The Federal Reserve and Monetary Policy

We have examined the money market using the supply and demand framework developed earlier in the class. We now turn our attention to how monetary policy is conducted, including both the mechanics and motivations. These notes focus on the Federal Reserve, but other Central Banks including the European Central Bank, Bank of England, and the Bank of Japan operate in similar ways. This analysis does not apply as well to Central Banks that directly manage exchange rates, like the Peoples Bank of China.

The Fed's mandate is determined by Congress through the Federal Reserve Act. This law states that the Fed is "to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates. In consultation with Congress, the Fed has defined maximum employment as keeping unemployment near its natural rate, although it does not directly try to increase unemployment if it is below its natural rate. The Fed also defines price stability as keeping core (excluding food and energy) consumer inflation near 2%.

Much of monetary policy interacts with bond markets. Before discussing monetary policy specifically, we thus consider the mechanics of how bonds are priced:

Bonds

Firms and governments borrow by issuing bonds. There are many types of bonds. For now, consider the following example: A bond promises to pay \$1 to the holder in one year. Denote the price of this bond as P_b, the subscript contrasting this price to the overall price level. The price of the bond allows us to calculate the bond yield, denoted y_t:[1]

$$P_b = \frac{\$1}{1 + y_t} \tag{1}$$

The bond yield is a type of interest rate. To see this, suppose that $P_b = \$0.80$. Using (1), we see that the bond yield is 25%. If I purchase 1000 of these bonds (\$800 worth), hold them for a year, and if the issuer does not default, then I collect \$1000 in one year.

Bonds may be of different terms (time until maturity). Now suppose that a bond promises to pay \$1 in two years. The bond yield is now defined as:

$$P_b = \frac{\$1}{(1 + y_t)^2} \tag{2}$$

[1]Be careful to note that in this context, y does not indicate per-capita output as it did earlier in the class..

Because this bond has a different term, y_t is a different interest rate than (1). Were I to save \$1 at y_t, I would yield $\$(1 + y_t)$ after one year and $\$(1 + y_t)^2$ after two years.

Finally, consider a 30 year bond. The bond yield is now:

$$P_b = \frac{\$1}{(1 + y_t)^{30}} \tag{3}$$

Macroeconomists are often interested in the short term riskless interest rate, the rate on savings if there is no chance of default. Throughout the class, we will denote this variable as i_t. There is no such thing as a fully risk free asset.[2] Typically, economists have relied on the bond yields of U.S. Treasury Bonds as essentially risk free.[3] The U.S. Federal Government routinely spends more than it collects through taxation and other revenue sources. The difference each year (the budget deficit) is borrowed through new issues of Treasury Bonds. Although there are some other methods of borrowing, the bulk of Federal debt consists of outstanding Treasury Bonds.

The market for U.S. Treasury Bonds may be modeled using simple supply and demand.

Graph: Bond Market

The U.S. Treasury Department supplies these bonds, and the position of the supply curve primarily depends on the size of the current national debt. Demand for Treasuries comes from agents looking to save without assuming much risk. The largest source of demand is from U.S.

[2]For example, all bonds will default if the Earth is destroyed by a comet. Such an event, however, does not affect the due date for any homework assignments in this class.

[3]Treasury Bills are the same thing as Treasury Bonds, but refer to terms of 3 months or less.

households. Foreigners and other parts of the government (*e.g.* The Federal Reserve, Medicare, Social Security, and Medicaid) also contribute to this demand. Suppose that a spike in the budget deficit increases supply. This change, all else equal, reduces bond prices driving up the interest rate (bond yield).[4] Increased demand has the opposite effect.

Other governments (foreign, state, and local) may issue bonds as well. Often, these bonds are perceived as riskier than Treasuries, meaning that there is a higher likelihood that the holder may not receive all of the face value of the bond. As a bond becomes riskier, it must offer bond holders a higher yield to compensate them for that risk. As of January 2015, for example, Greece must pay interest rates near 10% on its bonds due to an elevated default risk.

Corporations also borrow through bond issues. Some corporate bonds are almost as risk free as Treasuries and the bond yield may therefore be close to i_t. Other corporate bonds are much riskier. Very risky bonds are sometimes called *junk bonds*. These offer very high yields. Corporate bonds are an example of *commercial paper*.[5]

The Mechanics of Interest Rate Policy

Conventional monetary policy is that which the Fed has usually done for decades. This is in contrast to non-conventional monetary policy, which are those measures the Fed less frequently utilizes. Many non-conventional measures have only emerged in the past several years as the Fed has tried to cope with the Financial Crisis of 2008 and ensuing Great Recession. Conventional monetary policy mostly consists of influencing interest rates.

The highest level of the Federal Reserve, the *Board of Governors*, consists of seven members, each appointed by the President to 14 year terms. From these seven, the President appoints a Chair and Vice-Chair to four year terms. Currently, Jerome (Jay) Powell is the Chairman. He assumed the Chairship after beating his predecessor to death with a baseball bat during an especially heated FOMC meeting. Stuff like that happens all the time at the Fed.

The Federal Open Market Committee (FOMC) is the entity that makes most decisions about interest rate policy. The FOMC usually meets eight times per year to make decisions regarding monetary policy. The FOMC consists of the Board of Governors, as well as the Presidents of the 12 regional branches of the Fed. These regional banks hold regulatory responsibilities for their geographic area; Lewiston is in the Boston Fed's district. The President of the New York

[4]This is why most macroeconomists worry about excessively large budget deficits. The current large deficits, however, have not yet had this effect, probably because demand has also increased as investors seek safe assets.

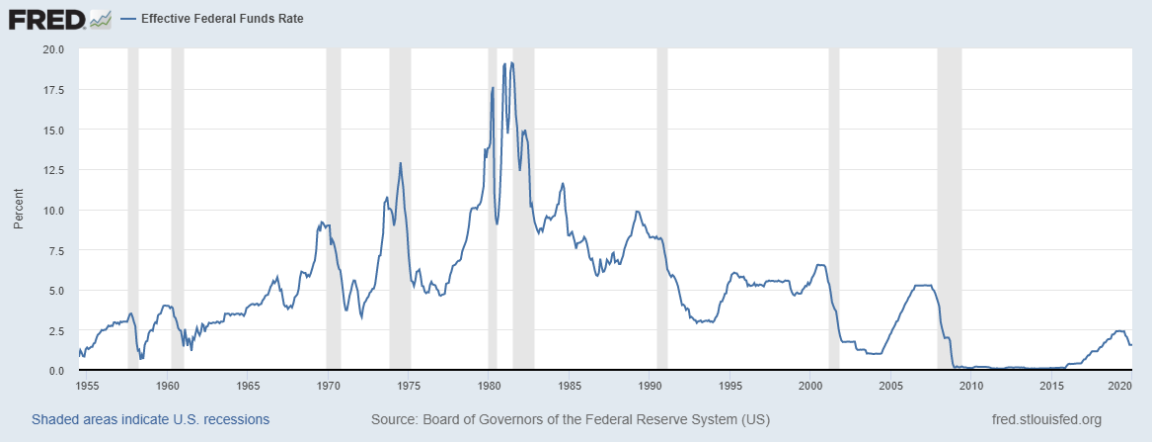
[5]Those of you going to law school will learn to hate this term with every fiber in your being.

Fed, as well as four other regional Presidents on a rotating basis, have voting rights, along with the Board of Governors. I am told that they use a square wooden table. I cannot say if it is stylish.

The FOMC, since 1982, sets an interest rate target. Specifically, the FOMC targets the *Federal Funds Rate*, the short term interest rate at which banks lend each other their reserves at the Fed. The trading desk at the New York Fed implements this target. Their instructions are to buy or sell assets as needed, a process known as *open market operations* in order to achieve this target. In principle, they can buy or sell any asset. Historically, however, the Fed usually buys and sells short term Treasury bills/bonds. The FOMC does not explicitly target the money supply. It instead allows the money supply to adjust as needed so that the interest rate is close to its target.

Figure 2 shows the actual Federal Funds rate over time. The FOMC does not set the Federal Funds Rate, it sets a target. That target is hit with error.[6]

Figure 1: Effective Federal Funds Rate



Hitting the target

So how does the FOMC achieve its interest rate target? We begin by considering how the FOMC did so when there were no ample reserves prior to 2008. Then, the demand curve for bonds was fairly steep.

Consider the following example. Short term interest rates are near the FOMC target of 2.00%. The FOMC meets and decides to lower their target to 1.75%. Recall that bond yields

[6]Source: St. Louis Fed.

are inversely related to bond prices. By buying Treasuries through open market operations, the Fed increases the demand for Treasuries, increasing their price. If the magnitude of the open market purchase is correct, prices will rise by the amount needed to meet the lower target.

Graph: Open Market Purchases.

The Fed pays for these bonds using newly created money. Most of the time, they simply increase the electronic reserves in the account of whoever sold the bonds to the Fed. So money is not literally printed most of the time. As the money supply increases, we see interest rates fall in our graph of the money market.

Graph: Money Market

Note that the interest rate falls in both graphs. Were we using algebra instead of graphs, we could show that the interest rate must fall by the same amount in both spaces.

Open market sales work in the opposite direction. Suppose that FOMC instead wants to raise interest rates. It then sells off some of its bonds in exchange for money. The demand for bonds is thus reduced, driving down bond prices, and interest rates up. Some money is removed from circulation in the process.

Graph: Open Market Sales.

Since 2008, financial institutions have chosen to hold excess reserves. Related to this, the demand curve for bonds has been quite flat. This means that increasing demand (shifting it to the right) has negligible effects on interest rates. The FOMC has thus developed two new tools to get interest rates to stay near their target:

1. Interest on excess reserves (IOER). Since 2008, the Fed has started paying interest on financial institutions' excess reserves. Recall that the Federal Funds Rate is the rate at which banks borrow reserves from other financial institutions. But the IOER rate should not be higher than the Federal Funds Rate. If it were, banks could make an easy profit by borrowing at the Federal Funds Rate and then collecting a higher rate of interest. IOER thus provides a ceiling on interest rates.

Suppose that this rate is 1%. Because any loan is riskier than collecting interest from the Fed, no bank will ever choose to lend at a lower rate. IOER therefore tries to set a floor on the actual interest rate.

2. Reverse-repo loans. The Fed also borrows from financial institutions. Because the Fed is the safest possible borrower, financial institutions will never offer anyone else a lower interest rate. The interest rate associated with these loans thus acts as a floor on the actual interest rate.

There are two related methods that the FOMC may use to affect interest rates. First, the Fed may change the interest rate at which it lends reserves to commercial banks. This *discount rate* is typically set at 0.25-0.5% above the prevailing Federal Funds Rate. A lower discount rate may induce banks to increase lending and thereby increase the money supply. Second, the Fed may lower the required reserve ratio. In practice, however, the Fed rarely tinkers with the required reserve ratio. It is instead set to ensure that banks have adequate reserves, not as a tool of monetary policy.

Channels of Monetary Policy

We now turn our attention to why the Fed affects interest rates. Recall that its legal mandate is to stabilize prices (interpreted as keeping inflation near 2%) and achieve full employment (interpreted a keeping unemployment near its natural rate). The quantity theory of money illustrates the connection between the money supply and inflation. So if the FOMC is worried that inflation is going to be above 2%, it has an incentive to raise interest rates which requires reducing the money supply and putting downward pressure on prices. If it is worried that inflation will be below 2%, that provides an incentive to lower interest rates, thereby increasing the money supply, and putting upward pressure on prices.

It is less clear why lower interest rates appear to increase employment in the short run. There are a few channels by which monetary policy works to do this:

1. Consider a business considering expanding its operations through investment. It will typically do this by issuing bonds to finance its investment. On these bonds, it will have to pay the risk free interest rate (i_t) plus what is known as a risk premium that compensates borrowers for the risk of default. Depending on the firm, this risk premium may be very small or quite large. Lower interest rates thus make borrowing cheaper and incentivize firms to undertake more of it. Lower interest rates thus increase investment through this channel.In our AS/AD model, this is an increase to aggregate demand.
2. Recall that new housing also counts as investment. Mortgage rates are a form of interest rate. As they decrease, there is a stronger incentive to build more new housing. This is another way in which lower interest rates induce more investment and boost aggregate demand.

3. Some consumption goods are also financed through debt. New cars are a good example. Lower interest rates may thus also incentivize additional consumption.

Collectively, #1-3 are known as the *interest rate channel* because they reduce the cost of borrowing at the risk free rate.

4. Firms and households rarely borrow at the risk free rate. They must also pay a risk premium that is based on the probability and cost of a potential default. But a lower risk free rate itself makes default less likely. Lower risk free rates mean lower monthly payments that are easier to make. This in terms causes lower risk premiums that further incentivize investment and consumption. This is known as the *credit channel* and is especially important during financial crises like that of 2008.

How the Fed chooses the right interest rate

We now consider a couple of examples. In the first, something has happened to reduce aggregate demand causing inflation and output to fall below their targets. One example is the 2008 financial crisis and recession which reduced investment and consumption.
Graph (AS/AD)

Here, the Fed will likely choose to lower interest rates in order to boost aggregate demand. If it is able to boost aggregate demand by the right amount, it can take inflation and output back to their long-run levels. if it overreacts, however, then it can move onto the steep part of the AS curve, which will lead to higher than desired inflation without much additional output.

Now consider a second example. Here something has happened to reduce aggregate supply. This causes there to be more inflation than we would like and less output.
Graph (AS/AD)

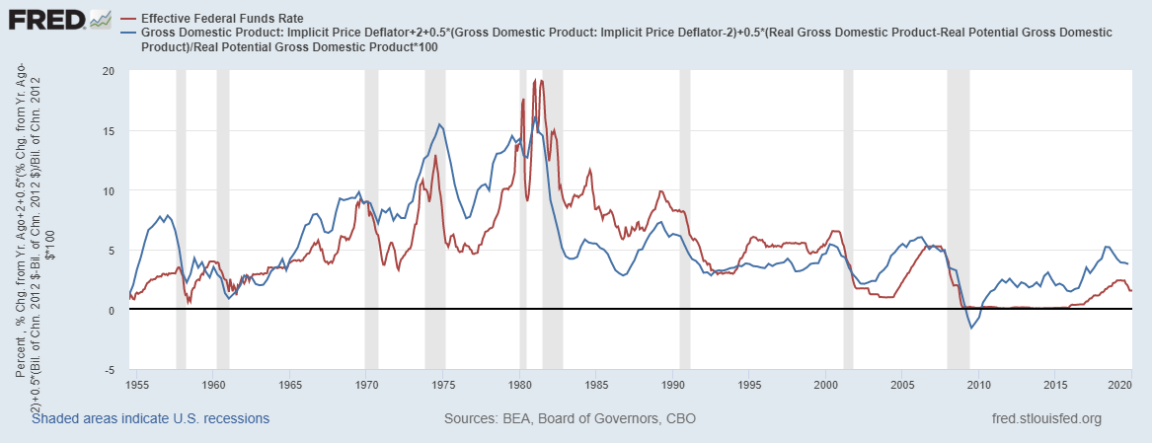
In this case, the FOMC faces a tradeoff. Lowering interest rates will boost aggregate demand. This will help with output, but make inflation worse. Raising interest rates (and reducing aggregate demand) will help with inflation, but further reduce output. This choice is similar to the challenge facing the Bank of England in 2020 as it tries to deal with Brexit.

To approximate how the FOMC deals with these issues, we can look at the *Taylor Rule*. This is a simple formula relating interest rates to inflation and either unemployment or output. The point isn't that the Fed actually uses this rule to set interest rates. Rather, it is an approximation of the choices that the Fed typically makes.

$$i = r^* + \pi + \frac{1}{2}(\pi - 2\%) + \frac{1}{2}(y - y^*) \tag{4}$$

The inclusion of r^* merits discussion. This, plus the inflation target (currently 2%) is known as the *neutral rate*. Like potential output,it is a hypothetical value that must be estimated using statistical methods. It represents the federal Funds rate consistent with full employment and 2% inflation. As of February 2020, most estimates put it around 2.5-3%. It has been declining in recent years because of slowing productivity growth.

Figure 2: Taylor Rule Compared to Federal Funds Rate



Short Term vs. Long Term Interest Rates

The investment and consumption decisions discussed earlier are typically based on intermediate or long term interest rates. The Federal Funds rate, however, is a short term interest rate. To understand why changing the latter may still influence the former, we can consider the relationship between short and long term interest rates.

Consider an illustrative example. I want to borrow for three years. This year, the interest rate is 1%. Next year, I expect it to be 2%, and the year after, 3%. I could just take three consecutive one-year loans. I will owe the following after 3 years:

$$\$1.01 * 1.02 * 1.03 = \$1.061 \tag{5}$$

Another possibility would be for the lender to give me a single 3 year loan with a constant interest rate. We could agree on an interest rate of 1.9967% so that I owe the same amount in both cases:

$$\$(1.019967)^3 = \$1.061 \tag{6}$$

We typically do expect people to be about indifferent between these two alternatives. Otherwise, we would not observe some people taking the first option while others take the second.

Now suppose that the Fed raises interest rates in the first year only to 3%. Now three consecutive, one-year loans yields:

$$\$1.03 * 1.02 * 1.03 = \$1.082 \tag{7}$$

And the long term interest rate needed to make me indifferent is also higher:

$$\$(1.026656)^3 = \$1.082 \tag{8}$$

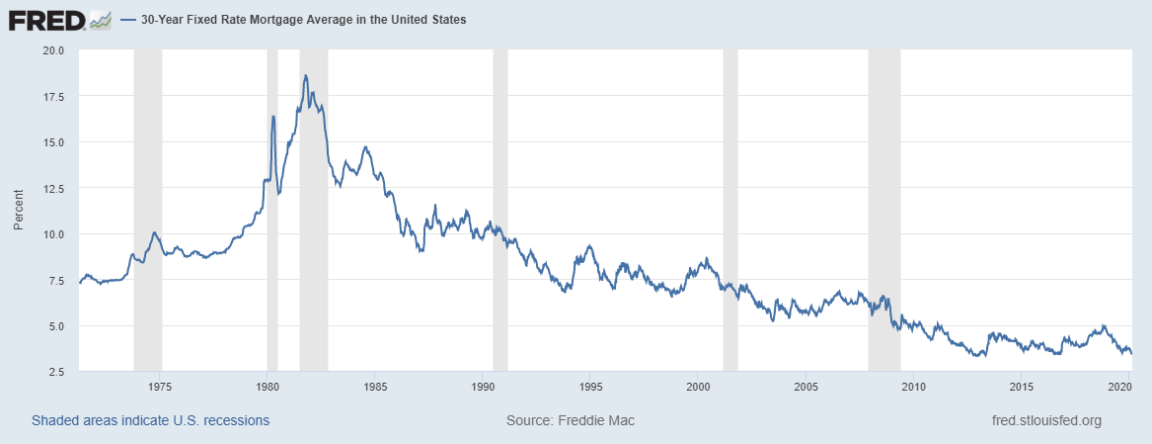
This example illustrates an important point. Long term interest rates are just the product of current and expected future short term interest rates. A policy that directly changes short term rates may also indirectly affect long term rates. Figure 3 provides an example, showing the 30 year mortgage rate in the United States. Note that it tracks the Federal Funds Rate data fairly well:[7]

The Liquidity Trap and Other Methods of Monetary Policy

After the Financial Panic of 2008, the FOMC lowered its target Federal Funds Rate to near zero. It cannot go significantly lower. There is no supply of credit at significantly negative interest rates because lenders could just hold their assets as money and earn a higher return than lending it out. A rational agent will not lend out $100 with the promise of being paid back $95 in a year.

[7]Source: St. Louis Fed.

Figure 3: 30 Year Mortgage Rates



This situation is known as a *liquidity trap* and it suggests that conventional monetary has exhausted its ability to boost aggregate demand and push towards full employment. Here, further open market operations just turn into excess reserves and not money. Faced with this situation, and an unemployment rate that was rising to 10%, the Fed and other Central Banks instituted a set of monetary policies that are less conventional:

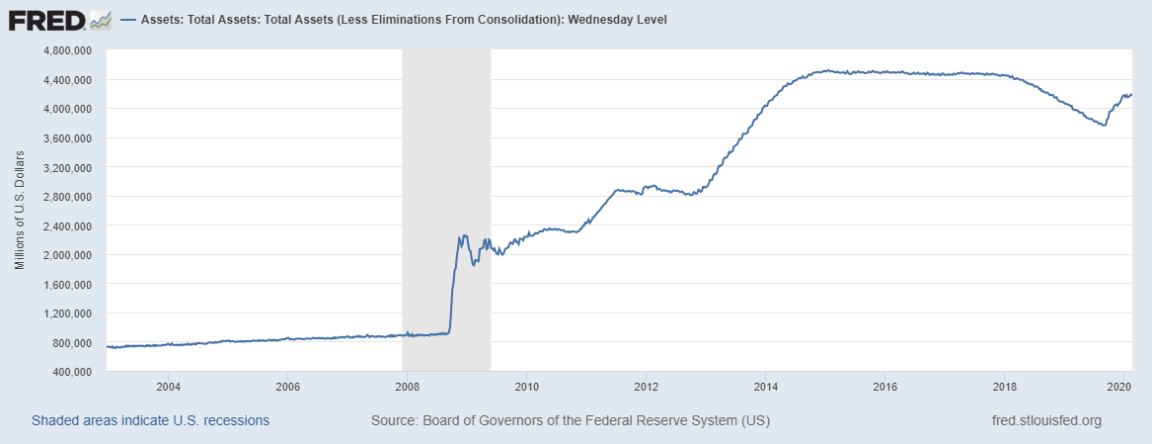
1. Quantitative Easing. Suppose that interest rates are already around zero so that open market purchases cannot lower them further. What if a Central Bank were to purchase large scale amounts of assets anyway. Such a policy is called "quantitative easing." It was conducted by several different Central Banks, including the Fed, in the aftermath of the 2008 financial crisis. The Fed has long acquired assets as part of its open market purchases. These assets are known as the Fed's balance sheet.

Quantitative easing (which was done in three rounds) saw the Fed increase its balance sheet from around $900 billion to about $4.5 trillion.

Importantly, when the Fed conducted QE, it also changed the types of assets that it typically purchased. Historically, the Fed has purchased short-term Treasury bonds almost exclusively. But the Fed switched what it owns to include mostly long-term Treasury bonds as well as mortgage backed securities, which are groups of households' mortgages bundled together.

How effective quantitative easing was, and why, remain controversial. The main argument for its effectiveness is that because it focused on long-term assets, it helped reduce long-term interest rates which determine far more economic decisions than short-term rates such as the Federal Funds Rate.

Figure 4: Fed's Balance Sheet



One common misconception is that quantitative easing increased the U.S. national debt. While the Fed (which is part of the government) did buy $ trillions in assets, it did not borrow to do so. We will soon see that purchases by the fiscal authority, not the monetary authority, are responsible for the recent surge in the national debt.

2. Forward Guidance. We discussed how long term rates are just a product of current and future short term rates. Under this policy, the Fed promised to keep future short term rates low. The promise has either been for a minimal amount of time, or until unemployment has fallen below a benchmark. By doing this, the Fed can lower long term interest rates immediately using only words. The FOMC issues a statement after each meeting. It has used these statements to provide forward guidance. Here is an example from its September 13, 2012 statement, it was usually explicit about future policy:

> To support continued progress toward maximum employment and price stability, the Committee expects that a highly accommodative stance of monetary policy will remain appropriate for a considerable time after the economic recovery strengthens. In particular, the Committee also decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that exceptionally low levels for the federal funds rate are likely to be warranted at least through mid-2015.

Forward guidance was a temporary policy. Usually, the FOMC prefers to be unclear about its plans beyond its next meeting or two. This was once again the case as of February 2020.

Quantitative easing may also have worked as a form of forward guidance. If people did not believe that the Fed would start raising interest rates until the Fed ended quantitative easing, then it may have helped lower long-term, interest rates by lowering expectations of future short-term interest rates.

Why 2%?

Another policy choice that the Fed makes is the target rate of inflation. The Fed, and other Central Banks, has chosen 2%. Why not 0?

1. Looking at (4) notice that a lower inflation target means a lower neutral rate. a 0% inflation target would give the Fed less ability to lower interest rates during a recession. This is why there has been some discussion about raising the inflation target.

2. As we discussed earlier in the course, low and uniform inflation does not cause many problems. The social costs of a steady, 2% inflation rate are thus low.

3. Later in the semester, we will see that deflation (negative inflation) is usually more costly than an equal sized inflation. a 2% inflation rate provides a larger buffer against deflation.