supply increases by a multiple of the original increase. In our example, we added \$100, and it led to a \$1000 increase in the money supply. This assumes that all excess reserves are loaned out and re-deposited an infinite number of times, perhaps not an extremely realistic assumption (more later), but the story should be clear. **Banks create money by making loans.** People deposit money, which then creates the excess reserves that allow banks to make the loans. This is the effect we are talking about when we talk about the money multiplier.

$$M = \beta * \mu$$

We can write the following:

$$\Delta M = \Delta B * \mu$$

$$\$1000 = \$100 * \mu$$

$$\mu = 10$$

It is the process of repeatedly (1) depositing the money (creating excess reserves) and (2) loaning out excess reserves that fuels this multiplier effect (which then are deposited, repeating the whole cycle).

If the person who originally picked up the \$100 bill had simply put under their mattress (held the money as currency rather than demand deposits) the multiplier process wouldn't have occurred. Or the fourth person on down the line could have put the money under their mattress, and there would have been no further multiplier effect. Holding more currency relative to deposits will slow down the multiplier effect.

Further, if the first bank, which received the original deposit, hadn't loaned out the excess reserves (held a large amount of reserves relative to the amount of deposits) the multiplier effect would not have occurred. Or the 7<sup>th</sup> bank down the line could have decided to loan out less. Holding more reserves relative to deposits will slow down the multiplier effect.

I have posted an Excel spreadsheet that allows you to change the values of C/D and the RRR. Check it out after reading the rest of these notes.

As a sneak preview of things to come, suppose we are in the 5<sup>th</sup> line of the chart above. Deposits are \$190, meaning that people have \$190 in their checking accounts. The bank is holding \$19 of reserves. That is, it has only \$19 worth of cash in the vault. What if everyone comes to the bank and asks for their \$190? Trouble. Much more later. Watch It's a Wonderful Life. Where does Jimmy Stewart say the money is? It's not in the vault.

Formalize

What does  $\mu$  depend on?

1. (C / D) - currency deposit ratio

If C/D is low people want to hold lots of D relative to C  $\Rightarrow \mu$  will be higher (and thus M will be higher)

If C/D is high people want to hold few D relative to C  $\Rightarrow \mu$  will be lower (and thus M will be lower)

E.g. Suppose C is \$100, and D is \$200. The C/D ratio would be  $\$100 / \$200 = 1/2$   
Now, suppose that C is \$50, but D is \$250. The C/D ratio is now  $\$50 / \$250 = 1/5$ .

In the second case, C/D is lower, but there are relatively more deposits to fuel the multiplier effect. When C/D is low, multiplier is large.

Thus, **C/D and the multiplier move in opposite directions**. A decrease in C/D will cause an increase in the multiplier. An increase in C/D will cause a decrease in the multiplier.

Considering the case where no one deposits their money in the bank, and instead holds it under their mattress as currency. (C/D infinite). There will be no multiplier effect at all.

Likewise, if everyone deposits all their money and holds no currency, we found a large multiplier effect. (C/D is zero).

2. (R / D) – reserve deposit ratio

If R/D  $\uparrow$ , a given amount of reserves can support fewer deposits  $\Rightarrow \mu$  will fall.

If R/D  $\downarrow$ , more deposits can be supported by any given R  $\Rightarrow \mu$  will rise.

**R/D and the multiplier move in opposite directions.**

The logic is the same as above.

If banks decide to hold a large fraction of their deposits as reserves (R/D high), there will be less money to loan out, slowing the multiplier effect.

If banks decide to loan out the maximum legal amount of their reserves, here R/D will be as low as the law allows. Now, there will be a large multiplier effect.

Generally, it will be the case that R/D will be constrained by the RRR. That is, banks will tend to hold as little R as they can for their level of D. In other words, banks tend to loans out all of their excess reserves. Thus, the R/D ratio will be equal to the required reserve ratio (RRR).

Why? Banks make money by loaning out these reserves. Banks do not earn interest on cash sitting in their vault (or even on their deposits at the Fed). Thus, they will generally want to loan out nearly all of their excess reserves.

Is there a mathematical expression for the value of the money multiplier?

Yes.  $\mu = (1 + C/D) / (R/D + C/D)$  (See me for a derivation)

What happens when we change C/D, R/D, or B?

$$M = B * \mu$$

Note: changing any of the above affects either B or  $\mu$  (not both)

<u>Causal Effect</u>	<u>Effect on B</u>	<u>Effect on <math>\mu</math></u>	<u>Effect on M</u>
↑ B	↑	No change	↑
↓ B	↓	No change	↓
↑ (C/D)	No change	↓	↓
↓ (C/D)	No change	↑	↑
↑ (R/D)	No change	↓	↓
↓ (R/D)	No change	↑	↑

Notice there is no event that simultaneously causes B and  $\mu$  to change at the same time.

Who determines each of these variables?

The monetary base (B) is determined solely by the Fed.

The currency-deposit ratio (C/D) is determined by decisions made by the public, with some help from banks.

You decide what fraction of your money to hold as currency, and what fraction to hold as deposits. Banks help a little. ATM machines have made it easier to get cash out of our checking accounts. As a result, we generally hold smaller amounts of cash at any given time (but make frequent trips to the ATM)

The reserve-deposit ratio (R/D) is determined jointly by the Fed and banks

First, the Fed sets the required reserve ratio (RRR). Banks will usually loan out all excess reserves. Thus, the R/D ratio will essentially be the RRR. For example, if the banks are required to hold 10% of deposits as reserves (RRR = 0.10), they will do just that. \$100 of deposits will end up with \$10 of reserves. The R/D ratio = \$10 / \$100 = 0.10, the RRR. They are one in the same (when banks loan out all excess reserves).

If banks for some reason hold more reserves than required by law, R/D will increase and the multiplier will fall. But banks don't earn interest income on reserves (cash sitting in their vault). They do earn interest by loaning out excess reserves, so banks will almost always loan out all excess reserves. Exceptions are historically rare and are brought on by banking panics (more later on panics).

Which of the above are important in explaining the actual observed changes in the US money supply?

C/D is not. C/D moves very slowly over time.

R/D is not. R/D also changes very slowly over time. Banks usually loan out all reserves and the Fed rarely changes the RRR

B is the key. Nearly all of the changes in the money supply will occur through changes in the monetary base.

We'll hit on these again when we have a lecture on the history of the Fed.

### The Fed, what is the Fed?

The Fed is the Federal Reserve System. It is the central banking system of the US. It serves as a bank for banks. The Fed is responsible for conducting monetary policy (controlling the money supply). It was created in 1913, by the Federal Reserve Act.

Board of Governors - 7 members, appointed by President subject to congressional approval, appointed to 14-year terms. Chairman is Alan Greenspan, very powerful.

Regional Banks - 12 Regional banks, distributed around the country. Controlled by 9 directors each.

Federal Reserve's Federal Open Market Committee (FOMC) - Meets regularly to set monetary policy and choose Fed actions. Includes Board of Governors (7), the President of the NY Fed, and 4 more Fed bank presidents. Again, Greenspan is very influential.

The Fed is a government agency, but is designed to be autonomous, so it can operate independent of political pressure. This is why the appointments are for 14 years. It is supposed to be independent of Congress and the President, but every so often, Congress or the President threatens to disband the Fed. They may not be as independent and immune to pressure as they might seem.

The Fed also holds a large portfolio of government bonds, of various maturities. (These will come in handy for open market operations.) The interest income on these bonds funds the expenses of the Federal Reserve.

The Fed also clears checks nationally and is responsible for regulating or overseeing banks.

### Fed policy actions to manipulate the money supply

1. Open market operations
2. Reserve requirements
3. Discount rate  
Federal funds target rate

### What should I read?

Chapter 16.