The Money Supply Process

This lecture examines the mechanism that determines the level of the money supply.

The Basics of the Money Supply Process

A. The Three Players in the Money Supply Process

1. The central bank (i.e., The Fed in the U.S.)
2. Banks
3. Depositors (individuals and nonbank businesses)

B. The Fed's Assets, Liabilities, and Balance Sheet

1. Assets
   a. Securities are the Fed's holdings of U.S. Treasury securities and other securities (ex., MBSs).

b. Loans to financial institutions are loans to banks and other financial institutions that are primarily made through the discount window. The interest rate on those loans is the discount rate which is set by the Fed.

2. Liabilities

   a. Currency outside of banks is the amount of currency held by the nonbank public.

   b. Reserves (i.e., total reserves) are bank deposits at the Fed plus currency held by banks (i.e., vault cash).

      i. Total reserves = required reserves + excess reserves (Required reserves are the reserves banks are required by the Fed to hold against deposits.)

      ii. Total reserves = nonborrowed reserves + borrowed reserves (Borrowed reserves are loans to financial institutions.)

3. The Fed's Balance Sheet

Assets	Liabilities
Securities	Currency outside of banks
Loans to financial inst.	Reserves

C. Control of the Monetary Base

1. The monetary base (or high-powered money) is the sum of the Fed's liabilities.

   Monetary base = currency outside of banks + reserves

2. Open market operations

   a. Open market purchase is when the Fed injects reserves into the banking system by purchasing bonds. These purchases increase the monetary base.

Suppose the Fed purchases $10 million in bonds.

The Fed's Balance Sheet

Assets		Liabilities	
Securities	+ $10	Reserves	+ $10

The Banking System's Balance Sheet

Assets		Liabilities
Securities	– $10	
Reserves	+ $10	

These purchases raise the monetary base by $10 million.

b. Open market sale is when the Fed withdraws reserves from the banking system by selling bonds. These sales decrease the monetary base.

Suppose the Fed sells $10 million in bonds.

The Fed's Balance Sheet

Assets		Liabilities	
Securities	– $10	Reserves	– $10

The Banking System's Balance Sheet

Assets		Liabilities
Securities	+ $10	
Reserves	– $10	

These sales reduce the monetary base by $10 million.

3. A shift from checkable deposits to currency reduces the level of reserves but leaves the monetary base unchanged.

Suppose $10 million moves from checkable deposits to currency.

The Nonbank Public's Balance Sheet

Assets		Liabilities
Check. deposits	– $10	
Currency	+ $10	

The Banking System's Balance Sheet

Assets		Liabilities	
Reserves	– $10	Check. deposits	– $10

The Fed's Balance Sheet

Assets	Liabilities	
	Currency	+ $10
	Reserves	– $10

This shift from checkable deposits to currency reduces reserves by $10 million but leaves the monetary base unchanged.

4. A Fed loan to the banking system increases both reserves and the monetary base.

Suppose the Fed loans $10 million to the banking system.

The Fed's Balance Sheet

Assets		Liabilities	
Loans to banks	+ $10	Reserves	+ $10

The Banking System's Balance Sheet

Assets		Liabilities	
Reserves	+ $10	Loans from Fed	+ $10

These loans raise both reserves and the monetary base by $10 million.

5. The Fed's ability to control the monetary base depends on how the reserves are created.
    a. The Fed fully controls the amount of reserves and the monetary base created via open market operations.
    b. The Fed, however, cannot fully predict the amount of reserves and the monetary base created from loans to financial institutions.
    c. Reserves created via loans to financial institutions are called borrowed reserves.

A Simple Model of the Money Multiplier Process

A. Consider the following example on how banks create money. (assume the required reserves ratio is 10%)

1. Suppose Bank A sells $100 million in securities to the Fed.

Bank A's Balance Sheet

Assets		Liabilities
Securities	– $100	
Reserves	+ $100	

Since Bank A had no increase in checkable deposits, it can lend out the entire $100 million in increased reserves.

2. Bank A then makes $100 million in loans.

Bank A's Balance Sheet

Assets		Liabilities
Reserves	– $100	
Loans	+ $100	

3. The borrower spends the money, which is then deposited in Bank B.

Bank B's Balance Sheet

Assets		Liabilities	
Reserves	+ $100	Check. deposits	+ $100

Since Bank B had its checkable deposits rise by $100 million, it must hold $10 million in required reserves and can only lend out $90 million.

4. Bank B then makes $90 million in loans.

Bank B's Balance Sheet

Assets		Liabilities	
Reserves	+ $10	Check. deposits	+ $100
Loans	+ $90		

5. The borrower spends the money, which is then deposited in Bank C.

Bank C's Balance Sheet

Assets		Liabilities	
Reserves	+ $90	Check. deposits	+ $90

Since Bank B had its checkable deposits rise by $90 million, it must hold $9 million in required reserves and can only lend out $81 million.

6. Bank C then makes $81 million in loans.

Bank B's Balance Sheet

Assets		Liabilities	
Reserves	+ $9	Check. deposits	+ $90
Loans	+ $81		

7. This process continues until all of the increase in reserves is held as required reserves.

Bank	Increase in Deposits	Increase in Loans	Increase in Reserves
A	0.0	100.0	0.0
B	100.0	90.0	10.0
C	90.0	81.0	9.0
D	81.0	72.9	8.1
E	72.9	65.6	7.3
.	.	.	.
Total	1,000	1,000	100

8. The simple money multiplier

$$\Delta ChD = [1/rr] \times \Delta TR$$

ΔChD is the change in checking deposits
ΔTR is the change in total reserves
rr is the required reserves ratio

B. Deriving the formula for deposit creation

1. Assuming banks do not hold excess reserves, total reserves (TR) equals required reserves (RR)

$$TR = RR. \quad (1)$$

2. Required reserves equal checkable deposits (ChD) multiplied by the required reserves ratio (rr)

$$RR = rr \times ChD. \quad (2)$$

3. Combining equations (1) and (2), we get

$$TR = rr \times ChD. \quad (3)$$

4. Rearranging (3) and taking the change in both sides, we get the simple money multiplier

$$\Delta ChD = [1/rr] \times \Delta TR. \quad (4)$$

C. Problems with the simple money multiplier

1. Individuals deposit all of their funds into the bank and do not hold any of it as currency.

   a. When funds are held as currency and not deposited into the bank, the money multiplier becomes smaller.

2. The banks do not hold any excess reserves.

   a. When banks hold excess reserves, they lend out less money, which reduces the size of the money multiplier.

The Actual Money Multiplier

A. The money multiplier (m) is the multiple of the monetary base (M^B) that is transformed into the money supply (M^S)

$$M^S = m \times M^B$$

$$m = \frac{M^S}{M^B}. \quad (5)$$

B. The money supply formula

1. Money supply is equal to currency outside of banks (CU) plus checking deposits (ChD)

$$M^S = CU + ChD. \quad (6)$$

2. Currency outside of banks equals the currency-to-deposit ratio (c = CU/ChD) multiplied by checking deposits

$$CU = c \times ChD. \quad (7)$$

3. Substitute (7) into (6) to get the money supply as a function of checking deposits

$$M^S = c \times ChD + ChD = (1 + c) \times ChD. \quad (8)$$

C. The monetary base formula

1. The monetary base equals currency outside of banks (CU) plus total reserves (TR)

$$M^B = CU + TR. \quad (9)$$

2. Total reserves are required reserves (RR) plus excess reserves (ER)

$$TR = RR + ER. \quad (10)$$

3. Required reserves equal the required reserves ratio (rr) multiplied by checking deposits

$$RR = rr \times ChD. \quad (11)$$

4. Excess reserves equal the excess reserves-to-deposit ratio (e = ER/ChD) multiplied by checking deposits

$$ER = e \times ChD. \quad (12)$$

5. Substitute (11) and (12) into (10) to get total reserves as a function of checking deposits

$$TR = rr \times ChD + e \times ChD = (rr + e) \times ChD. \quad (13)$$

6. Substitute (7) and (13) into (9) to get the monetary base as a function of checking deposits

$$M^B = c \times ChD + (rr + e) \times ChD = (c + rr + e) \times ChD. \quad (14)$$

D. Substitute (8) and (14) into (5) to get the money multiplier

$$m = \frac{M^S}{M^B} = \frac{(1+c) \times ChD}{(c+rr+e) \times ChD} = \frac{(1+c)}{(c+rr+e)},$$

$$M^S = \left(\frac{(1+c)}{(c+rr+e)}\right) \times M^B.$$

E. Factors that increase the money supply

1. Open market purchases increase reserves, which push up the money supply. The Fed makes this decision.
2. A lower required reserves ratio increases the money multiplier, which raises the money supply. The Fed makes this decision.
3. More borrowed reserves from the Fed raise the level of reserves, which pushes up the money supply. Banks make this decision.
4. When banks hold less excess reserves (e falls), they lend more funds, which raises the money supply. Banks make this decision.
5. As individuals hold less currency (c falls), their checking deposits rise, which pushes up the money supply. Individuals make this decision.

F. Example 1

Suppose the rr = 0.10, c = 0.25, and e = 0.15. If the monetary base rises by $34 million, how much does the money supply increase?

$$\Delta M^S = \left(\frac{(1+c)}{(c+rr+e)}\right) \times \Delta M^B$$

$$\Delta M^S = \left(\frac{(1+0.25)}{(0.25+0.10+0.15)}\right) \times 34 = \left(\frac{1.25}{0.50}\right) \times 34$$

$$\Delta M^S = \$85 \text{ million}$$

G. Example 2

Suppose the required reserves ratio is 10%, currency outside of banks is $1,000 billion, checkable deposits are $2,000 billion, and excess reserves are $1,500 billion. Calculate required reserves, the monetary base, and the money supply.

Required reserves

$$RR = rr \times ChD = 0.1 \times 2{,}000$$
$$RR = \$200 \text{ billion}$$

Monetary base

$$M^B = CU + RR + ER = 1{,}000 + 200 + 1{,}500$$
$$M^B = \$2{,}700 \text{ billion}$$

Money supply

$$M^S = CU + ChD = 1{,}000 + 2{,}000$$
$$M^S = \$3{,}000 \text{ billion}$$