BOSTON UNIVERSITY Global Development Policy Center
Economics in Context Initiative

Chapter 11: Money and Monetary Policy

Appendices

Appendices to Chapter 11 of *Essentials of Economics in Context*

Global Development Policy Center
Boston University
53 Bay State Road
Boston, MA 02155
bu.edu/gdp

APPENDIX A: BOND PRICES AND INTEREST RATES

The process by which monetary policy influences interest rates can be explained by examining the market for federal funds, as was seen in the body of this chapter. Alternatively, it can also be explained by looking at the market for government bonds.

A **bond** represents debt, but, as a particular kind of financial instrument, bonds have some characteristics worth mentioning. When the government (or a business) borrows by selling a bond it makes promises. It promises to pay the bondholder a fixed amount of money each year for a period of time and then, at the end of this time, to repay the principal of the loan. The fixed amount paid per year is called the *coupon amount*. The date that the principal will be repaid is called the *maturity date*. The amount of principal that will be repaid is called the *face value* of the bond.

bond: a financial instrument that pays a fixed amount each year (the coupon amount) as well as repaying the amount of principal (the face value) on a particular date (the maturity date)

So far, it seems simple enough—a $100 bond at 5 percent, for example, specifies that its issuer will pay you $5 a year for ten years and then pay you $100 at the end of ten years. What makes bond markets more complicated, though, is that bonds are often sold and resold, changing hands many times before they mature. During the period to maturity, many factors affecting the value of the bond may change, and so the *bond price*—the price at which bondholders are willing to buy and sell existing bonds—may change.

For example, suppose that you bought the bond just described at its face value of $100. The *bond yield to maturity*, or annual rate of return if you hold a bond until it matures, would obviously be 5 percent ($5 annually is 5 percent of the $100 bond price). Suppose that after a couple of years you want to sell your bond (perhaps you need the cash), but meanwhile the rate of return on alternative (and equally safe) investments has risen to 10 percent. People will not be interested in buying your bond at a price of $100, because they would get only a 5 percent return on it, whereas they could get a 10 percent return by investing their $100 elsewhere. To sell your bond you will need to drop the price that you demand until your bond looks as attractive as other investments—that is, until the $5 per year represents a 10 percent yield to maturity.

Conversely, if the return on alternative investments has fallen, say to 2 percent, the $5 per year on your bond looks pretty good, and you will be able to sell it for *more than* $100. Bond prices and bond yields are thus inversely related.[*]

The U.S. Treasury issues a variety of different kinds of bonds. Treasury bills have a zero coupon amount and mature in one year or less. Because the holder receives no coupons, they are sold at a discount from their face value. Other Treasury bonds pay a coupon amount every six months and

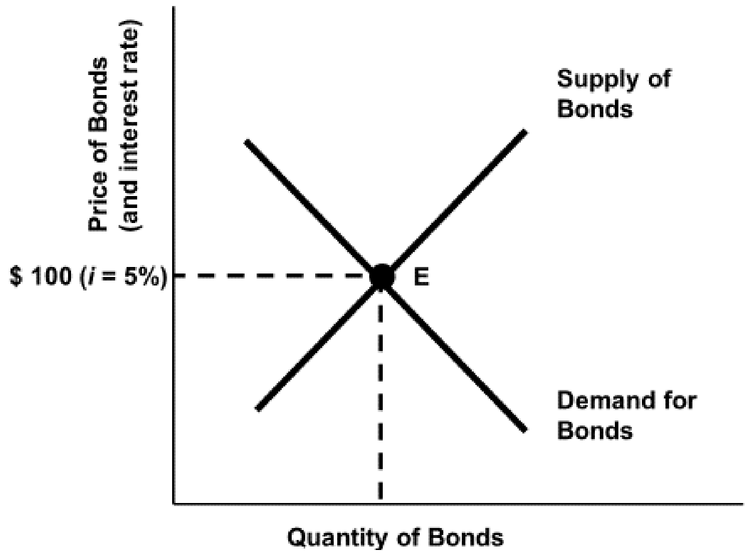
[*] If the bond has one year left to maturity, for example, its value one year from now is $105. We can use the formula [Value next year] / (1 + interest rate) = [Value now] to find out what you could get by selling the bond today. If the interest rate on alternative investments is 10 percent, then $105/(1 + .10) ≈ $95.45. The lower the bond price, the higher the bond yield, and vice versa. Conversely, if the return on alternative investments has fallen, say to 2 percent, the $5 per year on your bond looks pretty good, and you will be able to sell it for *more than* $100. If the interest rate is 2 percent, then $105/(1 + .02) ≈ $102.94.

have maturities that range from two to thirty years. In the real economy, then, there are many different "government bond" prices—and interest rates. It is only for the sake of simplicity of modeling that we assume only one type of bond and one interest rate.

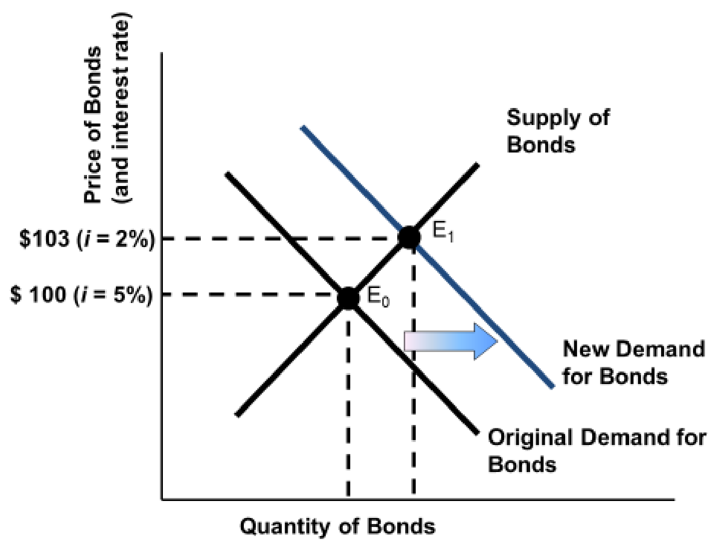
Although many people and organizations buy and sell government bonds on what is called the "secondary market" (the "primary market" being the Treasury's initial offering of the bonds), the Fed is a major player. Its actions in the market for government bonds are large enough to have discernible effects on the whole market. Expansionary policies tend to raise bond prices and lower bond yields and interest rates; contractionary policies do the opposite.

Figure 11.5(a) and 11.5(b) The Market for Government Bonds

(a)

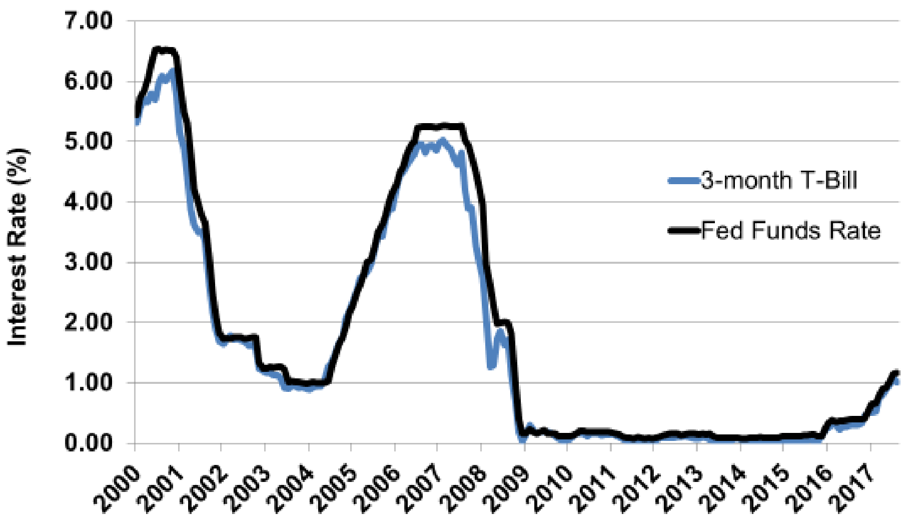


(b)



A simplified (secondary) bond market is shown in Figure 11.5(a). The price of bonds (and the corresponding nominal interest rate) is on the vertical axis and the quantity on the horizontal. The supply curve, in this case, is determined by the willingness of people to sell bonds—that is, to exchange their government debt for cash, which means, in effect, to *stop* lending to the government. The demand curve is determined by people's willingness to buy bonds—that is, to lend to the government. The effect of a Fed open market purchase of bonds is illustrated in Figure 11.5(b). A sizable Fed *purchase* shifts the demand curve for government bonds to the right. As a result, the price of bonds rises. Because bond prices and interest rates are inversely related, the rise in the price of bonds means that the going interest rate on them falls.[**]

Figure 11.6 The Federal Funds and Three-Month Treasury Bill Rates, 2000-2017



Although this explanation focuses on the market for government bonds, it is actually parallel to the earlier discussion of the Fed and the market for federal funds. The interest rate for three-month Treasury bills and the federal funds rate are graphed together in Figure 11.6 and they track each other closely. The bottom line of this story is the same as that given by the model of federal funds used in this chapter: A Fed open market purchase drives down interest rates.

APPENDIX B: SHORT VERSUS LONG-RUN AND REAL VERSUS NOMINAL INTEREST RATES

In the model of interest rates and aggregate expenditure discussed in Section 4 of Chapter 11, we assumed that the Fed, through open market operations, could change the interest rate that influences investment spending. In Figure 11.3 we used the symbol r to denote a generalized interest rate. In real life, however, many different interest rates have to be taken into account.

Here we present some basic facts about short-run vs. long-run and real vs. nominal interest rates.

[**] The exact relationship depends on the time to maturity of the bond. The longer this time, the greater the impact of an interest rate change on the bond price.

We also note the difference between the Fed's focus on the short-term, nominal interest rate and the interest rate that investors often consider the most relevant: that is, the long-term, real interest rate.

In Section 4.1 we discussed the federal funds rate as the principal interest rate targeted by the Fed. This is a short-term, nominal interest rate. It is short term, because while this rate is quoted in annualized terms (that is, what borrowers would pay if they kept the loan for a year), the loans are actually made on one day and paid back the next. The Fed uses a portfolio of government securities with various maturity dates in its open market operations, but many of them have maturity dates of three years or less. The federal funds rate—like any interest rate that you normally see quoted—is a *nominal* interest rate, not adjusted for inflation. The interest rates determined in markets for loanable funds are always nominal rates.

But if you are considering undertaking a substantial business investment project or buying a house, the interest rate that you should be taking into account, if you are a rational decision maker, is the *real* interest rate over the life of the business loan or mortgage. The **real interest rate** is:

$$r = i - \pi$$

where r is the real interest rate, i is the nominal interest rate, and π is the rate of inflation.

real interest rate: nominal interest rate minus inflation, $r = i - \pi$

For example, suppose that you borrow $100 for one year at a nominal rate of 6 percent. You will pay back $106 at the end of the year. If the inflation rate is 0, then the purchasing power of the amount that you pay back at the end of the year is actually $6 more than the amount you borrowed. However, if inflation is 4 percent during the year, the $106 that you pay back is in "cheaper" dollars (dollars that can buy less) than the dollars that you borrowed. The real interest rate on your borrowing will be only 2 percent. The higher the inflation rate, the better the deal is for a borrower at any given nominal rate (and the worse it is for the lender).

If inflation is fairly low and steady—as we assumed in the aggregate expenditure model—then this difference between real and nominal interest rates is not of crucial importance. If inflation is steady at, say, 2 percent, then both lenders and borrowers mentally subtract 2 percent to calculate the real rate that corresponds to any nominal rate. If the Fed lowers the prime rate from 8 percent to 5 percent, for example, then it correspondingly lowers the real rate from 6 percent to 3 percent.

In recent decades, inflation has been fairly low, usually between 1 and 3 percent. But inflation is not always so predictable. When inflation is high or variable, it is very important to realize that investors' decisions are in reality influenced by the **expected real interest rate**, r_e:

$$r_e = i - \pi_e$$

where i is the nominal rate the borrower agrees to pay and π^e is the *expected* inflation rate.

expected real interest rate: the nominal interest rate minus expected inflation, $r = i - \pi$

The actual real interest rate (r) can be known only with hindsight. That is, only *after* information on inflation has come for last month or last year, can you calculate what the real interest rate *was* in that period. But you never know with certainty what the real interest rate is right now or what it will be next year. The more changeable inflation is, the harder it is to form reliable expectations about real interest rates.

Since investors are usually interested in long-run, real interest rates, while the Fed controls primarily short-run, nominal interest rates, the impacts of various Fed policies on the economy may not be as straightforward as our basic models imply.

APPENDIX C: THE TRADITIONAL MODEL FOR MONEY SUPPLY AND MONEY DEMAND

Some find it helpful to look at the money supply in the context of a "market" for money in which there is also a demand side. Since nearly everyone wants more money, what exactly does it mean that money is "demanded?" Here it is important to recall the distinction made in Chapter 11 between money in the sense of a purely liquid asset such as currency, and other less liquid "non-money" assets like stocks or real estate. For our purposes, money demand will represent the extent to which we prefer to hold our household assets in liquid form.

Why not hold *all* of our assets as money? Typically, one earns little or no interest from keeping money in cash or checking accounts. So in a sense, the expected return (interest, dividend, or profit) on one's relatively illiquid assets represents the *opportunity cost* of holding money, since that return is sacrificed whenever one holds liquid money instead of assets. Yet it should be clear that there are also costs to holding no liquid money.

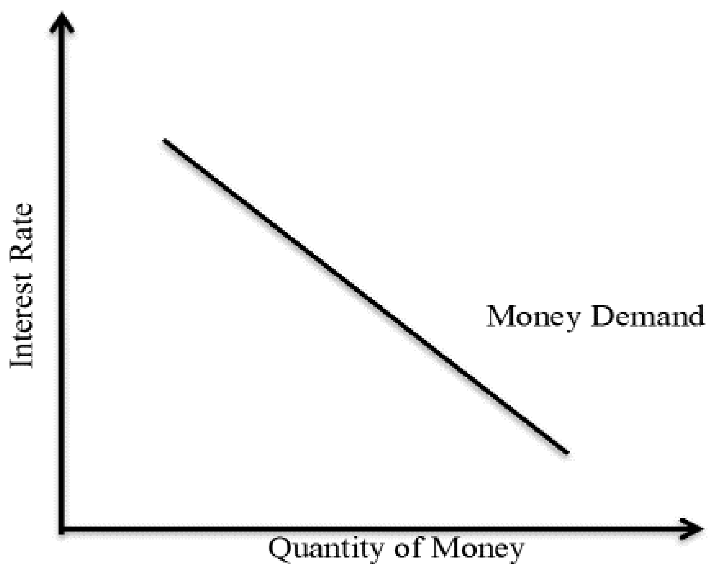
There are essentially three reasons that people choose to hold some of their assets as money. The first of these is known as the **transactions demand** for money, which is based on our need to finance our day-to-day existence. We need liquidity, for example, to make purchases at the grocery store or to pay our monthly bills. The second type of money demand is called **precautionary demand**, which is explained by our general need to always hold "a little extra" in case, for instance, our car broke down or we had to drop everything and travel to help a relative. Finally, some people like to keep some extra money liquid—often in a "cash account" with their broker—to readily exploit any new and often unpredictable investment opportunities. Such a demand for money is known as **speculative demand**.

transactions demand: the demand for money to pay for the goods and services that satisfy our day-to-day needs
precautionary demand: the demand for money to pay for contingencies
speculative demand: the demand for money to exploit new expectations of changes in asset prices

Together, these three types of demand constitute the overall demand for money in a market. As with any other commodity, the "cheaper" it is, the greater will be the quantity demanded. In this case, since we do not "buy" money in the store, its cheapness amounts to how little we give up by holding it (i.e., what is the opportunity cost of holding money).

So if we use the prevailing interest rate to represent the return on non-liquid assets* (see Figure 27.11), we can show how the money demanded in an economy varies according to its relative cheapness. As with any other theorized demand curve, the one for money is downward sloping. Like other demand curves, the money demand curve may *shift* as a result of a change in transactions, precautionary, or speculative demand for money. (This corresponds to what we have discussed above as a change in the velocity of money.)

Figure 11.7 The Demand Curve for Money

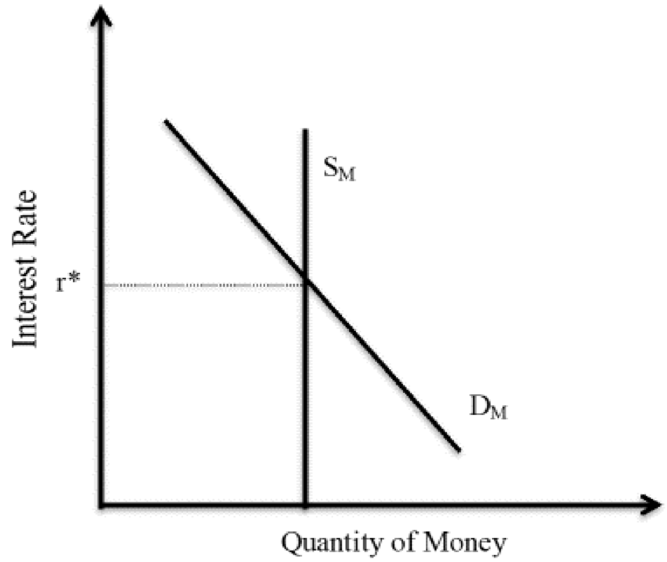


The supply curve for money shows the relationship between the quantity of money supplied and the market interest rate. But since the Fed, through open market operations, determines the quantity of bank reserves—and, through the money multiplier, the money supply—this analysis assumes that the Fed more or less "dictates" the money supply independent of prevailing interest rates. The result is a money supply curve that is vertical instead of the more familiar upward sloping curve. Together with money demand, it determines the equilibrium interest rate r* (Figure 11.8).†

* This is, of course, an enormous simplification, since in the real world there exist an almost endless variety of assets that vary in terms of liquidity, risk, and other factors. Moreover, many pay dividends or even profits instead of an interest rate. The main point about money demand is in no way invalidated, however, by the simplification.

† As noted earlier, Post Keynesian, Modern Monetary Theorists, and indeed, some central bankers strongly disagree with the traditional theory of money supply and money demand as it presented here. For example, some Post Keynesians such Basil Moore argue that curve for the money supply is vertical.

Figure 11.8 The Supply Curve for Money



In this approach it is not the case that the interest rate influences or determines the money supply. Rather, it is the money supply – or, to be precise, the point of equilibrium between it and money demand – that determines the interest rate. And as shown in Figure 11.9, when the Fed increases the money supply, the interest rate goes down. It should make sense since, *ceteris paribus*, the more money is available, the "cheaper" it is. The opposite would happen if the Fed decreased the money supply. Using a similar logic, you can determine for yourself the consequences of a shift in money *demand*.

Figure 11.9 An Increase in the Money Supply