Chapter 9

Money, Interest Rate Determination, and Monetary Policy

> All the Perplexities, Confusions and Distresses in America arise not from defects in their Constitutions or Confederation, not from a want of Honour [*sic*] or Virtue, So much as from downright Ignorance of the Nature of Coin, Credit and Circulation.[1]

Chapter Introduction

In Chapter 8, we learned about the Federal Reserve System (the Fed), the central bank of the United State. We learned that the Fed is responsible for the conduct monetary policy—changes in the money supply. In this chapter, first we define what money is, and then we go into the details of the conduct of monetary policy; we look at how the Fed uses various tools at its disposal to conduct monetary policy. After learning about money supply, we learn about money demand and how the interest rate is determined.

Definition of Money

While the phenomenon of money is ubiquitous—we use money to buy goods and services several times a day—the concept of money remains confusing for many. This confusion leads many to fall prey to various fads. At the time of this writing, cryptocurrencies (e.g., Bitcoin, Ethereum, among others) have captured the attention of many. It is important, then, that we clearly understand what money is and what it is not.

For an asset to function as money, it must have the following three characteristics.

- A Medium of Exchange
- A Unit of Account
- A Store of Value

As we will see in the coming pages, that asset may or may not have an intrinsic value. By having an intrinsic value, we mean that it may be useful for other purposes, other than money.

[1] Letter of John Adams to Thomas Jefferson. John Adams and Lester J. Cappon. *The Adams-Jefferson letters : the complete correspondence between Thomas Jefferson and Abigail and John Adams.* Chapel Hill, North Carolina] ;: Published for the Omohundro Institute of Early American History and Culture, Williamsburg, Virginia, by the University of North Carolina Press, 1987. Web.

Let us go into more details about each of these characteristics. Before moving on, however, let us clarify what do we mean by an asset? As asset is anything that is subject to ownership. A house is an asset, and so is a piece of paper with a particular writing and other markings and a likeness of Abraham Lincoln, i.e., a five-dollar bill. As we will see shortly, certain forms of assets are better at serving as money than others.

Now that we have defined what an asset is, let us now look in greater detail each of the three characteristics that must be present for an asset to serve as money.

A Medium of Exchange

By "A Medium of Exchange" we mean that economic agents are willing to exchange goods and services in exchange for this asset, whatever that asset happens to be. If the seller of a bottle of wine accepts US dollars or British pounds or euros, either of these will serve as a medium of exchange.

What if the vintner accepts a pound of meat in exchange for a bottle of wine? Will meat be considered a medium of exchange? The answer is, yes. A system where goods and services are exchanged for other goods and services is called a barter system. As we will see, the reason modern economies have moved on from barter system is the convenience that modern forms of money present.

A Unit of Account

"A Unit of Account" refers to the quality of this asset being used as a yardstick. That is, economic agents can evaluate goods and services in terms of this asset; they can quote prices in terms of this asset. In other words, this asset serves as a numeraire. Note that a medium of exchange and a unit of account are related. For the exchange to take place, the buyers and sellers must be able to evaluate they goods and services that the sellers are selling, and the buyers are buying.

A Store of Value

"A Store of Value" characteristic refers to this asset have the quality that economic agents can transfer purchasing power from one time-period to another in terms of that asset. That is, it serves a temporary resting place of purchasing power to bridge the gap between the sale of one item and the purchase of another.

Suppose that a potato farmer has a crop of potatoes in 2020. The crop has some purchasing power that she wants to use to buy a tractor, in six months, to till the land. She estimates, however, her tractor will work fine for another six months. Suppose also that a local tractor seller and the potato farmer agree on the price of tractor in terms of potatoes, say, 1,000 pounds of potatoes for the tractor. The farmer, however, does not want to buy the tractor today; she wants to wait for another six months. She wants to bridge the gap between the time when the crop of potatoes is ripe and the time when she wants to buy the tractor. If she were to leave the potatoes in the field, the potato crop will rot, and the purchasing power will be zero. She could keep the crop in a cold-storage facility. The cost of keeping these potatoes for six months in a cold-storage facility, however, could be substantial. Either way, she will lose quite a bit of the purchasing power in potatoes. Potatoes, in other words, do not serve as a good store of value. As a result, potatoes are not a good form of money.

Barter System and Its Infeasibility

In a system where buyers and sellers exchange goods and services for other goods and services, it is called a barter system. We used the example of the potato farmer exchanging 1,000 pounds of potatoes for a tractor. That is an example of barter. There are a few issues with barter system.

Double Co-Incidence of Wants

For the trade to take place, the seller must want what the buyer has to offer in exchange. If the seller of the tractor, in our example, does not want potatoes, the trade cannot take place. Furthermore, there are numerous types of potatoes, which differ in color, taste, size, and so on.[2] Not surprisingly, there are numerous kinds of tractors as well—brand, size, horsepower, usage, etc. For this transaction to take place, the seller of tractor must want the type of potatoes that the famer has to offer, and the farmer must want the kind of tractor that the tractor seller has to offer.

Recall the second characteristic that something that can serve as money, must have; A Unit of Account. For something to serve as money, the buyers and sellers must be able to evaluate goods and services in terms of that something. Given the vast variety of goods and services that exist in any modern economy, and the various kinds of goods and services buyers buy, and sellers sell, barter becomes extremely hard rather quickly.

To appreciate the infeasibility of a barter system, suppose that there are only ten goods in a hypothetical economy. Label these goods as Good 1, Good 2, …, and Good 10. Suppose that each good comes only in one quality, size, shape, color, etc. Suppose also that sellers of these goods are also the buyers of other goods. That is, sellers of Good 1 consume Good 2, Good 3, …, and Good 10. And the sellers of Good 2 consume Good 1, Good 3, and so on.

In this simple economy, with only ten goods, if buyers and sellers of these goods want to exchange goods for other goods (i.e., barter), the sellers of Good 1 must be able to evaluate Good 1 in terms of Good 2, Good 3, Good 4, …, and Good 10. Same goes for the sellers of Good 2; they must be able to evaluate Good 2 in terms of Good 1, Good 3, …, and Good 10. The number of evaluations that must be made in this simple economy is 45. That is, the number of prices that must be calculate is 45. Here is the formula:

$$\frac{n(n-1)}{2} \tag{9.1}$$

Where n is the number of goods to be evaluated, in this example $n = 10$. Some of you may recognize this formula from your basic statistics class. Suppose now that the number of goods and services in this hypothetical economy increases to 100. The number of prices that must be

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[2] Types of potatoes. (*Lost crops of the Incas little-known plants of the Andes with promise for worldwide cultivation*1989)

calculates increases to 4,950. Notice how quickly the number of prices one must calculate increases with the increase in the number of goods and services.

Divisibility Quality and Barter

Divisibility in this context refers to the quality of dividing something into smaller pieces while each piece maintaining its proportional value. This is another important quality that highlights the infeasibility of barter in the modern economy.

Take a simple example. Suppose that you have a car which is worth $15,000, and the going price of a dozen eggs is $4.00. You want to use your car to buy a dozen eggs. That is, you want to use your car as money. Suppose also that the poultry farmer wants your car, and you want the kind of eggs that the poultry farmer is selling, so that the issue of double co-incidence of wants is settled. Given these prices of your car and a dozen of eggs, your car in terms of eggs is worth 3,750 dozen eggs. But you only want to buy one dozen eggs. If you were to divide your car into 3,750 pieces, it will not be a car anymore; each piece will quite likely not be worth $(1/3{,}750)^{th}$ of the car. In other words, a car does not have the divisibility quality; each part does not maintain its proportional value. A dollar divided by 100 is, i.e., a penny, maintains its proportional value.

Reductio ad Absurdum Revisited

You may argue that if you lowered the price of your car enough so that you don't have to divide the car into 3,750 pieces. That is, you are willing to exchange your car for a dozen eggs. Yes, you may find someone who will sell you a dozen eggs in exchange for your car, but that will be an extremely expensive dozen of eggs since a car usually is worth a lot more than a dozen eggs. Indeed, in this extreme example, the double co-incidence of wants requirement no longer holds. But this runs into an absurd scenario. Recall the concept of *reductio ad absurdum* from Chapter 1. Recall that it is, indeed, a good practice to look at all the extremes when formulating a plan, one must, however, keep in mind what is probable.

Types of Money

Along one dimension, money may be divided into two main types. These are commodity money and non-commodity money.

Commodity money is the kind of money that has some intrinsic value. That is, it can be used for some other purpose as well. Over the recorded human history, most forms of money have been commodity monies. Humans have used precious metals—gold, silver, etc.—and precious stones as money. Tobacco, skins and hides, furs, and food grain have been used as money as well. All these objects can be used for some other purpose as well; food grain can be used for sustenance, fur can be used to stay warm, and so on. All these objects have intrinsic value.

Non-commodity money, on the other hand, does not have any intrinsic value. Its sole purpose is to serve as money—a medium of exchange; a unit of account; and a store of value. Fiat money is one form of non-commodity money. It is money because some central authority, usually the government, by fiat, says it is money. Fiat money is the most common form of money in any modern economy.

Often the term "legal tender" is used to refer to fiat money. When a government states that a particular piece of paper of a given size, with such and such printing, is worth this much, and that it must be used as money, it becomes legal tender. In the US, dollar bills of various denominations, are legal tender. If you look at any denomination US dollar bill, it states the following. "THIS NOTE IS LEGAL TENDER FOR ALL DEBTS, PUBLIC AND PRIVATE."

In principle, any financial asset that has the characteristics we just discussed—a medium of exchange; a unit of account, and a store of value—can be considered non-commodity money. Certain forms of financial assets, however, serve better as money than other. For instance, a five-dollar bill is more acceptable to the grocer for, say, a dozen eggs than is saving bond that you received from your grandparents on your birthday. (We will go into more detail about bonds in the coming pages.) Following closely behind cash is a check written on your bank account deposits. The reason is that the grocer can exchange cash or a check for the goods and services that she needs to buy.

The ease with which an asset can be converted into another asset is called liquidity. The easier it is to convert an asset into another asset, the more liquid it is. In our example, a five-dollar bill is more liquid than a check written in the same amount, and a check is more liquid is than a saving bond in the same amount.

In defining money, we mentioned that for an asset to serve as money, it must have three characteristics—a medium of exchange, a unit of account, and a store of value. Can a house be that asset? Can a house be used as money? The answer is "yes;" So long as a house can serve as medium of exchange, a unit of account, and a store of value. The reason that houses are not used as money is that houses are not very liquid; you cannot just sell a house at a moment's notice to buy breakfast. You may argue that if you lowered the price of your house enough, *someone* will step in and buy the house right away. Again, this scenario runs into *reductio ad absurdum*; a house is usually worth a lot more than a breakfast.

Note also that while a house may be a lot better store of value, it is not divisible. Once divided, each part does not maintain its proportional value. While a five-dollar bill may not be a good store of value, especially during times of high inflation, it is divisible into 500 pennies, and each penny maintains its proportional value. Because of these considerations—divisibility and liquidity—fiat money is the most used form of money in modern economies.

Based on the liquidity property of various assets, economists, at present, divide various financial assets into two main aggregates—M1 and M2. According to the Federal Reserve,[3]

> M1 consists of (1) currency outside the U.S. Treasury, Federal Reserve Banks, and the vaults of depository institutions; (2) demand deposits at commercial banks (excluding those amounts held by depository institutions, the U.S. government, and foreign banks and

[3] M1 and M2 components of money. https://www.federalreserve.gov/releases/h6/current/default.htm. (Accessed: January 3, 2023)

> official institutions) less cash items in the process of collection and Federal Reserve float; and (3) other liquid deposits, consisting of other checkable deposits (or OCDs, which comprise negotiable order of withdrawal, or NOW, and automatic transfer service, or ATS, accounts at depository institutions, share draft accounts at credit unions, and demand deposits at thrift institutions) and savings deposits (including money market deposit accounts). Seasonally adjusted M1 is constructed by summing currency, demand deposits, and other liquid deposits, each seasonally adjusted separately.

And

> M2 consists of M1 plus (1) small-denomination time deposits (time deposits in amounts of less than $100,000) less individual retirement account (IRA) and Keogh balances at depository institutions; and (2) balances in retail money market funds (MMFs) less IRA and Keogh balances at MMFs. Seasonally adjusted M2 is constructed by summing small-denomination time deposits and retail MMFs, each seasonally adjusted separately, and adding the result to seasonally adjusted M1.

There used to be other broader monetary aggregates as well. These were MZM, M3, and L. MZM (Money Zero Maturity) included, "M2 less small-denomination time deposits plus institutional money market funds."[4] M3 monetary aggregate included,[5]

> M2 plus large time deposits (those issued in denominations of $100,000 or more, net of the holdings of domestic banks, thrift institutions, the U.S. government, money market mutual funds, and foreign banks and official institutions), and term RE's [Repurchase agreements] at commercial banks and thrift institutions, net of term RE's held by money market mutual funds.

And L monetary aggregate included,

> M3 plus the non—bank public's holdings of U.S. savings bonds, short—term Treasury securities, commercial paper and bankers acceptances (which excludes money market mutual fund holdings of these assets). In addition, two addenda were included on the 11.6 release, overnight RPs

[4] MZM components. https://fred.stlouisfed.org/series/MZMNS. (Accessed: January 3, 2023.)
[5] Components of M3 and L. (Kavajecz, 1994, p.53)

at commercial banks plus overnight Eurodollars and money market mutual fund share.

The Fed stopped publishing data for three monetary aggregates, MZM, M3, and L, over time. These days the data that the Fed regularly publishes are M1 and M2. Note that since M1 is included in M2, all components of M1 are also part of M2. And since M2 is part of M3, all components of M2 are also part of M3, and so on.

When economists talk about money supply, they are referring to M1 and M2 monetary aggregates. Note that in all monetary aggregates we have included checking accounts, saving accounts, and other financial instruments that depository institutions offer. Just looking at the components of these monetary aggregates, one can see that the larger the amount held in, say, checking accounts, the larger the money supply.

How does the amount in checking account change? As we will see shortly, there are three main economic agents that play a role in the conduct of monetary policy. These are the Fed, commercial banks, and general public, which include firms and households. Note that foreign governments also buy bonds. For the sake of simplicity, we include those in general public.

How Do Banks Create Money? A Look Back

Banks create money by issuing more loans than they have deposits.

To appreciate the process of money creation, let's take a brief look back at the 15th and 16 centuries when gold was the main form of money. Gold, however, is inconvenient to carry around and susceptible to theft. Since not everyone had a safe in their homes, people would keep their gold with goldsmiths for safekeeping purposes. Goldsmiths would charge safekeeping fee and issue receipts to the depositors. Suppose that in an economy there were 100 ounces of gold at time *t*. Since gold is the main form for money in this economy, the quantity of money is 100 ounces at time *t*.

Suppose also that everyone kept gold with some goldsmith for safekeeping, and the goldsmith had issued 100 receipts, one receipt for each ounce of gold. At time *t* then there are 100 receipts, each representing one ounce of gold. Whenever someone needed to make a transaction, she/he would go to the goldsmith, present the receipt, get the gold, and make the transaction. Soon people realized that so long as the receipts were honored by the goldsmith who issue the receipts—they were "as good as gold"—it would be convenient to make transactions using the receipts. Indeed, that is what people in the 15th and 16th centuries economies started doing; they started making transactions using receipts. Receipt issued by goldsmiths became the de facto money. Recall from the definition of money, it serves a medium of exchange, a unit of account, and a store of value. All three functions were being served by receipts issued by goldsmiths. Gold was just sitting in goldsmith's safe.

Suppose that, at time *t*+1, someone needed to borrow 10 ounces of gold to, say, buy a house. Once the buyer and seller of the house settled on the price of the house, the buyer went to the goldsmith, and after agreeing on the terms of the loan, the borrower was handed 10 ounces of gold. (Note that, for our purposes, it does not matter whether there is only one goldsmith of 1,000 goldsmiths.) While the borrower could take physical gold, however, since everyone is making transactions using receipts, all the borrower needed was ten receipts—one receipt per ounce of gold. So, the borrower asked the goldsmith to issue ten receipts. Note that now, at time $t+1$, there 110 receipts, each receipt representing one ounce of gold. And, again, since everyone is using receipts to make transactions, the total quantity of money, i.e., receipts, in the economy, is 110. What the goldsmith has done is created money. The goldsmith created money by issuing more loans, i.e., receipts, than he/she had deposits.

Modern-day banks create money the same way; they create money by issuing more loans than they have deposits. Table 9.1 provides an example.

Table 9.1: The Process of Money Creation by Banks

[1]	[2]	[3]	[4]	[5]
Stage	Name of Bank	Deposits	Reserves	Loans
1	First Bank	$0	$0	$0
2	First Bank	$100,000	$100,000	$0
3	First Bank	-	$20,000	$80,000
4	Second Bank	$80,000	$80,000	$0
5	Second Bank	-	$16,000	$64,000
6	Third Bank	$64,000	$64,000	$0
7	Third Bank	-	$12,800	$51,200
⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮
	Total	$500,000	$100,000	$400,000

Source: M. Ashraf. Column [1] lists the stage, Column [2] lists the name of the bank, Column [3] lists the deposits amount, Column [4] lists the reserves amount, and Column [5] lists the loans amount. We assume that the required reserve ratio is 20%.

To understand the process of money creation, we make the following assumption.

1. The Fed requires banks to keep 20 percent of their deposits to keep as reserves to meet their withdrawal needs. The percentage of deposits that the Fed requires the banks to keep as reserves is called the required reserve ratio (*rrr*). Total reserves (*TR*) may be divided into required reserves (*RR*) and excess reserves (*ER*). That is,

$$TR = RR + ER \tag{9.2}$$

2. Banks do not keep excess reserves; each bank keeps only the amount as reserves that it is required to keep.
3. People are making transactions using checks. They do not use cash. This is analogous to the situation of people only using receipts issued by goldsmiths, as opposed to using gold, to make transactions.

Stage 1

We start at Stage 1, where First Bank has zero deposits, zero reserves, and zero loans. Note that, just as in the case of goldsmiths, for the purposes of money creation, the number of banks is irrelevant.

Stage 2

At Stage 2, suppose that Jane Public deposits $100,000 in First Bank. At this stage, First Bank has not made any loans; the total amount, $100,000, is kept as reserves. Since the bank is required to keep only 20% of deposits as required reserves, $20,000 (= $100,000 × 0.2), the bank has excess reserves of $80,000. Using Equation (9.2), we have excess reserves of $80,000 (= $100,000 - $20,000).

Stage 3

John Public, no relation to Jane Public, needs a loan in the amount of $80,000 to purchase a piece of land. He goes to First Bank, and after agreeing on the terms of the loan, First Bank issues the loan. Since everyone is using checks to make transactions, John Public only needs a checkbook allowing him to write checks up to $80,000. At this stage, the reserves are $20,000, which are required, and the loans are $80,000; First Bank does not have any excess reserves.

John Public finds the piece of land for which he was looking; Jill Public, no relation to either Jane or John, has the piece of land that she wants to sell. They agree on the price, $80,000, and John Public writes a check in this amount.

Stage 4

Jill Public maintains an account Second Bank. She deposits the check worth $80,000 in her account. (For the sake of simplicity, assume that Second Bank did not have any deposits before Jill Public deposited the check.) At this stage, Second Bank's total reserves are $80,000. Since Second Bank is required to keep only 20% of deposits, $16,000 (= $80,000 × 0.2), Second Bank has excess $64,000 (= $80,000 - $16,000) in excess reserves, and $0 in loans. We use Equation (9.2) to get this amount.

Stage 5

Jim Public, no relation to Jane, John, or Jill, needs a loan in the amount of $64,000 to purchase a machine. Once Second Bank and Jim Public agree on the terms of the loan, Second Bank issues a checkbook to Jim which he can use to write checks up to the amount of $64,000.

At this stage, Second Bank has $16,000 in required reserves, and $64,000 in loans. It does not have any excess reserves.

Stage 6

Joy Public, no relation to Jim, Jill, John, or Jane, has the machine that Jim wants to purchase. She is willing to sell it for $64,000. Joy and Jim agree on the price and Jim writes a check to Joy in the amount of $64,000. Joy deposits the check in her account which she maintains at Third Bank.

(Again, for the sake of simplicity, assume that Third Bank did not have any deposits before Joy Public deposited the check.)

At this stage, since Third Bank is required to keep only 20% of deposits are reserves, i.e., \$12,800 (=\$64,000 × 0.2), it has excess deposits of \$51,200 (= \$64,000 - \$12,800).

Stage 7

At Stage 7, when Third Bank makes a loan of \$51,200, it has only required reserved, \$12,800, left, and does not have any excess reserves.

This process continues until all the initial deposits, in this example, \$100,000 are kept as required reserves. These stages are represented by vertical dots "⁝" in Table 9.1. The final row of Table 9.1 shows total values; total deposits are \$500,000, total reserves are \$100,000, and total loans are \$400,000.

A few points to note in Table 9.1.

- At each stage, the amount deposited at the next bank keeps decreasing. This is because each bank keeps a percentage of the deposits as required reserves, 20% of deposits in this example, as required reserves and issues loans for the remaining 80%.
    - First Bank, in Stage 2, had \$100,000 in deposits, kept \$20,000 in required reserves and issued loans for the remaining \$80,000 in Stage 3.
    - In Stage 4, Second Bank had \$80,000 in deposits. In Stage 5, Second Bank kept 20% of \$80,000, i.e., 16,000 in required reserves, and issued the remaining \$64,000 in loans. And so on.
- The banking system can keep on extending loans till all the initial deposits are kept as required reserves.
    - In this example, the original deposits of \$100,000, which became reserves—Stage 2, Columns [3] and [4]—are kept as required reserves. See the final row in Column [4].
- The ability of the banking system to extend loans is constrained by the requited reserve ratio (*rrr*). The higher the *rrr* the lower the amount in loans issued at each stage. And the lower the *rrr*, the higher the amount in loans issued at each stage.
    - Had the *rrr* been 30%, then First Bank would have kept \$30,000 as required reserves and issued loans worth \$70,000. On the other hand, had the *rrr* been 10% then First Bank would have kept \$10,000 as required reserves and issued loans worth \$90,000. Analogously for Second Bank, Third Bank, and so on.
- The banking system was able to loans by a multiple of the change in reserves, ΔR. This multiple is determined by ratio, $\left(\frac{1}{rrr}\right)$, where *rrr*, as defined earlier, is the required reserve ratio. This ratio is called the money multiplier.

$$\text{Money Multiplier: } \left(\frac{1}{rrr}\right) \tag{9.3}$$

- In our example, from Stage 1 to Stage 2, reserves changed from \$0 to \$100,000. That is, ΔR = \$100,000.
- In our example, the rrr is 20%. This means that the value of the money multiplier is $\left(\frac{1}{rrr}\right) = \left(\frac{1}{0.2}\right) = 5$.

- The total change in deposit, ΔD, is equal to the change in reserves, ΔR, times the money multiplier, $\left(\frac{1}{rrr}\right)$.

$$\Delta D = \left(\frac{1}{rrr}\right) \times \Delta R \tag{9.4}$$

- In our example, Table 9.1, ΔR = \$100,000, and rrr = 0.2, the money multiplier, using Equation (9.3), is $\left(\frac{1}{rrr}\right) = \left(\frac{1}{0.2}\right) = 5$, and total change in deposits, using Equation (9.4), is (see the final row of Table 9.1),

$$\Delta D = \left(\frac{1}{rrr}\right) \times \Delta R = 5 \times \$100{,}000 = \$500{,}000$$

Note that Equation (9.4) multiplies change in reserves, ΔR, with the money multiplier, $\left(\frac{1}{rrr}\right)$, to find change in deposits, ΔD. In our example in Table 9.1, however, we started by someone depositing \$100,000, which led to changing money supply. Why? The reason is that when the Fed wants to change money supply, the actions of the Fed, as we will see shortly, lead to changes in reserves, which in turn, lead to change money supply, holding all else constant. In Table 9.1, we started by someone depositing \$100,000 at Stage 2, just as an example to show how banks create money. Recall that, just as the goldsmiths of the 15th and 16th centuries did, modern-day banks create money by issuing more loans than they have deposits.

A Bank Run

What may happen if everyone who had a receipt went to cash their receipt and get gold? Since there are only 100 ounces of gold in the goldsmith's safe, and there are 110 receipts, not everyone will be able to get their gold. In our example of modern-day banks presented in Table 9.1, what may happen if the depositor who deposited funds in First Bank wants to withdraw her \$100,000? Since First Bank has issued loans worth \$80,000, the bank would not be able to give the depositor her funds back. This situation is referred to as a bank run.

Bank runs take place when all, or most, depositors want to withdraw their deposits at the same time.

What may trigger a bank run?

In our example of the house transaction, suppose that the seller of the house, due to whatever reason, felt that she would rather hold gold than the receipt. Maybe, due to some reason, she had lost trust in the goldsmith. Maybe she had seen the goldsmith engaging in an activity, say, gambling, which she felt was unworthy of the goldsmith. The reason for that feeling is beside the point, and basically irrelevant. Her neighbor also felt the same way and decided to cash her receipts, and so did the neighbor across the street, so on and so forth. A bank run has started. Bank runs are self-fulfilling prophesies.

For a bank run to stop, or not to start in the first place, there must be some agency that guarantees the safety of deposits. Indeed, as we saw in Chapter 8, that was one of the main reasons for the establishment of the central bank—the First Bank of the United States, the Second Bank of the United States, and the Federal Reserve System (the Fed). The Fed ensures that banks are following the rules and safe financial practices. As a bankers' bank, the Fed also provides a lifeline to banks that may find themselves in financial distress.

To further assure public of the safety of their deposits and to monitor the financial health of financial institutions, another federal government agency, Federal Deposit Insurance Corporation (FDIC), was established in 1933 by the US Congress. The FDIC guarantees that depositors' savings. The depositors do not have to purchase insurance; it's the banks that purchase insurance. So long as the deposits are in an FDIC-insured bank, the deposits up to $250,000 per depositor, per insured bank are automatically insured. The insured types of accounts include,[6]

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Checking accounts
Negotiable Order of Withdrawal (NOW) accounts
Savings accounts
Money Market Deposit Accounts (MMDA)
Time deposits such as Certificates of Deposit (CDs)
Cashier's checks, money orders, and other official items
issued by a bank
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Note that savings in the following forms are not insured by the FDIC,

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Stock investments
Bond investments
Mutual funds
Life insurance policies
Annuities
Municipal securities
Safe deposit boxes or their contents
U.S. Treasury bills, bonds or notes
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Now that we understand what money is and how banks create money, we next turn to the conduct of monetary policy by the Fed.

The Conduct of Monetary Policy

The Fed conducts monetary policy by changing money supply in the economy. However, before we discuss the details of the conduct of monetary policy, we need to learn a few more concepts.

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[6] FDIC. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.fdic.gov/resources/deposit-insurance/brochures/documents/your-insured-deposits-english.pdf. (Accessed: January 8, 2023)

We want to learn about bonds, the prices of bonds, and the relationship between the price of a bond and its interest rate. Let's start with bonds.

Bond

A bond is a promissory note. It is an agreement between the borrower(s) and the lender(s). The borrower of funds promises to pay back the principal and the interest rate at a future date. The date at which the borrower promises to pay back the principal (and makes the final interest payment, if any remaining) is called the maturity date. Interest rate is the rental rate of the funds that you have lent.

A few points that we should keep in mind.

- Price of a bond is the amount of funds you are willing to lend.
- When you are buying a bond, you are lending funds, and when you are selling or issuing a bond, you are borrowing funds.
- There is an inverse relationship between the price of a bond and its interest rate. When the price of the bond increases, its interest rate decreases, and vice versa.

Numerous entities sell or issue bonds. These include governments, corporations, households, etc. Take the example of a student borrowing funds to go to school. The student has, in effect, issued or sold a bond. And the entity that has lent the student the funds, has bought the bond. Similarly, when a household borrows funds from a bank to buy a house, the household has sold or issued the bond, and the bank has bought the bond. While the details of how the principal and interest will be paid may differ, the underlying concept remains the same whether the borrower is a private entity or the government.

Let us take the example of promissory notes issued or sold by the US Treasury—Treasury Bills, Treasury Notes, and Treasury Bonds—to solidify our understanding of the concept. All three—Treasury Bills, Treasury Notes, and Treasury Bonds—are promissory notes that the US Treasury issues to borrow funds. The differences in names represent the differences in maturity dates and how the interest is paid. Table 9.2 lists the main differences between the three.

Table 9.2: Main Differences Between Treasury Bill, Treasury Notes, And Treasury Bonds

Type	Maturity	Interest Rate
Treasury Bill (T-Bill)[7]	From a few weeks up to 52 weeks. At the time of this writing, T-bills are being sold with four-weeks, eight-weeks, thirteen-weeks, seventeen-weeks, twenty-six-weeks, and fifty-two-weeks maturities.	This means that the face value (also called par value)—the amount that you will get back when the T-bill matures is greater than the amount you lend, i.e., the price of the T-bill. If the face value of the T-bill and its price are the same, it is said to be sold at par. Interest rate is the difference between the price of the T-bill and its face value, as a percentage of the price of the T-bill.
Treasury Note[8]	Greater than a year, up to 10 years. At the time of this writing, Treasury Notes are being sold with two-year, three-year, five-year, seven-year, and ten-year maturities.	Interest is paid every six months. It is set at the time the Note is sold, and it doesn't change over the life of the Note. Furthermore, it is neve less than 0.125%.
Treasury Bond[9]	Greater than ten years, up to 30 years. At the time of this writing, Treasury Bonds are being sold with 20-year and 30-year maturities.	Interest is paid every six months. It is set at the time the Bond is sold, and it does not vary over the life the bond. Furthermore, it is never less than 0.125%.

Source: M. Ashraf. Data Source: US Department of Treasury (www.treasury.gov)

Note that the terms "selling" and "issuing" are used interchangeably in the field. There is, however, one difference: An original lender, i.e., a buyer of a bond, may resell the bond, at a later date, in a secondary market. In this situation, the reseller of the bond is not "issuing" a new bond; the seller is selling a pre-existing bond.

As we learned above, there is an inverse relationship between the price of a bond and its interest rate. An example will make this easier to understand. We will take the example of a discount bond; a bond whose price is below its face value. We will use "bond" as a generic term to represent a promissory note.

Suppose that there are two firm, Firm A and Firm B. Both firms are issuing bonds to borrow funds, with a one-year maturity. Firm A is issuing Bond A, and Firm B is issuing Bond B. Both

[7] Treasury Bills. https://www.treasurydirect.gov/marketable-securities/treasury-bills/ (Accessed: January 5, 2023)
[8] Treasury Notes. https://www.treasurydirect.gov/marketable-securities/treasury-notes/ (Accessed: January 5, 2023)
[9] Treasury Bonds. https://www.treasurydirect.gov/marketable-securities/treasury-bonds/ (Accessed: January 5, 2023)

bonds have a face value of $100. Assume also that both firms are equally reliable. That is, the riskiness of both bonds is the same. The only difference is in the prices of the two bonds.

Bond A:

Amount Lent (P) = $90

Amount Paid Back in a Year, i.e., Face Value (FV) = $100

Bond A's Interest Rate: $\left(\frac{FV-P}{P}\right) \times 100 = \left(\frac{100-9}{90}\right) \times 100 \approx 11.11\%.$

Bond B:

Amount Lent (P) = $80

Amount Paid Back in a Year, i.e., Face Value (FV) = $100

Bond B's Interest Rate: $\left(\frac{FV-P}{P}\right) \times 100 = \left(\frac{100-80}{80}\right) \times 100 \approx 25.00\%.$

Note that as the price of the bond increases, its interest rate decreases, and vice vera. This principle stays put no matter what the situation, holding all else constant.

Another important point to note is that while changes in interest rate get a lot of discussion in the press, changes in interest rates are the result of changes in the prices of the bonds: Interest rate is result of comparing the difference between the face value (FV) of the bond and the amount lent (i.e., the price of the bond, P), with the amount lent (P). Interest rate is what we get when we solve the equation $\left(\frac{FV-P}{P}\right) \times 100.$

Now that we understand what a bond is and how the price of a bond and its interest rate move in the opposite direction, we are ready to study the conduct of monetary policy.

As we study details of the conduct of monetary policy, keep in mind that there are three economic entities that play a role in this process. These are the Fed, the depository institutions, and general public, which include households and firms.

Tools of Monetary Policy

There are four main tools that the Fed uses to change money supply in the economy. These are,

- Changes in Reserve Requirements
- Changes in Discount Rate
- Open Market Operations
- Interest on Reserve Balances

Let us look at each tool in detail.

Changes in Required Reserve Ratio

Required reserve ratio is the percentage of deposits that a bank must hold either in its vaults, called vault cash, or in its account at the Fed.

In Table 9.1, we assumed that the required reserve ratio to be 20%. As discussed, had the required reserve ratio been higher, the banking system would have been able to issue loans in a smaller amount. This would have led to a smaller change in deposits. On the other hand, had the required reserve ratio been higher, the banking system would have been able to issue loans in a larger amount. This would have led to a larger change in deposits. And since demand deposits are part of money supply, the quantity of money supply would have changed accordingly.

By Equation (9.4), we see that a given change in reserves, ΔR, leads to a change in deposits, ΔD, by a multiple of $\left(\frac{1}{rrr}\right)$, the money multiplier—Equation (9.3). When the Fed increases required reserve ratio, the value of money multiplier decreases; the denominator in $\left(\frac{1}{rrr}\right)$ increases, and the value of the money multiplier decreases. The reverse happens when the Fed lowers the required reserve ratio.

Let us look at an example. Suppose that the required reserve ratio (rrr) is 15%, and as before, the change in reserves, ΔR, is \$100,000. Using Equations (9.3), the value of the money multiplier is, $\left(\frac{1}{rrr}\right) = \left(\frac{1}{0.15}\right) \approx 6.67$.

Using Equation (9.4), we get, $\Delta D = \left(\frac{1}{rrr}\right) \times \Delta R = 6.67 \times \$100{,}000 = \$667{,}000$.

The money supply increases from \$500,000 to \$667,000 when we lower the required reserve ratio. Why does this happen?

As we saw earlier, with lower required reserve ratio, at each step banks are required to keep a lower percentage of deposits as reserves and able to lend a larger percentage as loans. The reverse happens when the Fed increases the required reserve ratio; banks are required to keep a larger percentage of their deposits as reserves and lend a lower percentage of deposits as loans.

I will leave it for you to calculate the value of the money multiplier when the required reserve ratio is 25%.

How does the Fed determine the required reserve ratio? This required reserve ratio is determined by the Fed based on the depository institution's transactions and its financial health. In the aftermath of the financial crisis of 2007-2009, the efficacy of this tool to change money supply decreased significantly. The Fed used required reserve ratio as a tool until March 2020. At present, however, the required reserve ratio is zero percent. This means that the value of the money multiplier is infinite; indeed, the money multiplier function, $\left(\frac{1}{rrr}\right)$, is undefined.

Why did the Fed lower the required reserve ratio to zero?

Before the financial crisis, banks did not keep much, if any, excess reserves. While before the financial crisis, banks were relaxed their lending standards too much and did not care much about the financial status of the borrower, after the financial crisis, banks became too careful; as opposed to lending, banks started keeping a large portion of their deposits as excess reserves. Figure 9.1 plots excess reserves held by the banking sector from January 2000 to January 2020.

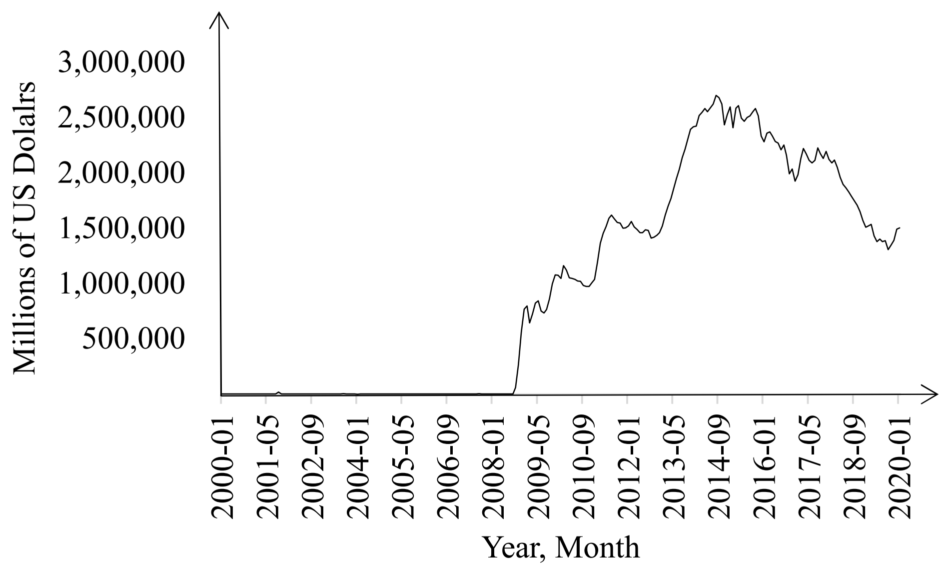

Figure 9.1: Excess Reserves Held by Depository Institutions

Source: M. Ashraf. Data Source: Federal Reserve Bank of St. Louis, Excess Reserves of Depository Institutions [EXCSRESNS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/EXCSRESNS. (Accessed: January 12, 2023).

Figure 9.1: The amount of excess reserves (in millions) is on the vertical axis and time (from January 2001 to January 2020) is on the horizontal axis. The curve shows the amount of excess reserves over time.

Figure 9.1 plots excess reserves held by depository institutions data, from January 2000 to January 2020. Note the jump in excess reserves around late 2008. Before the financial crisis set in, excess reserves held by depository institutions averaged around $1,789 million. Once the financial crisis set in, excess reserves held by depository institutions averaged around $1,729,960 million. This increase in excess reserves decreased the efficacy of this tool to conduct monetary policy vanished.

Change in Discount Rate

Recall that the Fed also functions as a bankers' bank; commercial banks may borrow from the Fed. Discount rate is the interest rate that the Fed charges commercial banks when they borrow from the Fed. When the Fed wants to increase money supply, it lowers discount rate, making it cheaper for banks. As a result, banks borrow more, make more loans, and money supply increases. On the other hand, when the Fed wants to decrease money supply, it raises discount rate, making it more expensive for banks to borrow. As a result, banks borrow less and extend fewer loans, and money supply decreases.

Open Market Operations

Recall the three economic entities that play roles in brining change in money supply, leading to changes in interest rate, which in turn, leads to changes in economic activity. These are the Fed, commercial banks, and households.

Open market operations are the main tool that the Fed uses to change money supply. These refer to buying and selling of government bonds by the Fed in the open market. The Fed does not buy newly issued bonds by the US Treasury. It buys and sells already existing bond from and to the general public and commercial banks in the open (secondary) market.

Note that while we use the term "bond," the Fed almost always trades Treasury securities with short maturities, i.e., Treasury bills. In the past, on rare occasions, such as in the aftermath of the 2007-2009 financial crisis, the Fed did buy, and later sold, Treasury notes and bonds, but that was an outlier event. So, when we talk about the Fed buying and selling of Treasury bonds, we are referring to the Fed buying and selling Treasury bills.

Note also that the term "security" in the context of financial markets, refers to any financial asset that can be bought and sold or resold.

Let us take examples of open market purchase and open market sale, and the effect of each action on money supply. In these examples will assume that the required reserve ratio (rrr) is 20%. This implies that the money multiplier, $\left(\frac{1}{rrr}\right)$, is $\left(\frac{1}{0.2}\right) = 5$.

As before, also assume that people do not use cash to make transactions; they use checks.

Open Market Purchases

When the Fed wants to increase money supply, it engages in open market purchases; it buys Treasury bills in the open market from the general public and commercial banks.

Suppose that the Fed purchased bonds worth $100 from Jane Public, who maintains an account at First Bank. (See Table 9.1.) The Fed writes a check to Jane Public in exchange for bonds. She deposits the check in her account at First Bank. Recall that commercial banks hold accounts at the Fed. First Bank deposits that check in its account at the Fed. The Fed increases the reserves of First Bank by $100. That is, ΔR = $100.

Let us now plug these values in Equation (9.4), reproduced here for convenience, to find out how will this action by the Fed affect money supply.

$$\Delta D = \left(\frac{1}{rrr}\right) \times \Delta R \tag{9.4}$$

$$\Delta D = \left(\frac{1}{0.2}\right) \times \$100 = 5 \times \$100 = \$500$$

Since demand deposits, *D*, (see components of M1), are part of money supply, an increase in reserves, *R*, by \$100, with *rrr* = 20%, leads to an increase in money supply by \$500.

Open Market Sales

Now suppose that the Fed wants to decrease money supply. The Fed will engage in open market sales. The process just described of how an open market purchase affects money supply reverses.

Suppose that the Fed sells bonds worth \$100 to Jane Public, who maintains an account at First Bank. Jane Public writes a check in the amount of \$100 in exchange for bonds. Since First Bank maintains an account at the Fed, the Fed *decreases* the reserves that First Bank has by \$100. That is, ΔR = - \$100.

As before, let us plug these values in Equation (9.4) to find out how will this action by the Fed affect money supply.

$$\Delta D = \left(\frac{1}{0.2}\right) \times \$100 = 5 \times -\$100 = -\$500$$

Since demand deposits, *D*, are part of money supply, a decrease in reserves, *R*, by \$100, with *rrr* = 20%, leads to a *decrease* in money supply by \$500.

Interest on Reserves

The US Congress authorized the Fed to pay interest on reserve balances (IORB) kept at the Fed via the Financial Services Relief Act of 2006.[10] On October 1, 2008, the Fed started paying interest to depository institutions IORB. This tool provided the Fed more flexibility in conducting monetary policy. When the Fed wants to decrease money supply, it raises IORB, thereby providing an incentive to the banks to hold more reserves and extend fewer loans. On the other hand, when the Fed wants to increase money supply, it lowers IORB, thereby providing incentive to the banks to hold fewer reserves and extend more loans.

We are now, in a position to draw the money supply curve. We draw the money supply curve in the interest rate (*i*) and money (*M*) space. Figure 9.2 draws the money supply curve.

[10] Interest on reserves. https://www.federalreserve.gov/monetarypolicy/reserve-balances.htm. (Accessed: January 15, 2023)

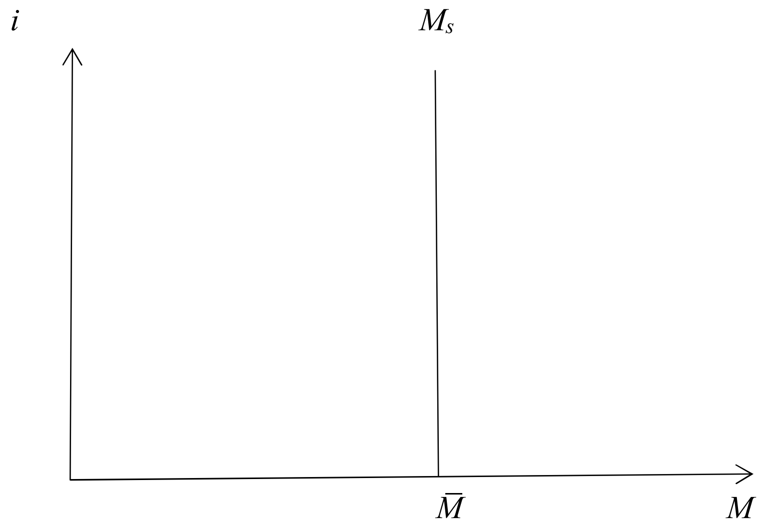

Figure 9.2: The Money Supply Curve

Source: M. Ashraf.

Figure 9.2: Quantity of money (M) is on the horizontal axis, and the interest rate (i), is on the vertical axis. The money supply curve, M_s, is vertical in the interest rate, i, and the quantity of money, M, space. This tells us that the quantity of money supplied does not depend upon the interest rate.

Note that the money supply curve, M_s, is vertical in the interest rate, i, and the quantity of money, M, space. This tells us that the quantity of money supplied does not depend upon the interest rate. As we will see shortly, the Fed changes in money supply to affect the interest rate, which in turn, affects the economy. First, let us see how changes in money supply affect the money supply curve.

Changes in Money Supply

When the Fed changes money supply, the money supply curve shifts. This is shown in Figure 9.3.

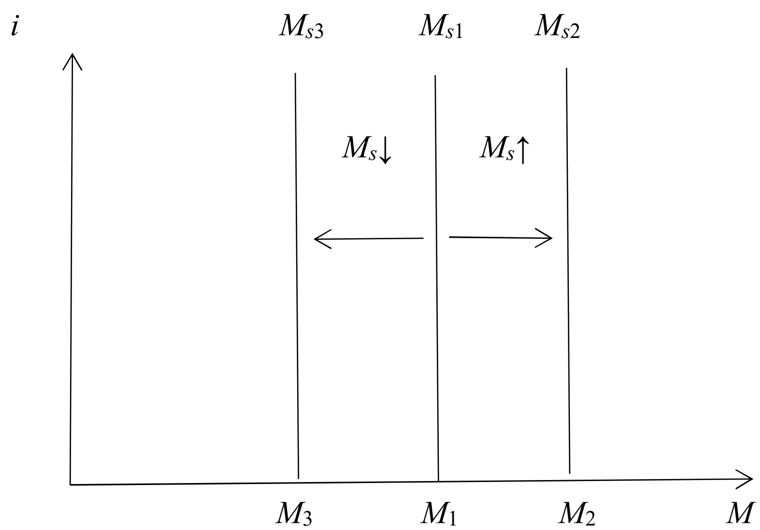

Figure 9.3: Shifts in the Money Supply Curve

Source: M. Ashraf.

Figure 9.3: Quantity of money (M) is on the horizontal axis, and the interest rate (i), is on the vertical axis. When the Fed increases money supply ($M_s\uparrow$), the money supply curve shifts to the right from M_{s1} to M_{s2}. One the other hand, when the Fed decreases money supply ($M_s\downarrow$), the money supply curve shifts to the left from M_{s1} to M_{s2}.

When the Fed increases money supply ($M_s\uparrow$), the money supply curve shifts to the right from M_{s1} to M_{s2}. One the other hand, when the Fed decreases money supply ($M_s\downarrow$), the money supply curve shifts to the left from M_{s1} to M_{s2}.

As of now, the figure does not tell us how the interest, *i*, is determined, or changes, or what role do changes in *i* play in the economy. For the money supply curve to be informative, we must draw a money demand curve.

Money Demand

Money demand is the amount of money economic agents, in this case, individuals and firms, want to hold outside interest-bearing account.

When you keep money outside interest-bearing accounts, you are not earning interest income. The opportunity cost of holding funds outside interest-bearing accounts is the interest income that you give up. So, why would someone want to give up that interest income? While there are other motives for holding funds outside interest-bearing accounts, the main motive for keeping funds outside interest-bearing accounts is to make transactions.

I briefly note that other motives for holding funds outside interest-bearing accounts are precautionary motive and speculative motive. The former motive refers to holding funds outside interest-bearing account just-in-case, as a precaution, to meet unforeseen demands. The latter motive refers to holding funds outside interest-bearing accounts when one deems interest rates to be "too" low, and the person is waiting till interest rates increase. A detailed discussion is beyond the scope of this textbook. These motives, however, further strengthen the point being made here.

Interest-paying accounts come with restrictions on the amount of funds one may withdraw at a time. Depending upon the account type, there may also be certain early withdrawal penalties.

"But checking account pay interest, and one can use debit cards to make transactions," you may ask. While this is technically true, note that interest paid on checking account balances is relatively low as compared with interest paid on balances that put restrictions on withdrawal amounts and institute time limits. In general, the longer the period before which funds cannot be withdrawn, the higher the interest rate; and the shorter the period before which funds cannot be withdrawn, the lower the interest rate.

Take the examples of Treasury bill, Treasury notes, and Treasury bond. As we saw earlier (see Table 9.2), the maturity dates of Treasury bills are the shortest (up to 52 weeks), the maturity dates of Treasury notes are greater than a year, and up to 10 years, and the maturity dates of Treasury bonds is greater than 10 years and up to 30 years. While there are exceptions to this rule, almost always, Treasury bills pay the lowest interest rate, and Treasury bonds pay the highest interest rate. The interest rate paid on Treasury notes falls in between the two. The discussion of this rule, and the exceptions to this rule, is beyond the scope of this textbook.

For the ease of exposition, we will assume that all bonds pay the same interest rate, we will put all interest-paying forms of money in one group and call it "bonds." We will call all the non-interest paying forms of money "cash." This means that there are two forms of holding financial assets—bonds and money. Bonds pay interest, and cash does not.

To summarize,

- Money demand is the amount of funds we want to hold outside interest-bearing accounts,
- The main motive for holding funds outside interest-bearing accounts is to make transactions, and that
- The opportunity cost of holding funds outside interest-bearing accounts is the interest income forgone.
- There are two forms of holding financial assets—bond and cash. Bonds pay interest while cash does not.

It should not come as a surprise then that, holding all else constant, the higher the opportunity cost of holding funds outside interest-bearing accounts, the lower the quantity of funds held outside interest-bearing accounts, and the lower the opportunity cost of holding funds outside interest-bearing accounts, the higher the quantity of funds held outside interest-bearing accounts. Since the opportunity cost of holding funds outside interest-bearing account moves positively with interest rate, we can state that the higher the interest rate, the lower the quantity of money demanded, and the lower the interest rate, the higher the quantity of money demanded.

The Money Demand Curve

Recall the law of demand that we learned in Chapter 3. It states that, holding all else constant, as the price of a product increases, its quantity demanded for the product decreases, and vice versa. In this case, the price is the interest rate, and the product is money. That is, there is a negative relationship between the interest rate and the quantity of money demanded. We can show this negative relationship with a curve drawn in the interest rate and money space. Figure 9.4 drawn this curve.

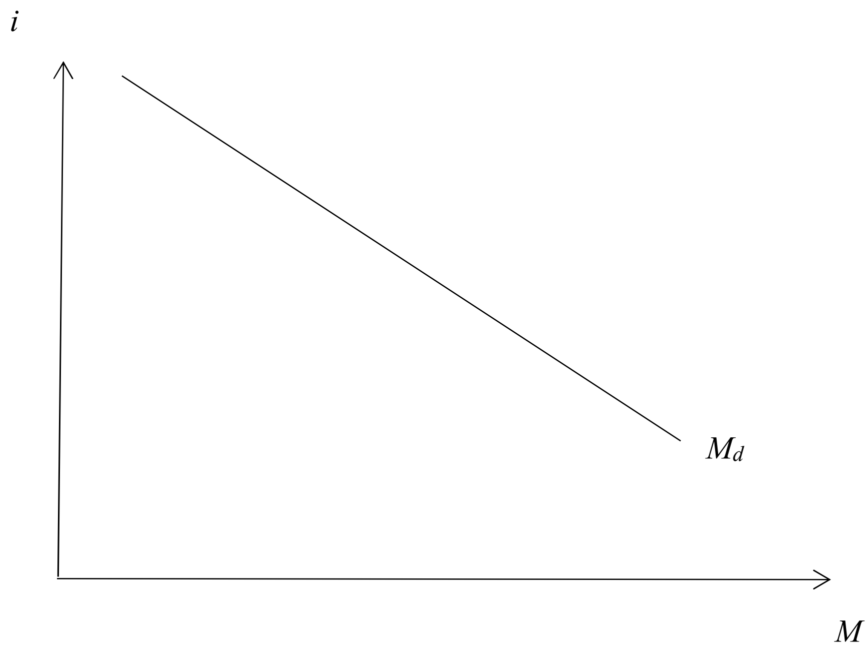

Figure 9.4: Money Demand Curve

Source: M. Ashraf.

Figure 9.4: The interest rate, *i*, is on the vertical axis, and the quantity of money, *M*, is on the horizontal axis. The curve, M_d, represents the negative relationship between the interest rate and the quantity of money demanded. All else constant, as the interest rate increases, the quantity of money demanded decreases, and vice versa.

In Figure 9.4, interest rate, *i*, is on the vertical axis, and the quantity of money, *M*, is on the horizontal axis. The curve, M_d, represents the negative relationship between the interest rate and the quantity of money demanded. All else constant, as the interest rate increases, the quantity of money demanded decreases, and vice versa.

Shifts in the Money Demand Curve

In Chapter 3, we drew the demand curve of a good or service in the price of the good or service, and the amount of that good or service purchased space, while holding other factors that may affect the amount purchased of that good or service constant. When any other factor, other than the price of the good or service changed and it affected the amount of that good or service purchased, we shifted the demand curve.

The reasoning for the shifts in the money demand curve is the same. We drew the money demand curve in the interest rate, *i*, and money, *M*, space, while we held other factors constant. There are two factors, that we will consider, which may affect the amount of money held outside interest-bearing accounts. One is the prices of goods and services, and the other is the number of transactions. When either of these factors changes, the money demand curve shifts. Here is why?

Remember that the main reason for holding money outside interest-bearing accounts is to make transaction. When the price of a product changes, the amount of money needed to purchase that product changes along with it; if the price increases, all else constant, the amount of money needed to make that transaction will increase, and vice versa.

Now look at the effect of the number of transactions on money demand. As the number of transactions changes, so does the amount of money needed to make those transactions, at any given price. If you make more transactions, you will need more money, all else constant. The reverse will happen when you make fewer transactions, holding all else constant.

One's income level, *y*, is a good proxy for the number of transactions one make. Individuals with higher income levels make more transactions and need more money to hold outside interest-bearing accounts to make these transactions. On the other hand, individuals with lower income levels make fewer transaction, and need less money to hold outside interest-bearing accounts to make these transactions. As always, we hold other factors constant. We can show the effects of these factors by shifting the money demand curve in the interest rate, *r*, and money, *M*, space.

Recall from Chapter 6 that an "average" of all the prices is represented by the overall price level, *P*, and the aggregate income level represented by *Y*. At the aggregate level, then we can make the following statements.

- As price level, *P*, increase, money demand curve shifts to the right, and as price level, *P*, decrease, money demand curve shifts to the left, all else constant.
- As aggregate income, *Y*, increases, money demand curve shifts to the right, and as aggregate income, *Y*, decreases, money demand curve shifts to the left, all else constant.

Figure 9.5 shows the shifts in the money demand curve due to changes in the price level, *P*, and changes in the aggregate income, *Y*.

Figure 9.5: Shifts in the Money Demand Curve

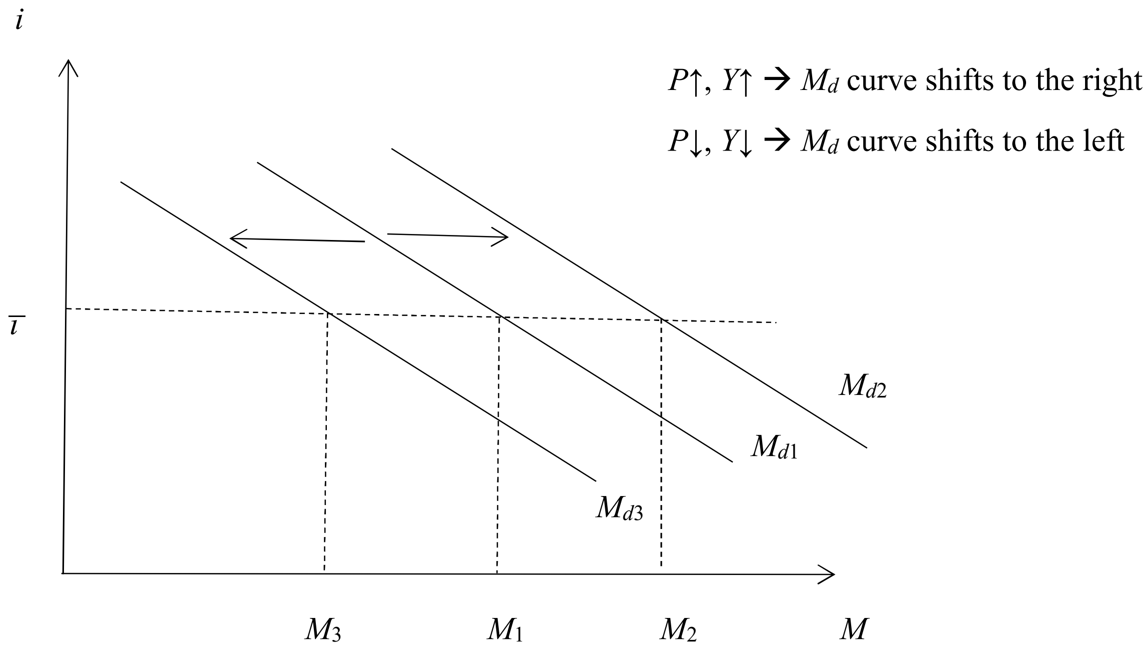

Figure 9.5: Shifts in the Money Demand Curve

Source: M. Ashraf

Figure 9.5: The interest rate, *i*, is on the vertical axis, and the quantity of money, *M*, is on the horizontal axis. As either *P* or *Y* increases, money demand increases from M_1 to M_2, and the money demand curve shifts to the right, from M_{d1} to M_{d2}. When either *P* or *Y*, decreases, money demand decreases from M_1 to M_3, and the money demand curve shifts to the left, from M_{d1} to M_{d3}. These shifts happen at any given interest rate, represented here by $\bar{\imath}$.

Figure 9.5 shows the effects of changes in the price level, *P*, and changes in income, *Y*. Note that the effects of changes in *P* and *Y* shift the money demand curve in the same direction. As either *P* or *Y* increases, money demand increases from M_1 to M_2, and the money demand curve shifts to the right, from M_{d1} to M_{d2}. On the other hand, when either *P* or *Y*, decreases, money demand decreases from M_1 to M_3, and the money demand curve shifts to the left, from M_{d1} to M_{d3}. These shifts happen at any given interest rate, represented here by $\bar{\imath}$.

The Market for Money: The Equilibrium Interest Rate

Let us now see how equilibrium interest rate is determined. We find the equilibrium interest rate where the quantity supplied of money is equal to the quantity demanded of money. That is,

$$i^*: M_d = M_s = M^* \tag{9.5}$$

We represent equilibrium interest rate in Equation (9.5) by i^*, and equilibrium quantity of money is represented by M^*.

We can show this equilibrium interest rate with the help of a diagram. We have done all the necessary preparation; we have drawn the money supply curve (Figure 9.2), and the money demand curve (Figure 9.4). We plot these two curves on the same set of axes in Figure 9.6.

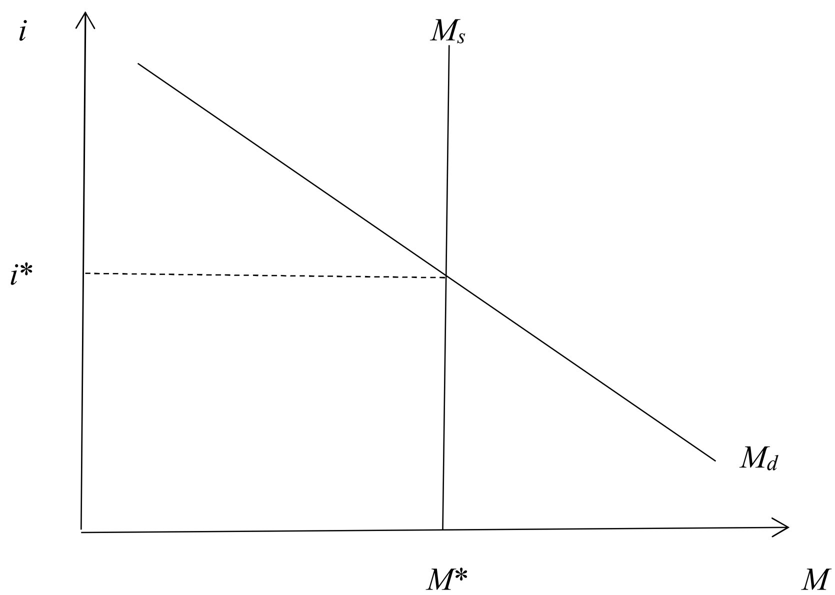

Figure 9.6: The Equilibrium Interest Rate

Source: M. Ashraf

Figure 9.6: The interest rate, *i*, is on the vertical axis, and the quantity of money, *M*, is on the horizontal axis. The equilibrium takes place where quantity of money demanded is equal to the quantity of money supplied, and M_d and M_s curves intersect each other; *i** represents the equilibrium interest rate and *M** represents the equilibrium quantity of money.

In Figure 9.6, we have the interest rate, *i*, on the vertical axis, and the money, *M*, on the horizontal axis. The equilibrium takes place where quantity of money demanded is equal to the quantity of money supplied, and M_d and M_s curves intersect each other; *i** represents the equilibrium interest rate and *M** represents the equilibrium quantity of money—Equation (9.5).

Reaching the Equilibrium

Suppose that we happen to be away from the equilibrium interest rate, *i**. That is, interest rate is either above the equilibrium interest rate, or it is below the equilibrium interest rate. These two situations are shown in Figure 9.7.

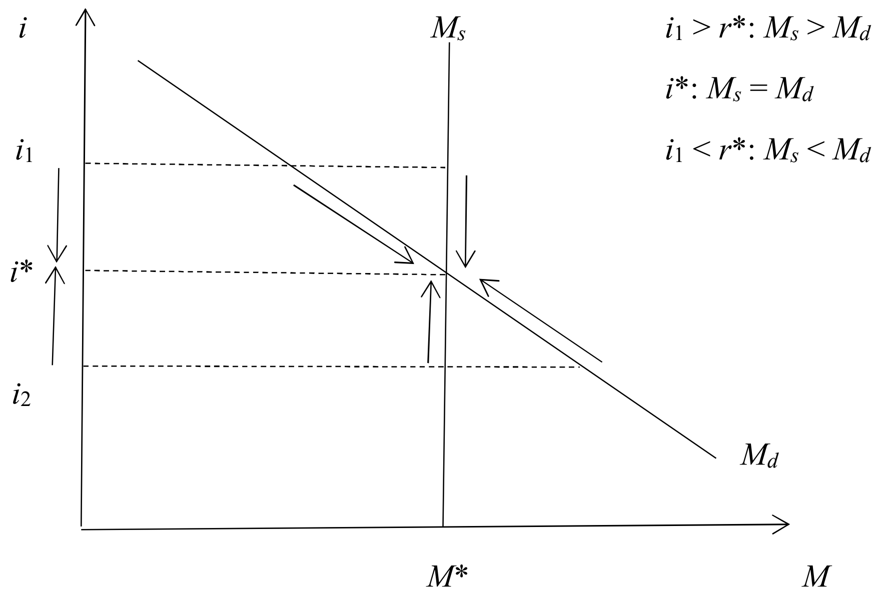

Figure 9.7: Reaching the Equilibrium

Source: M. Ashraf

Figure 9.7: The interest rate, i, is on the vertical axis, and the quantity of money, M, is on the horizontal axis. The interest rate, i_1 is above i^*, and i_2 is below i^*. At i_1, $M_s > M_d$, and at i_2, $M_s < M_d$.

In Figure 9.7, i_1 is above i^*, and i_2 is below i^*. At i_1, $M_s > M_d$, and at i_2, $M_s < M_d$. How do we reach i^* if we happen to find ourselves in either of these situations?

Let us start with $i_1 > i^*$. At this interest rate, quantity of money supplied is greater than the quantity of money demanded: $M_s > M_d$. Given the price level, P, and aggregate income, Y, economic agents do not want to hold this much money outside interest-bearing accounts at this interest rate. How do we get to the equilibrium interest rate, i^*, where $M_s = M_d$?

Recall that economic agents have two forms of holding financial assets—bonds and cash. Bonds pay interest, while cash does not. Since economic agents do not want to hold cash in this amount, they convert cash into bonds. All else constant, as the demand for bonds increases, so does the price of bonds (i.e., the amount of funds that you want to lend). Since price of bonds and interest rate move in opposite directions, interest rate decreases; price of bonds increases, interest rate decreases. (See Section 9.5.1.) As interest rate decreases the quantity of money demanded increases. We move downward along the money demand curve, M_d, and money supply curve, M_s, till we get to i^*, and the quantity of money supplied, and the quantity of money demanded are, again, equal—$M_s = M_d$. See the direction of arrows in Figure 9.7.

Now look at the situation where $i_2 < i^*$. At this interest rate, quantity of money demanded is greater than the quantity of money supplied: $M_d > M_s$. Given the price level, P, and aggregate income, Y, economic agents want to hold more money outside interest-bearing accounts at this interest rate. How do we get to the equilibrium interest rate, i^*, where $M_s = M_d$?

Since there are only two forms in which financial assets can be held, bonds and cash, economic agents convert bonds into cash. All else constant, as the demand for bonds decreases, so does the price of bonds and interest rate increases. When interest rate increases the quantity of money demanded decreases. We move upward along the money demand curve, M_d, and money supply curve, M_s, till we get to i^*, and the quantity of money supplied, and the quantity of money demanded are, again, equal—$M_s = M_d$. See the direction of arrows in Figure 9.7.

Monetary Policy Transmission

Now that we have learned about how, through the interaction of money supply and money demand, we reach equilibrium interest rate, it is time to learn about how the actions of the Fed affect the economy.

First, note that while I have used the term "the interest rate," there are several interest rates that prevail in the economy. The differences in the levels of interest rates depend upon, among other factors, the riskiness of borrowers, the maturity dates of loans, and of course, the demand for loans and the supply of loans. The reason I have used the term "the interest rate" is that while the levels of interest rates differ at any point in time, the direction of the change in various interest rates is similar. Figure 9.8 plots, as an example, four different rates. These are the federal funds rate (more on this shortly), the 3-month Treasury bill rate, the 10-year Treasury note rate, and the AAA corporate bonds rate. AAA corporate bonds are bonds issued by corporations that are rated as very secure by Moody's, a ratings agency.

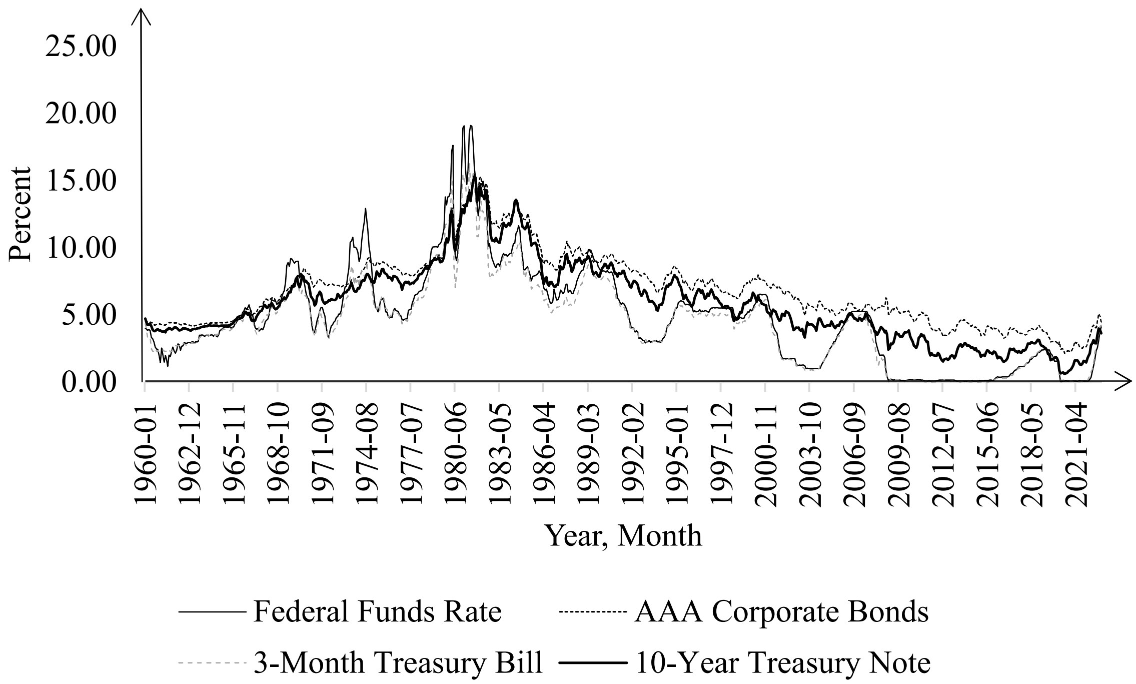

Figure 9.8: Co-Movement of Interest Rates

Source: M. Ashraf. Data Sources. Federal Funds Rate: Board of Governors of the Federal Reserve System (US), Federal Funds Effective Rate [FEDFUNDS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/FEDFUNDS. (Accessed: January 16, 2023)

3-Month Treasury Bill: Board of Governors of the Federal Reserve System (US), 3-Month Treasury Bill Secondary Market Rate, Discount Basis [TB3MS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/TB3MS. (Accessed: January 16, 2023)

AAA Corporate Bonds: Moody’s, Moody's Seasoned Aaa Corporate Bond Yield [AAA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/AAA. (Accessed: January 16, 2023)

10-Year Treasury Note: Organization for Economic Co-operation and Development, Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for the United States [IRLTLT01USM156N], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/IRLTLT01USM156N. (Accessed: January 16, 2023)

Figure 9.8: Various interest rates are on the vertical axis and time is on the horizontal axis. The various interest rates move in the same direction.

Figure 9.8 plots monthly interest rate data for federal funds rate (solid thin line), 3-month Treasury bill (broken line), 10-year Treasury note (solid bold line), and AAA corporate bonds (dotted line) from January 1960 to December 2022. Note that while the levels of these four interest rates differ, the direction of movement is very similar. This is why we can use the term "the interest rate" in our discussion.

What is Federal Funds Rate?

Federal funds rate is the interest rate that banks charge each other for overnight loans.

At the end of each business day, some commercial banks may have more funds than they need to satisfy their needs, whereas other commercial banks may have fewer funds than they need. Banks that have excess funds, as opposed to letting the funds sit idle, lend the funds to banks that need to meet their needs. The interest rate that banks charge each other for these overnight loans is called federal funds rate. It is somewhat of a misnomer; the federal government or the Fed does not determine this interest rate.

We often hear in the news that the Fed has increased or decreased the interest rate. What the news media are referring to is the changes in federal funds rate. Furthermore, since this is an interest rate on borrowing and lending funds between private entities, i.e., commercial banks, the Fed cannot dictate these private entities what interest rate to change. What the Fed does is that it sets a targe for federal funds rate, and changes money supply such that the target is met.

Suppose that the Fed wants to decrease interest rates. Since, as we saw in Figure 9.8, various interest rates move in similar direction, the actions of the Fed change the direction of interest rates that prevail in the economy by changing the target federal funds rate (*ffr*) and changing the money supply such that the target is met. Let us show this with the help of Figure 9.10.

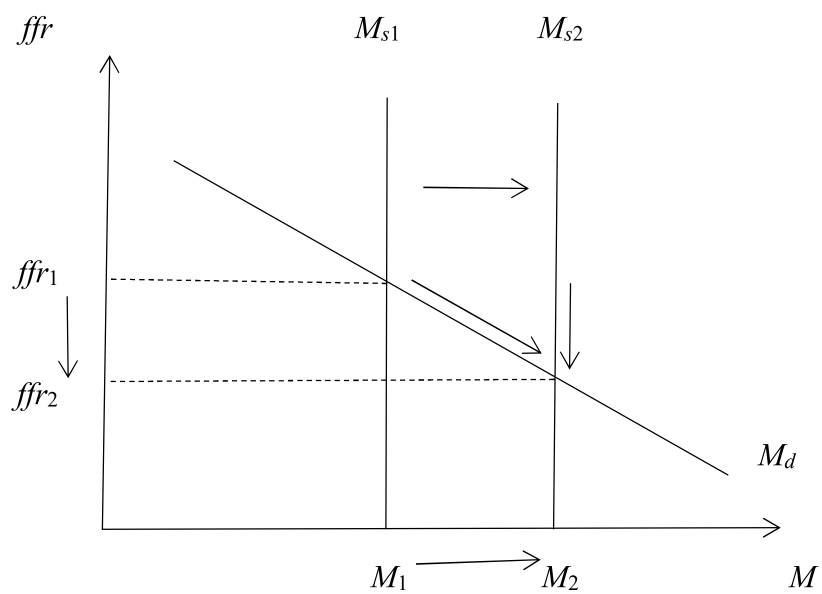

Figure 9.10: Changing Money Supply to Meet the Federal Funds Rate Target

Source: M. Ashraf

Figure 9.10: The federal funds rate (*ffr*) is on the vertical axis, and quantity of money (*M*) is one the horizontal axis. M_s and M_d represent the money supply curve and money demand curve, respectively.

In Figure 9.10, federal funds rate (*ffr*) is on the vertical axis, and quantity of money (*M*) is one the horizontal axis. M_s and M_d represent the money supply curve and money demand curve, respectively.

Start at the point where M_d is equal to M_{s1}, and the ffr_1 is the equilibrium federal funds rate, and the equilibrium quantity of money in the economy is M_1. Suppose that the Fed lowers the federal funds rate target to ffr_2. As stated above, federal funds rate is the interest rate that banks charge each other for overnight loans, and the Fed cannot dictate banks to charge a particular interest rate for inter-bank loans. What the Fed does is increase money supply so that money supply curve shifts to M_{s2}.

How do we get to ffr_2, the new target of the federal funds rate?

The process of getting to the lowered target federal funds rate, ffr_2 is the same as we saw in Figure 9.7 when the interest rate was i_1, which was above the equilibrium interest rate, i^*.

After the increase in money supply, the (new) money supply curve being M_{s2}. At ffr_1, quantity of money demanded is less than quantity of money supplied; at this interest rate, ffr_1, people do not want to hold this amount of money outside interest-bearing accounts. They convert their cash into bonds, the demand for bonds increases, as does the price of bonds. Recall that the price of a bond is the amount of funds lenders are willing to lend. As we know, the price of bonds and interest rate move in the opposite direction; as the interest rate decreases, quantity demanded of money increase, and we move downward along the money demand curve, M_d, and the money supply curve, M_{s2}, till we get to ffr_2. See the direction of arrows in Figure 9.10. At this point, the equilibrium federal funds rate is ffr_2, and the equilibrium quantity of money in the economy is M_2.

This process works in the opposite direction when the Fed wants to increase interest rates in the economy. The Fed increases the federal funds rate target, and decreases money supply such that the new target federal funds rate target is met.

Now that we understand how the Fed affects interest rates in the economy, and that various interest rates move in similar direction (see Figure 98), to avoid confusion, we will revert to using *i* to represent interest rate.

Interest Rate, Planned Investment Spending, and the Keynesian Cross Diagram: Linking the Financial Sector and the Goods and Services Sector

How does interest rate, which is determined in the financial sector, affect the goods and services sector of the economy? In other words, how does monetary policy affect the economy's output? In this section, we link the financial sector with the goods and services sector.

In Chapter 7, we noted that macroeconomic equilibrium took place where output, Y, was equal to the planned aggregate expenditure, $AE \equiv C + I + G$. This equilibrium condition was presented in Equation (7.21). We reproduce Equation (7.21) here.

$$Y = C + I + G \tag{7.21}$$

Where C is aggregate consumption, I is planned investment spending, and G is government spending. Note, again, that this a closed economy model; we do not have net exports, NX, in the model. We will add net exports in Chapter 12.

Table 7.5 showed this condition with numerical data, and Figure 7.9, showed this graphically.

To create a link between the financial sector and the goods and services sector, we bring in the investment function. The investment function says that there in an inverse relationship between investment spending and interest rate. Mathematically, we may present the investment function as follows.

$$I = I(i_{-}) \tag{9.6}$$

Equation (9.6) states that planned investment spending is a negative function of interest rate, i, the negative sign (-) next to i indicates this. All else constant, as interest rate increase, quantity of planned investment spending decreases, and when interest rate decreases, planned investment spending increases.

Here is the reason for this negative relationship. As interest rate increases, fewer projects remain profitable, and quantity of investment spending decreases. The reverse happens when interest rate decreases. With a decrease in interest rate, more projects become profitable, and quantity of investment spending increases.

Let us take an example. Suppose that there are four projects—Project A, Project B, Project C, and Project D. The rates of return on these projects are 10%, 8%, 6%, and 4%, respectively.

When the interest rate is 9%, only Project A is profitable. When the interest rate is 7%, both Project A and Project B are profitable. If interest rate declines to 5%, Projects A, B, and C become profitable. And when interest rate declines to 3%, all four projects become profitable. Table 9.3 presents these data along with the total planned investment spending.

Table 9.3: Rate of Return, Interest Rate, and Investment Spending

Project	Rate of Return	Interest Rate	Total Planned Investment Spending
A	10%	9%	\$1,000,000
B	8%	7%	\$2,000,000
C	6%	5%	\$3,000,000
D	4%	3%	\$4,000,000

Source: M. Ashraf.

Note the negative relationship between interest rate and total planned investment spending; as interest rate increases, total planned investment spending decreases. Figure 9.11 plots the total planned investment spending (I) and interest rate (i) data.

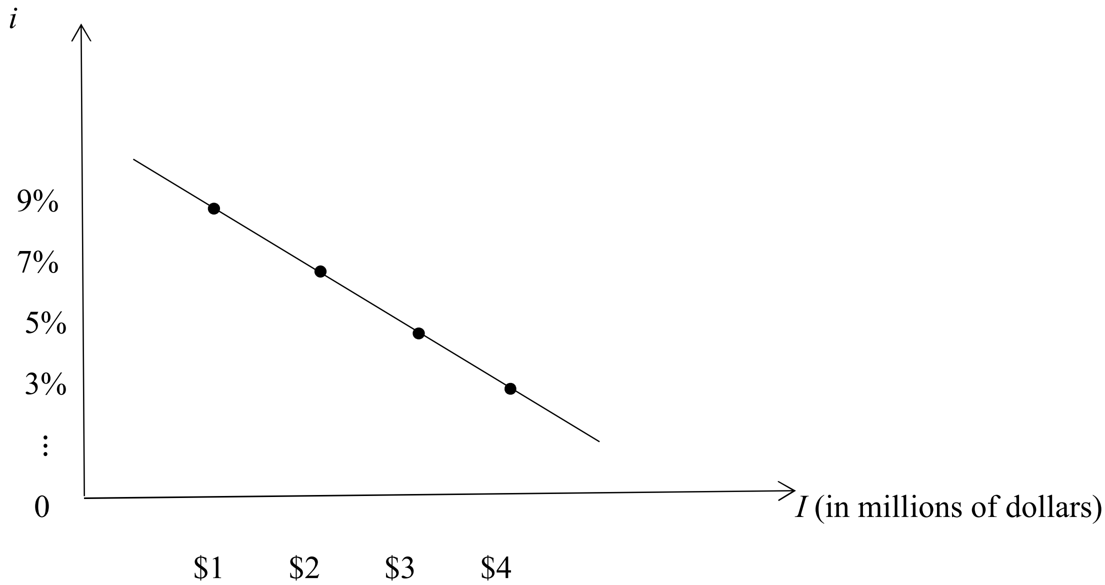

Figure 9.11: Total Planned Investment Spending

Source: M. Ashraf

Figure 9.11: The interest rate is on the vertical axis, and planned investment spending is on the horizontal axis. As interest rate increases, planned investment spending decreases, and vice versa.

Note that as interest rate increases, planned investment spending decreases, and vice versa. We can combine this relationship between interest rate and planned investment spending with the Keynesian Cross diagram (see Chapter 7) to create a link between the financial sector and the goods and services sector. Figure 9.12 shows this link.

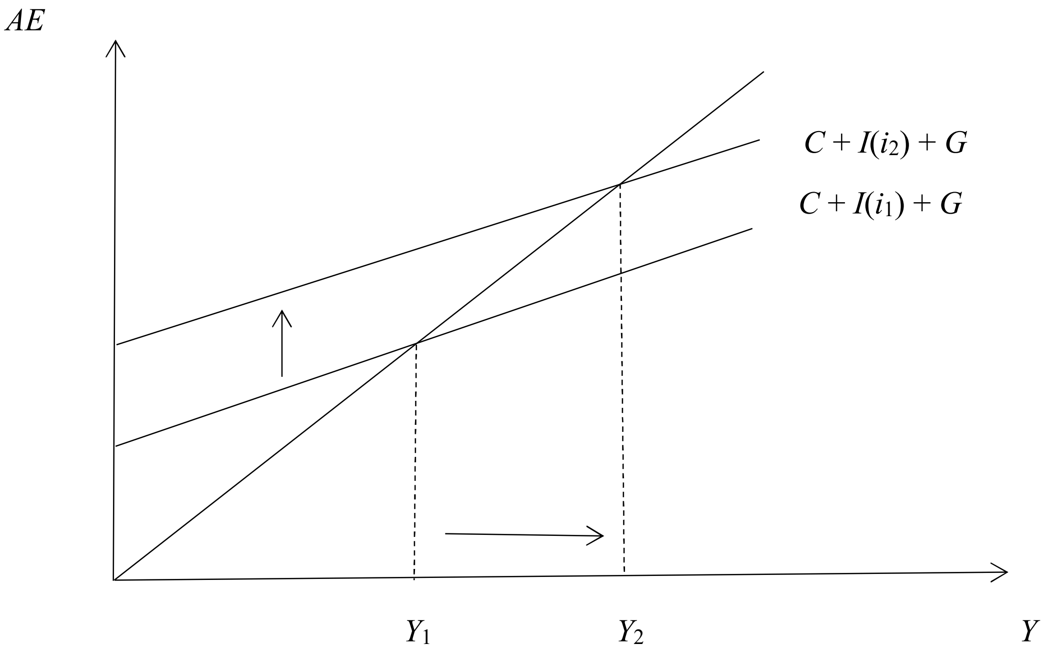

Figure 9.12: Keynesian Cross Diagram: Linking the Financial Sector with the Goods and Services Sector

Source: M. Ashraf.

Figure 9.12: Planned aggregate expenditure is on the vertical axis and aggregate income or output is on the horizontal axis. Holding all else constant, as interest rate decreases, planned investment spending increases, and the planned aggregate expenditure curve shifts up.

Figure 9.12 combines the effect of a decrease, i, in interest rate on planned investment, I, spending and the resulting increase in output, Y.

As we saw in Table 9.3 and Figure 9.11, holding all else constant, as interest rate decreases, planned investment spending increases, and vice versa. Figure 9.12 links this effect to the goods and services sector using the Keynesian Cross diagram. Suppose that interest rate decreases from 7% (= i_1) to 5% (= i_2). (See Table 9.3 and Figure 9.11). Now that Project C also becomes profitable, planned investment spending increases from \$2,000,000 (= I_1) to \$3,000,000 (= I_2). In Figure 9.12, which is a Keynesian Cross diagram, I show this increase in planned investment spending by shifting the planned aggregate expenditure curve up from $C + I(i_1) + G$, to $C + I(i_2) + G$. Recall that the Keynesian Cross diagram is drawn in the planned aggregate expenditure, AE, and output, Y, space, and to show an increase in planned investment spending, I, we shift the planned aggregate expenditure curve up. For a given investment multiplier, this leads to an increase in equilibrium output from Y_1 to Y_2. (Review Chapter 7 if you are confused about this point.)

Chapter Conclusion

In this chapter we learned what money is and how banks create money. We learned about various monetary aggregates. We learned how the Fed, the central bank of the US, conducts monetary policy, i.e., changes money supply. We also learned how interest rate is determined with the intersection of quantity of money supplied and the quantity of money demanded. Finally, we connected the financial sector and the goods and services sector via the investment function and the Keynesian Cross diagram.

In the next chapter we learn about how the Fed determines which federal funds rate target to pick. Then we build a model of the overall economy which helps us determine the equilibrium price level and the equilibrium output.

A Review of Terms

- Monetary Policy: Changes in money supply.
- Asset: Something that is subject to ownership.
- For any asset to serve as money it must be a medium of exchange, a unit of account, and a store of value.
- A Medium of Exchange: What economic agents are willing to exchange goods and services in exchange.
- A Unit of Account: It refers to the quality of this asset being used as a yardstick.
- A Store of Value: It refers to this asset have the quality that economic agents can transfer purchasing power from one time-period to another in terms of that asset.
- Barter System: A system where economic agents exchange goods and service for other goods and services.
- Commodity Money: It is the kind of money that has some intrinsic value. That is, it can be used for some other purpose as well.
- Non-Commodity Money: Non-commodity money, on the other hand, does not have any intrinsic value. Its sole purpose is to serve as money—a medium of exchange; a unit of account; and a store of value. Fiat money is one form of non-commodity money.
- Fiat Money: A form of money that has been declared money by the fiat of the government.
- Banks create money by issuing more loans than they have deposits.
- The Fed changes money supply by changing the required reserve ratio, by changing the discount rate, by conducting open market operations, and by changing the interest rate on reserves kept at the Fed.
- Money demand is the amount of funds that people want to hold outside interest-bearing accounts.
- The main motive for holding funds outside interest-bearing accounts is to make transactions.
- A bond is a promissory note. When you buy a bond, you are lending funds. When you issue or sell a bond, you are borrowing funds.
- The price of a bond is the amount of funds you are willing to lend.
- There is an inverse relationship between the price of the bond and its interest rate.
- There is an inverse relationship between interest rate and planned investment spending.
- Legal Tender: When a government states that a particular piece of paper of a given size, with such and such printing, is worth this much, and that it must be used as money, it becomes legal tender.
- Money Multiplier: $\left(\frac{1}{rrr}\right)$
- Bank runs take place when all, or most, depositors want to withdraw their deposits at the same time.