13 Central Banks & The Federal Reserve System

The financial crisis that started in September 2007 would create the worst economic downturn since the the Great Depression. The Federal Reserve acted quickly lowering the federal funds rate target to near zero by December 2008. This expansionary policy failed to be sufficient by itself leading the Fed to implement large liquidity injections into the credit market in order to get creditors to lend. The Fed extended it's influence to investment banks creating a large number of lending programs (bailouts).

This recent global crisis demonstrated the importance of central banks to the health of the financial system and the economy. This section lays out what the Fed is trying to achieve, what motivates them, and how they are structured.

13.1 Structure of the Federal Reserve System

Of all the Central Banks, the Federal Reserve Bank of the United States has one of the most unusual. To understand why the structure is so unusual, we must look at the origins of the Federal Reserve. Because of the origins of the United States, Americans typically fear centralized power. For example, the Constitution establishes a system of checks and balances at the federal level and aims to preserve state rights. Americans are also extremely distrustful of any centralized authority that controls money interests.

Because of American distrust, the First Central Bank of the U.S. was disbanded in 1811. A second failed attempt occurred when the Second Central Bank of the U.S. was disbanded in 1836 after President Jackson vetoed the renewal of it's charter. Without a lender of last resort, the financial system in the U.S. experienced a bank panic about every 20 years. In 1913, Congress established the Federal Reserve Act which established the Fed with an elaborate system of checks and balances.

Federal Reserve Banks:

Figure 1 illustrates the locations of each Federal Reserve district and their bank locations.

- Twelve districts
- Quasi-public (part private, part government)
- Nine Directors (6 elected/3 appointed)
    A. 3 elected - Bankers
    B. 3 elected - Community Leaders
    C. 3 appointed by Board of Gov.

Figure 1: Federal Reserve Districts

District Bank Functions:

Some of the functions each of the twelve Federal Reserve banks perform are *(not inclusive)*:

- Clear Checks
- Issue New Currency
- Make discount loans
- Evaluate proposed mergers
- Collect data on local business conditions
- Staff professional economists for research

All national banks are required to be members of the Federal Reserve System. However, banks chartered by states are not required to be members but may choose to join. Currently, all banks regardless of membership status are subject to the Fed's reserve requirement and have access to their facilities (such as the discount window, check clearing).

Board of Governors:

- Head of the Federal Reserve System
- Headquartered in Washington D.C.
- Seven members appointed by President
- Each member serves a 14-year term
- Chairman chosen from members serving a 4-year renewable term

Board Functions:

- All members serve on FOMC
- Sets reserve requirement & discount rate
- Chairman advises POTUS
- Staffs economists, approve bank mergers & activities

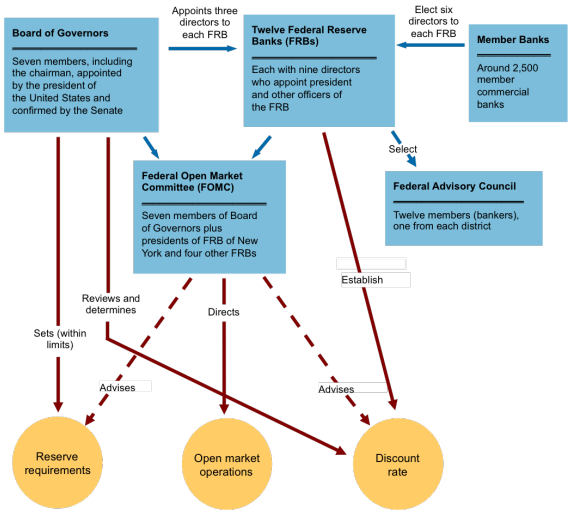


Figure 2: Structure of Fed Reserve

Federal Open Market Committee (FOMC)

The FOMC is often mistakenly referred to as "The Fed" in the news. The committee meets *8 times per year* to determine the conduct of open market operations and policy regarding the interest rate.

Headed by the *Chairman* of the Board of Governors, the FOMC membership is as follows:

- Seven members from the Board of Governors
- President of the FRB of New York
- Presidents of four other FRBs
  - These positions rotate

Because the FOMC makes decision regarding open market operations policy (which is the most important policy tool for controlling the Money Supply), the FOMC is the focal point for policy making in the Federal Reserve System. After the FOMC meetings, they will direct the New York FRB trading desk to execute sales or purchases of securities.

By setting the agenda of the Board and FOMC meetings, the chairman wields a great deal of power in policy decisions. The chairman is also responsible for communicating with the President & Congress as well as the media. Figure 2 illustrates the structure of the Federal Reserve System and indicates the division of responsibility.

13.2 Central Bank Independence

In the U.S. each member of the Board serves a single (non-renewable) 14-year term so that they may survive multiple presidents and congressional assemblies. Because this term is non-renewable and they because they cannot be removed from office, there is little incentive to favor with the president/congress. The Fed generates a significant amount of revenue and profit which minus operational costs, is turned over to the Treasury. In 2010, for example, after expenses, the Fed had a net profit of $80 billion. Being self sufficient allows the Fed to get out from under the appropriation process controlled by Congress.

Although the U.S. Central Bank is one of the most independent in the world, it is not completely immune to political pressure. Because Congress initially chartered the Fed in 1913, they may change the responsibilities whenever they are not happy with it's performance. Additionally, the President can also influence the Federal Reserve through the appointment process.

Should the Fed be independent? An argument can be made for yes and no. However, in the macroeconomy, there is a strong evidence in support of independence. The more independent the Central Bank, the better the economy performs.

14 The Money Supply Process

As we saw, movements in the money supply affect interest rates and inflation and thus affect us all. In this section we aim to understand the money supply determination process. In the money supply creation process, there are three key players:

1. The Central Bank
2. Banks
3. Depositors

14.1 Fed Balance Sheet

In this section, I only discuss the items on the Balance Sheet that are critical to understand the money supply process.

Table 1: Federal Reserve System Balacne Sheet

Assets	Liabilities
Securities - U.S. Treasury Securities & occasionally other securities	Currency in Circulation - Fed issues currency serving as an "IOU" - Catch: Payback IOUs with other IOUs
Loans to Financial Institutions - Discount loans to banks & other financial institutions	Reserves - Bank deposits at Fed & vault cast - Banks can demand payment at anytime requiring the Fed to repay the debt (w/ more IOUs)

Assets:

The Fed provides reserves to the banking system by purchasing securities and increasing its asset holdings. As a consequence, money supply will rise. An alternative method to provide reserves is by making loans to banks and other financial institutions. Changes in the asset items lead to changes in reserves and the monetary base, and consequently the money supply.

Liabilities:

The two liabilities on the balance sheet are important part of the money supply story because changes in either/both will impact the money supply.

14.2 Monetary Base

Def^n: *Monetary Base* - Is comprised of the Fed's monetary liabilities (currency in circulation plus reserves)

$$MB = C + R \tag{14.1}$$

Changes in the Fed's liability position (monetary base) will impact the money supply. The monetary base is deemed an important concept because of the ease at which it can be converted into goods & services. They manipulate the base through *open market operations.* Consider the following example:

Example: 14.1. *Suppose the Fed buys \$100 million in bonds from banks and pays for them with a check. Bank securities fall by \$100 million. Banks then will either deposit their check in their account at the Fed or cash it, both of which increase their reserves \$100 million. The Fed finds it's assets has increased with the purchase of \$100 million in bonds and paying for the securities in reserves has increased it's liabilities by \$100 million. Because there has been no change in currency in circulation, the monetary base has also risen by \$100 million. (The effect on the base is the same if the Fed buys bonds from individuals/firms & they cash the checks rather then deposit them)*

Initially, this OMO in example 14.1 has no impact on the economies money supply. However, this is only the first step in the money creation process.

14.3 Money Creation

Suppose the reserve ratio is 10% and the Fed makes an open market purchase of $100 million bonds. The Fed writes a check to the sellers (suppose they are individuals/firms) that deposit the check into their account at PNC. We can then see how an open market purchase of bonds will increase the money supply:

Table 2: Banking System Balacne Sheet

Assets		**Liabilities**	
1. Reserves	+$100 million	2. Deposits	+$100 million
1. Securities	– $100 million	3.	+$90 million
			⋮
		Total:	+$1,000 million
2. Loans	+$100 million		
3.	+$90 million		
	⋮		
Total:	+$1,000 million		

The open market operation purchasing +$100 million in bonds increased the Reserves of the Banking System and reduced it's Securities. Because this initial step did not change Checking Deposits, the entire Banking System now has +$100 million in Excess Reserves (assuming they held zero before the Fed's purchase). This open market purchase initiated the bank lending process. The above table is the first few steps. The process will continue until the Banking System is holding zero excess reserves.

14.4 Deriving Money Multiplier

Def^n: *Money Multipler* - Tells us how much the M^S changes for a given change in the monetary base (MB).

$$M^S = m \times MB \tag{14.2}$$

Define the following terms:

1. Required Reserves: RR
2. RR ratio: rr
3. Excess Reserves: ER
4. Currency: C
5. Checking Deposits: D
6. Currency Ratio: $c = C/D$
7. ER Ratio: $e = ER/D$

1. Start with Total Reserve Equation:
$$R = RR + ER$$

2. Substitute $RR = rr \times D$:
$$R = (rr \times D) + ER$$

3. Substitute into the equation for the Base:
$$MB = R + C$$
$$MB = (rr \times D) + ER + C$$

4. Solve the Currency & ER Ratio for C & ER:
$$MB = (rr \times D) + e \times D + c \times D$$
$$\Rightarrow D = \frac{1}{rr + e + c} \times MB \tag{14.3}$$

5. Move to the $M1$ equation for money supply:
$$M^S = D + C$$
$$= D + c \times D$$
$$\Rightarrow D = \frac{M^S}{1 + c} \tag{14.4}$$

6. Substitute 14.4 into 14.3 and solve for M^S:
$$M^S = \frac{1 + c}{rr + e + c} \times MB \tag{14.5}$$
$$M^S = m \times MB$$

14.4.1 Determinants of Money Supply

Equation 14.5 shows the relationship between the money supply and the monetary base. It also shows what factors impact the money multiplier so the Fed can make better policy decisions. The multiplier:

$$m = \frac{1+c}{rr+e+c} \tag{14.6}$$

Given this equation, we can determine the following four factors that influence the money supply:

1. Monetary Base
2. Required Reserve Ratio
3. Currency Holdings
4. Excess Reserve Holdings

14.5 Decomposing the Monetary Base

Recall the Monetary Base is:

$$MB = C + R$$

Because the Fed offers discount loans to banks by setting a discount rate, Bank demand will determine how much in discount loans will be utilized. If a bank takes a discount loan out with the Fed, the Fed provides the bank with needed reserves which expands the Monetary Base. On repayment, it will contract the Monetary Base. Because of this, the Fed cannot fully control the amount that banks borrow in discount loans. Thus, we can decompose the Monetary Base in two parts:

1. Non-Borrowed Reserves: MB_n
   - Non-Borrowed Monetary Base at which the Fed has complete influence through OMO
2. Borrowed Reserves: BR
   - Reserves obtained through discount policy at which the Fed cannot fully control

The equation for the Monetary Base can be rewritten as:

$$MB = MB_n + BR \tag{14.7}$$

15 Tools of Monetary Policy

In this section, we examine the Monetary Policy tools the Fed has at its disposal to influence the Money Supply and Interest Rates.

15.1 Market for Reserves & Fed Funds Rate

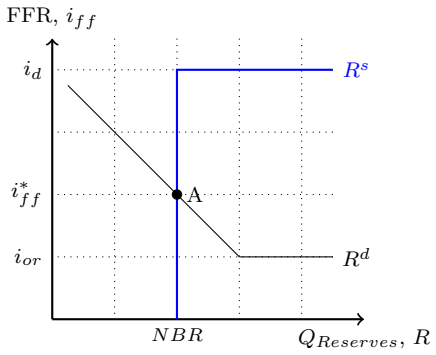
Def^n: *Federal Funds Rate (i_{ff})* - Interest rate on overnight loans of reserves between banks

Recently, the Federal Funds Rate has been the primary focus of the Federal Reserve. The Federal Funds Rate is determined in the market for reserves. In the following model, banks are the demanders of reserves and the Federal Reserve is the supplier of reserves.

15.1.1 Demand for Reserves

What happens to the quantity of reserves demanded by banks as the federal funds rate (i_{ff}) increases? To answer this question, recall that a banks reserves are the sum of two parts: $R^d = Required + Excess$. Required reserves are fixed as the bank cannot change this amount.

Excess reserves serve as insurance on deposit outflows. Holding excess reserves has an *opportunity cost* equal to the interest the bank could make if lent it out (Federal Funds Rate, i_{ff}). As i_{ff} decreases, the opportunity cost of holding excess reserves falls. Thus the quantity of reserves demanded will increase as we move down R^d. Banks are like any other profit maximizing business/ individual: no one likes to pay high prices. Considering i_{ff} to be the "price" of buying reserves. As i_{ff} increases, banks would purchase less reserves to hold in their vaults.



Before 2008, the Fed did not pay interest on reserves. Since then, they began doing so to avoid a hyperinflation situation that results from such rapid expansion of the monetary base. Because of this, we have to adjust the demand curve, R^d, to include the interest rate (i_{or}) banks can receive from the Fed. At this point, if the federal funds rate drops below the interest paid on holding reserves or $i_{ff} < i_{op}$, the opportunity cost of holding reserves is zero. Banks will collect interest on excess reserves as there is no incentive to loan at the lower i_{ff}.

15.1.2 Supply for Reserves

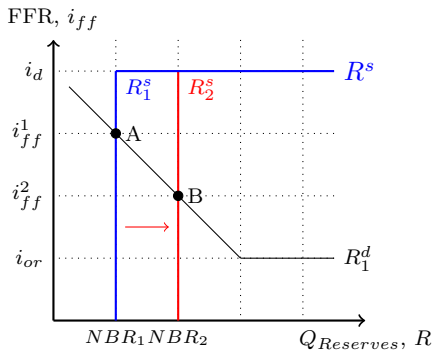
While the Fed wields a great deal of influence on R^s, they do not have complete control. The supply of reserves is determined such that: $R^s = Non\ Borrowed\ Reserves + Borrowed\ Reserves$ ($R^s = NBR + BR$). Recall by using OMOs, the Fed has complete control over the quantity NBR. Graphically, this portion of R^s is a vertical line. This is because NBR is a fixed number set by the Fed for each and every i_{ff}.

Next, we must account for the second portion of R^s where the Fed does not have complete control, BR. Borrowed Reserves, BR, is determined by how much banks would like to borrow from the Fed via discount loans. Discount Loans have an associated discount rate i_d, which is set at the Feds discretion. Graphically, this modifies the R^s curve such that there is a kink at i_d. In other words, the discount rate acts as a price ceiling. As a result, an arbitrage situation arises. Suppose i_{ff} rises above i_d, banks first would borrow an infinite amount from the Fed paying i_d. Then banks would lend out the proceeds at the federal funds market earning a higher rate i_{ff}.

15.1.3 Changes in Monetary Policy Tools & The Fed Funds Rate

The following factors are Monetary Policy Tools used by the Fed to manipulate the Federal Funds Rate. Each example shows the typical case that is experienced in real life, however, other examples are plausible in theory.

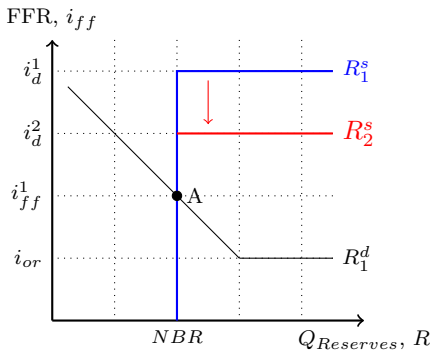
1. **OMO: Open Market Purchase**



An open market purchase of securities, the Fed has increased the amount of non-borrowed reserves in the banking system. Graphically, this is a shift from R^s_1 to R^s_2 which decreases the equilibrium federal funds rate from i^1_{ff} to i^2_{ff}.

Note: The effect depends on where R^s intersects R^d. Typical case above: $i_{ff} > i_{or}$.

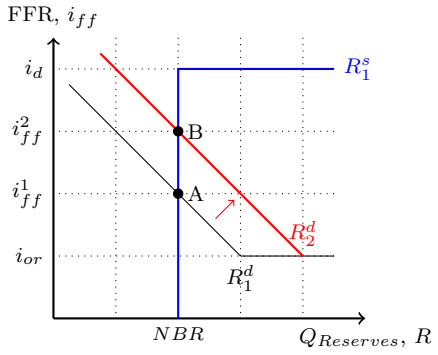
2. **Discount Lending: Fed lowers i_d**



The Fed decreasing the discount rate from i^1_d to i^2_d will move the horizontal portion of R^s_1 down to meet i^2_d. In this scenario, decreasing the discount rate will have no effect on the federal funds rate.

Note: The effect depends on where R^s intersects R^d. Typical case above: $i_{ff} < i_d$ to ensure R^d does not intersect flat portion.

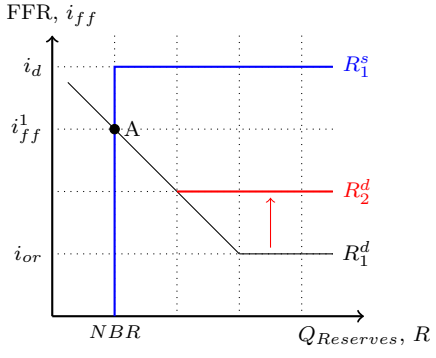
3. **Reserve Requirement: Increase**



If banks hold zero excess reserves, increasing the reserve requirement will make banks to fall below the legal limit. Banks then attempt to gather funds to meet the new legal limit causing the demand for reserves to increase.

Note: The effect depends on where R^s intersects R^d. However, the reserve requirement is not adjusted very frequently. It is not binding for 70% of banks and has remained 10% for the last 24 years.

4. **Interest on Reserves: Increase**



If the Fed raised interest paid on bank reserves from i^1_{or} to i^2_{or}, the result in this example has no impact on the federal funds rate.

Note: The effect depends on where R^s intersects R^d. Since this program only began in 2008, the figure above shows the only case we have experienced. In theory, this is the typical case where $i_{or} < i_{ff}$. The Fed should use i_{or} as a price floor to achieve its target i_{ff}.

15.2 Conventional Monetary Policy Tools

During normal times, the Fed uses three policy tools to control the money supply and interest rates.

1. Open Market Operations 2. Discount Lending 3. Reserve Requirements

Among the three, OMOs constitute the most important tool as it has several advantages over the others.

Relative Advantages of OMOs:

1. Allows for complete control over volume of reserves injected/taken out
2. Flexible and precise allowing the ability to pin down targets
3. Easily Reversed if federal funds rate swings too much in one direction
4. Quickly Implemented with little to no administrative delays

Although OMOs are the clear favoriate, the Fed also has the responsibility to be the *Lender of Last Resort* which involves *Discount Lending*. During times of crisis, discount lending plays a critical role in ensure the stability of the economy. Typically, crisis/shocks are synonymous with credit crunches with lenders try to protect themselves as they grow weary of the future. Lastly, I have previously stated, the reserve requirement is almost obsolete as a policy tool. It has not been changed in over 20 years. This is due to the large amount of excess reserves most banks hold for operational purposes (ATMs).

15.3 Nonconventional Monetary Policy Tools

Conventional Monetary Policy Tools fail to stabilize the economy during full-scale financial crisis like that of 2007-2009 recession. One problem that arises with conventional tools:

Def^n: *Zero Lower Bound Problem* - Central Bank unable to lower interest rates any further because they are already at zero which occurred in 2008.

For this reason, the central bank needs non-interest rate tools to stimulate the economy. Nonconventional tools take the form of:

1. Liquidity Provision

   - Lowered discount rate, Established Term Auction Facility, Began lending to IBs

2. Asset Purchases

   - 11/2008 QE1: purchased $1.25T in mortgage backed securities
   - 11/2010 QE2: began buying $75B in long-term U.S. Treasury securities to lower long-term rates
   - 09/2012 QE3: combo of 1 & 2 to improve the conditions of the labor market

   From 2007-2014, the monetary base quadrupled as a result of the Feds Large-Scale Asset Purchases. Should such an expansion of the monetary base have consequences? Could this unprecedented expansion lead to higher future inflation (perhaps even hyperinflation like that of 1924 Germany or present day Zimbabwe)?

3. Commitment to future policy actions

   - To reduce long-term rates, people must believe the Fed will keep i_{ff} near zero indefinitely
   - To see how this works, recall the Expectations Theory of the term structure:

   - Long-term rates are just the average of the one year expected bond rates. By committing to keeping short-term rates for indefinitely,the Fed could lower the markets expectations of the future short-term rates, thereby causing the long-term rates to fall.