In the United States the Fed carries out monetary policy, and in this chapter we look at tools it uses to do so. Monetary policy can mean several different things and the vagueness of the term causes confusion from time to time. When we talk about monetary policy, we mean changes in the money supply. These changes may then have consequences for the price level, real output, the interest rate, and so forth; but we will refer to these as the results, effects, or consequences of the policy and not the policy itself.

The Fed also serves some functions other than setting the money supply. For example, the Fed regulates and supervises depository institutions. In this capacity the Fed examines banks, writes regulations, and, as it did in 1980, can impose certain types of restrictions on bank lending. These other functions are important, but considering them would lead us too far afield.

**Some Measurement Issues**

Up to now we have defined the money supply as the currency in circulation. The introduction of banks and the Fed requires a modification of this definition. Banks, and now all depository institutions, can hold deposits at the Fed. These deposits are very close substitutes for currency. Just like cash, they do not pay interest. Also like cash, deposits at the Fed are an asset to the bank; and a liability to no private household or business. Moreover, the deposits at the Fed can be turned into cash very quickly and without fail. The bank can just call the Fed, tell it to reduce its account by, say, $1 million, and send $1 million in currency over to the bank. The Fed cannot be caught short of currency because it has the power to issue new notes. Since a deposit at the Fed is a very close substitute for cash, we add the two together as if they were the
same. The result is the **monetary base**, which is sometimes called **high-powered** money. We summarize

\[ \text{monetary base} = \text{currency} + \text{deposits at the Fed}. \]

Some economists use another definition of money. They focus on the funds that households and businesses have ready to spend. Since they are interested in households and businesses, they take out deposits at the Fed and currency held by banks, but, since they are interested in readily spendable funds, they include checkable deposits. This definition of money is called M1, and is given by

\[ M1 = \text{currency held by the non-bank public} + \text{checkable deposits}. \]

Other economists object to this definition because checkable deposits differ in at least two important ways from currency. First, many checkable accounts, unlike cash, pay interest or give the holder access to various services, ATM machines for instance. Second, if you have $500 in your checking account, it is an asset to you, just like $500 in cash; but, unlike cash, it is a liability to other private citizens. More specifically, your $500 deposit represents a liability, a debt, to the owners of the bank. In short, currency represents net wealth to economy, but deposits in checkable accounts do not. Since checkable deposits differ from currency, these economists object to adding the two together. Nevertheless, many economists prefer to work with M1.

Other economists go further, and prefer a broader concept of money than M1. They believe that, for example, savings accounts are good substitutes for checking accounts, and so they should be included in the definition of money. This definition of money also includes some less familiar items: (1) small, which means less than $100,000 here, time deposits, (2) money market deposit accounts, (3) shares of money market mutual funds held by non-institutional investors, (4) overnight repurchase agreements, and (5) overnight eurodollar deposits. **Time deposits** are interest earning accounts that have a maturity date, and withdrawal of funds before this date results in a penalty, usually the loss of the interest payment. Examples of time deposits are Christmas club accounts, and certificates of deposits (CDs). Banks also offer **money market deposit accounts**. These accounts typically pay higher interest rates than checkable deposits,
but allow only a few checks to be written on them each month. A **mutual fund** pools the funds of many small investors. The pool or fund hires professional investors to buy and sell assets and manage a portfolio. In a **money market mutual fund** the fund restricts itself to buying low risk assets that mature within a year. In the definitions below money market mutual funds are broken into two groups: 1) funds that are managed for non-institutional investors, for example households and 2) funds that are managed for institutional investors, insurance companies for example.

Repurchase agreements and eurodollar deposits are more esoteric still. In an **overnight repurchase agreement** a bank sells government securities to one of its depositors for, say, $10,000,000, but promises to buy them back, or we could say repurchase them, at the beginning of the next business day for, say, $10,002,600. The $2,600 represents an interest payment on the $10,000,000. You may be excused for thinking that this is a very odd arrangement. These agreements originated at a time when banks could not pay interest on deposits, and they allowed banks to circumvent these laws.

**Eurodollar deposits** are dollar denominated deposits held outside the United States. For example, a $1,000,000 time deposit in a bank in London or Hong Kong would be a eurodollar deposit. Why would someone want a dollar deposit held in London? Why not have the deposit valued in British pounds? After World War II the United States was the dominant economy, and the dollar became the dominant currency in international trade. This made it convenient for foreign firms to hold dollar deposits. The Soviet Union wanted to engage in international trade too, but did not want to hold dollar deposits in the United States. Why? The cold war had begun, and if the Soviets held deposits in the U.S., it would give the U.S. leverage in a confrontation. Not soon before, German deposits had been frozen at the beginning of the World War II. To avoid this threat the Soviets held dollar denominated deposits with a bank in France. The market for eurodollars then spread as a convenient way for traders to hold and swap assets. Eurodollar deposits also became another way to pay interest on deposits. U.S. banks would open offshore branches or subsidiaries abroad. At the end of the business day a U.S. bank would transfer the deposits of one of its large customers to an account in, say, the Cayman Islands. These islands are not subject to U.S. law so the Cayman branch could pay interest on the eurodollar deposits. The deposits are then returned to the U.S. bank at the beginning of the next business day. To summarize:
\[ M2 = M1 + \text{savings deposits} + \text{small time deposits} + \text{overnight repurchase agreements and eurodollar deposits} + \text{shares in non-institutional money market mutual funds} \]

The definitions don't stop here. There is an M3 that includes M2 plus large time deposits, shares of money market mutual funds held by institutional investors, and term repurchase agreements and eurodollar deposits; and it continues on. A concept labeled L includes all of M3 plus short-term treasury securities and some other short-term financial instruments.

It turns out that many of these instruments have fascinating histories as clever ways to serve particular customers and to avoid the regulator's hand. However, they are the topics for a course in money and banking. We only present the definitions here because they are often reported in the financial press and you should be exposed to their meaning. When we talk about money, we mean the monetary base.

**The Policy Tools**

There are three main policy tools in the hands of the Fed, and we have already introduced them in the previous chapter. The three tools are:

1) the discount rate
2) reserve requirements
3) open market operations

We now turn to the details of each.

\textit{a. the discount rate}

As we mentioned earlier, the discount rate is the interest rate the Fed charges on loans that it makes to banks. In the early days of the Fed the discount rate played an important role in monetary policy. If the Fed wanted to increase the money supply, it would lower the discount
rate. The lower discount rate would encourage banks to borrow from the Fed. When the borrowing occurred, the Fed issued new currency in making the loan, and the money supply increased. Raising the discount rate would contract the money supply.

Originally the regional Feds set their own discount rates, and this gave them a good deal of power. Over time, however, local credit markets have become integrated into a national one, and different regional rates are no longer viable. Moreover, any discount rate change must now be approved by the Board of Governors. In practice, the FOMC decides discount rate changes at its meetings.

Fed lending has also changed over time. The Fed still makes loans to banks that have short-term liquidity problems. It also lends to some smaller banks in tourist or agricultural areas where loan demand is seasonal, and local banks do not have access to national credit markets. For example, the Fed made substantial loans in 1984 to the very large Continental Illinois Bank of Chicago when the Chicago bank suffered severe liquidity problems because of loan defaults. However, the Fed will not, in general, lend to others. In particular, it will not lend, or at least continue to lend, to banks that want to profit from the differential between the discount rate and the rate at which the bank can lend.

What is the purpose of the discount rate today? Many argue that it acts as a signal through which the Fed can announce its intentions to the public. For example, suppose the public fears that inflation is about to accelerate. The Fed may increase the discount rate to allay these fears. Discount rate changes receive considerable publicity, and would signal to the public that the Fed takes the problem of inflation seriously. On the other hand, if the economy turns toward recession, the Fed may lower the discount rate to convey its concern and willingness to act to counter the downturn. Though this signaling function is useful, the discount rate no longer serves as a primary tool to change the money supply.

b. reserve requirements

The Fed obtained the power to set legal reserve requirements for its member banks in 1935. The power was expanded to include all depository institutions in 1980. Changing reserve requirements has a powerful influence on the lending behavior of banks. For example, suppose the required reserve ratio is 15%. This means a bank that has $5,000,000 in deposits must hold
$750,000 as reserves in its vault or as deposits at the Fed. The bank can lend the remaining $4,250,000. Now, if the Fed lowers the required reserve ratio to, say, 10%, required reserves fall to $500,000, and the bank can make $250,000 worth of new loans. Lowering the reserve ratio increases the amount of lending that banks can do, and typically banks welcome reductions in required reserve ratios, but oppose increases.

However, any change in reserve requirements, up or down, can be very costly for banks. Banks must carefully manage their assets in order to meet these legal requirements, and changes in the law are followed by costly adjustment periods as bankers learn how best to meet the new requirements. Frequent changes in required reserve ratios would be very disruptive, and would make bank management a more difficult task than it already is. So, though changes in the required reserve ratio can have powerful effects, they are seldom used as a tool of monetary policy.

We must pause here to confess that we have strayed from our definition of monetary policy. We have included the setting of the reserve requirement as a tool of monetary policy even though changes in it do not affect the monetary base. Instead, the reserve requirement is like a tax. If the Fed raises the reserve requirement, then some assets must be held as reserves instead of loans, and will not earn interest. Higher reserve requirements lower bank profits just like a tax and are an aspect of the Fed's regulatory function. Nevertheless, changes in reserve requirements are usually discussed under the heading of monetary policy because they can have strong effects on bank lending.

c. open market operations

We listed three monetary tools, and have concluded that the first two are either no longer powerful or not used very often. The third had better be important, and indeed it is. Open market operations, the buying and selling of government securities, are far and away the most important monetary policy tool in the hands of the Fed.

To see how the purchase of a government security changes the money supply, suppose that the Fed buys a government bond from you for $100. You hand over the bond to the Fed, so there is one less government bond in the hands of the public. The Fed pays you by issuing a new
$100 bill, and the stock of money increases by $100. When the Fed buys a government security, the money supply increases. This is shown schematically in Figure 20.1.

Now suppose the Fed sells $100 worth of government bonds to the public. When the buyer receives the bond, she pays with $100 in cash, and the supply of currency falls. There is one less $100 bill in circulation, and one more in the stacks at the Fed. When the Fed sells government securities, the money supply declines.

We could complicate the story a little bit, and let the Fed pay or receive payment by check. This would not change our result. Suppose in the above example the Fed wrote you a check instead of giving you a crisp new bill. You would take the check to your bank, and deposit it in your account. That ends the story so far as you are concerned, and if we stopped here, it would look as if the money supply did not change. But the story continues. Your bank will present the check to the Fed. At this stage the Fed just adds $100 to your bank's deposits with them. But remember, deposits at the Fed are very close substitutes for currency and we count them in the money supply. So, if the Fed pays you with a check, the monetary base increases by the same $100 that it would have had the Fed pay you in new currency. The only difference is that the increase shows up as an increase in deposits at the Fed instead of a larger stock of currency.

**Extension: The Money Multiplier**

Many economists closely monitor M1 and M2. Though these measures are conceptually distinct from the monetary base, they are linked to the base through the money multiplier. The
key to understanding this multiplier is in understanding multiple deposit creation and we turn to this task now.

Consider Bank A, a fractional reserve bank with a reserve ratio of 10% and deposits of $5 million. This means that the bank currently holds $500,000 in reserves. Now, suppose that Zack, a depositor at Bank A, finds $10,000 in cash buried in his back yard. Zack would probably take some of the money and throw a big party, but to keep things simple suppose he rushes down to the bank and deposits his bonanza. All of the sudden Bank A has $10,000 more cash in its vault. It will want to keep 10% of this amount on reserve to back the new deposit. What will it do with other $9,000? Banks are in the business of lending and when they find a willing borrower, a new loan will be issued.

Suppose Susan comes by Bank A to see if she can get a loan for a new motorcycle. It turns out that she needs $9,000. Susan has fine credit and Bank A lends her the funds. There are many ways for the bank to transfer the funds to Susan. If she is a depositor of the bank, $9000 could be credited to her account, or Bank A could issue her a check. For simplicity, let's assume that she takes the loan in cash and goes directly to Jake's Cycle Shop. She buys her bike and roars off.

Jake now has $9,000. He banks at Bank B and deposits his cash there at the end of the day. Bank B is also a fractional reserve bank with a reserve ratio of 10%. The bank will keep $900 of Jake's new deposit in reserves and will try to lend the rest. As it happens, Scott is on his way to Bank B for a loan of $8,100 to buy a hot tub. When he arrives with a stellar credit report Bank B is happy to lend him the money. Scott takes the $8,100 in cash and heads down to Pat's Hot Tub Bazaar where he plucks it down for a snazzy new tub. At the end of the day Pat deposits the money in her bank, Bank C.

You can see how this story is going and it is a good time to summarize the action. Table 20.1 records the loans, deposits, and the reserves for each transaction. There are two question marks because we stopped just as Bank C received a new deposit. What will they do?

<table>
<thead>
<tr>
<th>Table 20.1</th>
<th>Multiple Deposit Creation</th>
</tr>
</thead>
<tbody>
<tr>
<td>deposit</td>
<td>loan</td>
</tr>
</tbody>
</table>
Bank C will keep 10% on hand as reserves, which amounts to $810 now, and loan out the remaining $7,290. And where will this $7,290 end up? After it is spent by the borrower, Bank D will have it in their vault.

Now let's see how many dollars of deposits have been created. The initial deposit of $10,000 set off a chain of events that has so far accounted for an increase in total deposits of

$$34,390 = 10,000 + 9,000 + 8,100 + 7,290$$

But the story doesn't stop here. It keeps going and going and going. How can we find the total amount of deposits that will ultimately be created in this infinite progression? Notice that each new deposit is 90% of the previous one: $9,000 = .9 \times 10,000, \$8100 = .9 \times 9,000$, and $\$7,290 = .9 \times 8,100$. This means that we can write the total amount of new deposits as

$$\text{total new deposits} = 10,000 + .9 \times 10,000 + (.9)(.9)10,000 + (.9)(.9)(.9)10,000 + ...$$

$$= 10,000(1 + .9 + .9^2 + .9^3 + ...).$$

The sum in parentheses may be recognized as a geometric sum and it has the solution

$$1/(1-.9) = 1 + .9 + .9^2 + .9^3 + ...$$

or

$$10 = 1 + .9 + .9^2 + .9^3 + ...,$$

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34 This solution turns out to be straightforward, as these things go anyway, to find. A geometric sum, S, is given by $S = 1 + x + x^2 + x^3 + ...$. This sum converges to a number so long as the absolute value of x is less than one. Whatever this sum is, multiply it by x to get $xS = x + x^2 + x^3 + ...$. Now all we do is to subtract $xS$ from S to get $S-xS = 1$, because the x and $x^2$ and $x^3$ and so on will cancel out. Now just factor out the S to get $S(1-x) = 1$ and divide to get $S = 1/(1-x)$. In the present case x equals .9 so that $S = 1/.1$ or $S = 10$. 

<table>
<thead>
<tr>
<th>Bank A</th>
<th>$10,000 (Zack)</th>
<th>$9,000 (Susan)</th>
<th>$1,000 (Bank A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank B</td>
<td>$9,000 (Jake)</td>
<td>$8,100 (Scott)</td>
<td>$900 (Bank B)</td>
</tr>
<tr>
<td>Bank C</td>
<td>$8,100 (Pat)</td>
<td>$?</td>
<td>$?</td>
</tr>
</tbody>
</table>
and so

\[ \text{total new deposits} = (10)\$10,000 \]

or

\[ = \$100,000. \]

This result may be obtained with less pain, but also with less insight. To see how, let \( CD \) be the checkable deposits in the economy, \( RR \) be the dollar value of reserves, and let \( \rho \) be the reserve ratio. By the definition of the reserve ratio we have

\[ RR = \rho \cdot CD. \]

We take the reserve ratio to be constant (in the example it was .1 or 10%). This means that

\[ \Delta RR = \rho \cdot \Delta CD \]

or

\[ \frac{\Delta RR}{\rho} = \Delta CD. \]

In the example the change in reserves is the $10,000 that Zack found and \( \rho \) was .1 so that the change in deposits is the same $100,000 that we found above.

Just a bit more algebra provides the link from the monetary base to the M1. Recall that M1 is the sum of currency held by the public, which we write as CP, and checkable deposits, which is again CD. The monetary base is \( B = CP + RR \), the sum of currency held by the public and bank reserves. Two ratios are important: the reserve ratio \( rr = RR/CD \) and the currency-to-deposit ratio \( k = CP/CD \). The last ratio reflects the relative demands for cash and deposits. For example, a rumor of a bank panic will sharply increase \( k \), while the spread of credit cards will tend to decrease \( k \).

Now we are ready to derive the money multiplier. We first write out the definition of M1 and the monetary base
\[ M1 = CD + CP \]

\[ B = CP + RR. \]

The reserve and currency-to-deposit ratios imply that

\[ CP = k \cdot CD \]

\[ RR = rr \cdot CD. \]

We can substitute these expressions into the definitions of \( M1 \) and the monetary base to get

\[ M1 = CD + k \cdot CD = (1 + k)CD \]

\[ B = kCD + rr \cdot CD = (k + rr)CD. \]

Dividing the base by checkable deposits gets us

\[ \frac{B}{(k + rr)} = CD \]

and substituting this expression for checkable deposits into the definition of \( M1 \) yields

\[ M1 = \left[ \frac{(1 + k)}{(k + rr)} \right] B. \]

The term in brackets is called the \( M1 \) money multiplier. It is the link from the base to \( M1 \) in the sense that if you know the base and the multiplier, then you can calculate \( M1 \). It is important to note that if the currency-to-deposit ratio and the reserve ratio are relatively stable, then the money multiplier is also stable and the growth rate in the base and the growth rate in \( M1 \) will be very similar. In this case the practical difference in following \( M1 \) or the base is small.
However, there are times when the two measures behave in dramatically different ways. For example, in December of 1929 the currency-to-deposit ratio was about .17 and the reserve ratio was about .14. These numbers imply that the money multiplier was about 3.77 and since the monetary base was about $7 billion dollars M1 stood at about $26.4 billion. Over the next four years the U.S. experienced the worst series of banking panics in its history. By 1933 the panics had driven the currency-to-deposit ratio up to .33 and the reserve ratio to .21. The money multiplier in December of 1933 was therefore about 2.46, only two-thirds its 1929 value, and even though the monetary base increased over the same period to $8.3 billion, M1 fell to about $20 billion. During this period an increase in the base of a bit over 4% per year occurred at the same time that M1 was falling at a rate of about 6.5% per year!

Summary

In our analysis of the effects of changes in the money supply we assumed that the money supply was changed by "helicopter" drops of currency. In this chapter we landed the helicopter. The Fed controls the money supply, and, though the Fed has several alternatives, the most important control it uses is open market operations.

Review Questions

1) In what ways are checkable deposits like bonds? In what ways are they like money?

2) What would happen today if one regional Fed set its discount rate at 5%, while another regional Fed set its at 5.25%.

3) What would happen to the money supply if:

   a) the Fed sells $5,000,0000 of government bonds to the public

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35 These numbers are found or derived (using the money multiplier in the text) from figures in the appendices of Milton Friedman and Anna Schwartz A Monetary History of the United States, 1867 - 1963 Princeton University Press, Princeton, N.J., 1963.
b) the Fed raises the discount rate from 6% to 6.5%
c) the Fed decreases the reserve requirement from 15% to 10% (this is a trick question)