BOSTON UNIVERSITY

Global Development Policy Center

Economics in Context Initiative

Chapter 11: Money and Monetary Policy

Appendix

Appendix to Chapter 11 of Essentials of Economics in Context, Second Edition

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APPENDICES: BOND PRICES, INTEREST RATES, AND REAL VERSUS NOMINAL INTEREST RATES

A1 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 Chapter 11. 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 special characteristics. 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.

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 $\$105/(1 + .02) \approx \$102.94$.

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 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 effects on the whole market. In the limited reserve monetary system, expansionary policies tend to raise bond prices and lower bond yields and interest rates; contractionary policies do the opposite.

A simplified (secondary) bond market is shown in Figure 11A.1(a). The price of bonds (and the corresponding nominal interest rate) is on the vertical axis and the quantity on the horizontal axis. 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. The demand curve is determined by people's willingness to buy bonds. This gives an equilibrium interest rate, shown in this example as 5 percent.

The effect of a Fed open market purchase of bonds is illustrated in Figure 11A.1(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. In this example the price rises to \$103, and the interest rate falls to 2 percent.

Figure 11A.1(a) The Market for Government Bonds

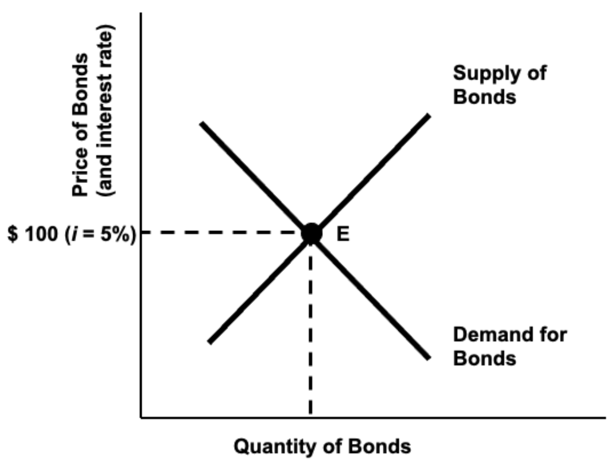


Figure 11A.1(b) Impact of Fed's Open Market Purchase of Bonds

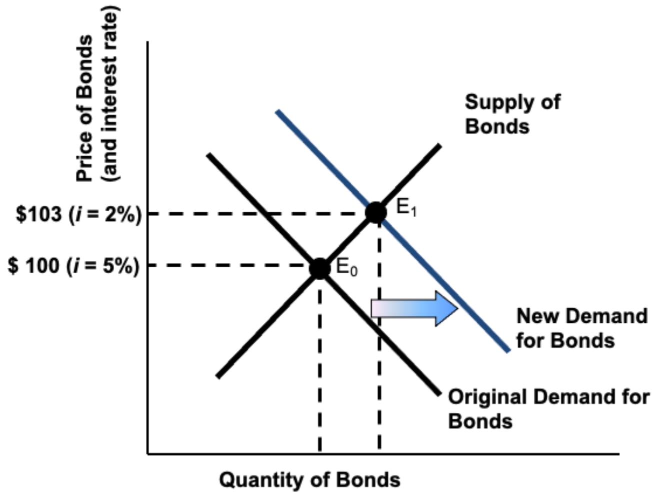
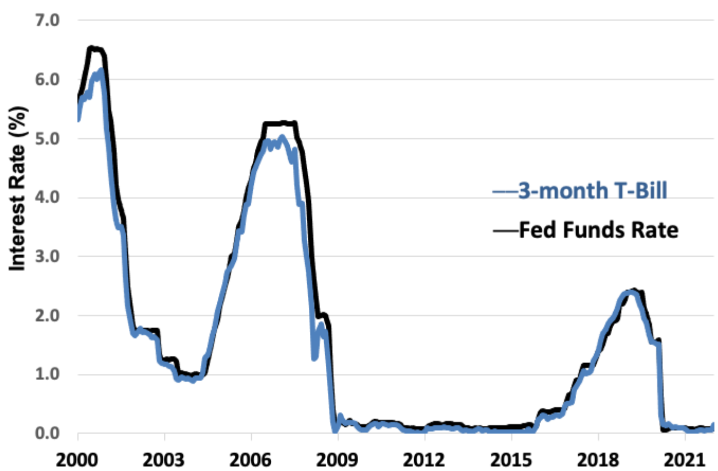


Figure 11A.2 The Federal Funds and Three-Month Treasury Bill Rates, 2000–2021



Source: Federal Reserve, monthly data.

Although this explanation focuses on the market for government bonds, it closely parallels 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 11A.2, and we can see that 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 Chapter 11: A Fed open market purchase drives down interest rates.

A2. SHORT VERSUS LONG-RUN AND REAL VERSUS NOMINAL INTEREST RATES

In the discussion of interest rates and investments in Section 4 of Chapter 11, we assumed that a change the interest rate influences investment spending. In Figure 11.5 in the textbook 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. We also note the difference between the Fed's focus on the short-term, nominal interest rate and the interest rate that is often most important to investors: that is, the long-term, real interest rate.

The federal funds rate, which is the principal interest rate, targeted by the Fed 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 federal funds rate—like any interest rate that you normally see quoted—is a *nominal* interest rate, not adjusted for inflation.

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, 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.

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, $r_e = i - \pi_e$

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-term, real interest rates, while the Fed controls primarily short-term, nominal interest rates, the impacts of various Fed policies on the economy may not be as straightforward as our basic models imply. In making decisions that affect economic activity, investors will consider both the short-term interest rates strongly affected by Fed policy, and long-term rates taking into account expected inflation.