Chapter 5

The Behavior of Interest Rates

PREVIEW

In the early 1950s, nominal interest rates on three-month Treasury bills were about 1% at an annual rate; by 1981, they had reached over 15%, then fell to 3% in 1993, rose to above 5% by the mid-1990s, and fell below 2% in the early 2000s. What explains these substantial fluctuations in interest rates? One reason why we study money, banking, and financial markets is to provide some answers to this question.

In this chapter, we examine how the overall level of *nominal* interest rates (which we refer to as simply "interest rates") is determined and which factors influence their behavior. We learned in Chapter 4 that interest rates are negatively related to the price of bonds, so if we can explain why bond prices change, we can also explain why interest rates fluctuate. To do this, we make use of supply and demand analysis for bond markets and money markets to examine how interest rates change.

In order to derive a demand curve for assets like money or bonds, the first step in our analysis, we must first understand what determines the demand for these assets. We do this by examining an economic theory known as the *theory of asset demand,* which outlines criteria that are important when deciding how much of an asset to buy. Armed with this theory, we can then go on to derive the demand curve for bonds or money. After deriving supply curves for these assets, we develop the concept of *market equilibrium*, the point at which the quantity supplied equals the quantity demanded. Then we use this model to explain changes in equilibrium interest rates.

Because interest rates on different securities tend to move together, in this chapter we will proceed as if there were only one type of security and a single interest rate in the entire economy. In the following chapter, we expand our analysis to look at why interest rates on different types of securities differ.

Determinants of Asset Demand

Before going on to our supply and demand analysis of the bond market and the market for money, we must first understand what determines the quantity demanded of an asset. Recall that an asset is a piece of property that is a store of value. Items such as money, bonds, stocks, art, land, houses, farm equipment, and manufacturing machinery are all assets. Facing the question of whether to buy and hold an asset or

whether to buy one asset rather than another, an individual must consider the following factors:

1. **Wealth**, the total resources owned by the individual, including all assets
2. **Expected return** (the return expected over the next period) on one asset relative to alternative assets
3. **Risk** (the degree of uncertainty associated with the return) on one asset relative to alternative assets
4. **Liquidity** (the ease and speed with which an asset can be turned into cash) relative to alternative assets

Study Guide

As we discuss each factor that influences asset demand, remember that we are always holding all the other factors constant. Also, think of additional examples of how changes in each factor would influence your decision to purchase a particular asset: say, a house or a share of common stock. This intuitive approach will help you understand how the theory works in practice.

Wealth

When we find that our wealth has increased, we have more resources available with which to purchase assets, and so, not surprisingly, the quantity of assets we demand increases. Therefore, the effect of changes in wealth on the quantity demanded of an asset can be summarized as follows: ***Holding everything else constant, an increase in wealth raises the quantity demanded of an asset.***

Expected Returns

In Chapter 4, we saw that the return on an asset (such as a bond) measures how much we gain from holding that asset. When we make a decision to buy an asset, we are influenced by what we expect the return on that asset to be. If a Mobil Oil Corporation bond, for example, has a return of 15% half the time and 5% the other half of the time, its expected return (which you can think of as the average return) is 10% ($= 0.5 \times 15\% + 0.5 \times 5\%$).[1] If the expected return on the Mobil Oil bond rises relative to expected returns on alternative assets, holding everything else constant, then it becomes more desirable to purchase it, and the quantity demanded increases. This can occur in either of two ways: (1) when the expected return on the Mobil Oil bond rises while the return on an alternative asset—say, stock in IBM—remains unchanged or (2) when the return on the alternative asset, the IBM stock, falls while the return on the Mobil Oil bond remains unchanged. To summarize, ***an increase in an asset's expected return relative to that of an alternative asset, holding everything else unchanged, raises the quantity demanded of the asset.***

[1] If you are interested in finding out more information on how to calculate expected returns, as well as standard deviations of returns that measure risk, you can look at an appendix to this chapter describing models of asset pricing that is on this book's web site at www.aw.com/mishkin. This appendix also describes how diversification lowers the overall risk of a portfolio and has a discussion of systematic risk and basic asset pricing models such as the capital asset pricing model and arbitrage pricing theory.

Risk

The degree of risk or uncertainty of an asset's returns also affects the demand for the asset. Consider two assets, stock in Fly-by-Night Airlines and stock in Feet-on-the-Ground Bus Company. Suppose that Fly-by-Night stock has a return of 15% half the time and 5% the other half of the time, making its expected return 10%, while stock in Feet-on-the-Ground has a fixed return of 10%. Fly-by-Night stock has uncertainty associated with its returns and so has greater risk than stock in Feet-on-the-Ground, whose return is a sure thing.

A *risk-averse* person prefers stock in Feet-on-the-Ground (the sure thing) to Fly-by-Night stock (the riskier asset), even though the stocks have the same expected return, 10%. By contrast, a person who prefers risk is a *risk preferrer* or *risk lover.* Most people are risk-averse, especially in their financial decisions: Everything else being equal, they prefer to hold the less risky asset. Hence, ***holding everything else constant, if an asset's risk rises relative to that of alternative assets, its quantity demanded will fall.***

Liquidity

Another factor that affects the demand for an asset is how quickly it can be converted into cash at low costs—its liquidity. An asset is liquid if the market in which it is traded has depth and breadth; that is, if the market has many buyers and sellers. A house is not a very liquid asset, because it may be hard to find a buyer quickly; if a house must be sold to pay off bills, it might have to be sold for a much lower price. And the transaction costs in selling a house (broker's commissions, lawyer's fees, and so on) are substantial. A U.S. Treasury bill, by contrast, is a highly liquid asset. It can be sold in a well-organized market where there are many buyers, so it can be sold quickly at low cost. ***The more liquid an asset is relative to alternative assets, holding everything else unchanged, the more desirable it is, and the greater will be the quantity demanded.***

Theory of Asset Demand

All the determining factors we have just discussed can be assembled into the **theory of asset demand**, which states that, holding all of the other factors constant:

1. The quantity demanded of an asset is positively related to wealth.
2. The quantity demanded of an asset is positively related to its expected return relative to alternative assets.
3. The quantity demanded of an asset is negatively related to the risk of its returns relative to alternative assets.
4. The quantity demanded of an asset is positively related to its liquidity relative to alternative assets.

These results are summarized in Table 1.

Supply and Demand in the Bond Market

Our first approach to the analysis of interest-rate determination looks at supply and demand in the bond market. The first step in the analysis is to obtain a bond **demand curve**, which shows the relationship between the quantity demanded and the price when all other economic variables are held constant (that is, values of other variables are taken as given). You may recall from previous economics courses that the

SUMMARY **Table 1 Response of the Quantity of an Asset Demanded to Changes in Wealth, Expected Returns, Risk, and Liquidity**

Variable	Change in Variable	Change in Quantity Demanded
Wealth	↑	↑
Expected return relative to other assets	↑	↑
Risk relative to other assets	↑	↓
Liquidity relative to other assets	↑	↑

Note: Only increases in the variables are shown. The effect of decreases in the variables on the change in demand would be the opposite of those indicated in the rightmost column.

assumption that all other economic variables are held constant is called *ceteris paribus*, which means "other things being equal" in Latin.

Demand Curve

To clarify our analysis, let us consider the demand for one-year discount bonds, which make no coupon payments but pay the owner the $1,000 face value in a year. If the holding period is one year, then as we have seen in Chapter 4, the return on the bonds is known absolutely and is equal to the interest rate as measured by the yield to maturity. This means that the expected return on this bond is equal to the interest rate i, which, using Equation 6 in Chapter 4, is:

$$i = RET^e = \frac{F - P}{P}$$

where i = interest rate = yield to maturity
RET^e = expected return
F = face value of the discount bond
P = initial purchase price of the discount bond

This formula shows that a particular value of the interest rate corresponds to each bond price. If the bond sells for $950, the interest rate and expected return is:

$$\frac{\$1{,}000 - \$950}{\$950} = 0.053 = 5.3\%$$

At this 5.3% interest rate and expected return corresponding to a bond price of $950, let us assume that the quantity of bonds demanded is $100 billion, which is plotted as point A in Figure 1. To display both the bond price and the corresponding interest rate, Figure 1 has two vertical axes. The left vertical axis shows the bond price, with the price of bonds increasing from $750 near the bottom of the axis toward $1,000 at the top. The right vertical axis shows the interest rate, which increases in the *opposite* direction from 0% at the top of the axis to 33% near the bottom. The right and left vertical axes run in opposite directions because, as we learned in Chapter 4, bond

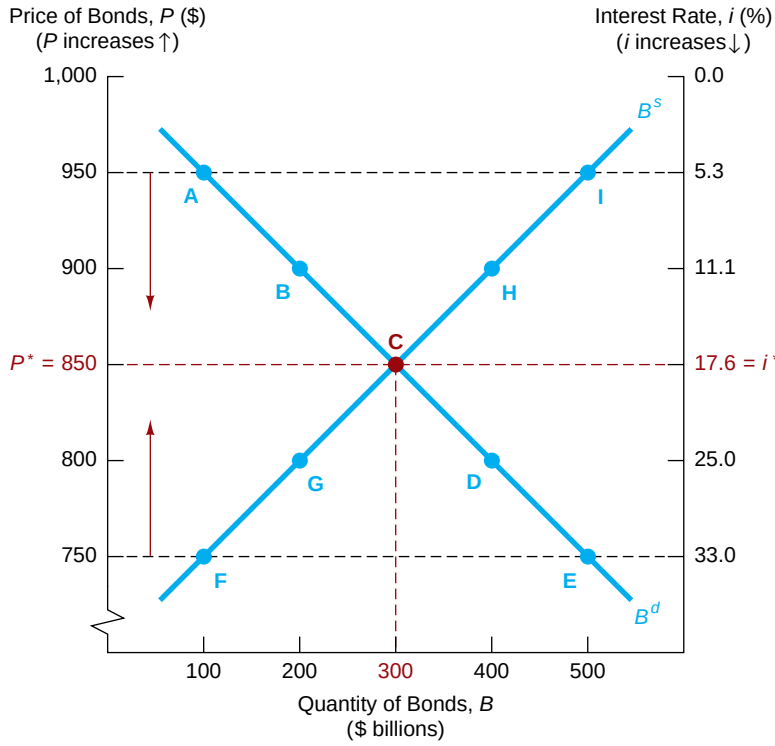

FIGURE 1 Supply and Demand for Bonds

Equilibrium in the bond market occurs at point C, the intersection of the demand curve B^d and the bond supply curve B^s. The equilibrium price is $P^* = \$850$, and the equilibrium interest rate is $i^* = 17.6\%$. (*Note:* P and i increase in opposite directions. P on the left vertical axis increases as we go up the axis from \$750 near the bottom to \$1,000 at the top, while i on the right vertical axis increases as we go down the axis from 0% at the top to 33% near the bottom.)

price and interest rate are always negatively related: As the price of the bond rises, the interest rate on the bond necessarily falls.

At a price of \$900, the interest rate and expected return equals:

$$\frac{\$1{,}000 - \$900}{\$900} = 0.111 = 11.1\%$$

Because the expected return on these bonds is higher, with all other economic variables (such as income, expected returns on other assets, risk, and liquidity) held constant, the quantity demanded of bonds will be higher as predicted by the theory of asset demand. Point B in Figure 1 shows that the quantity of bonds demanded at the price of \$900 has risen to \$200 billion. Continuing with this reasoning, if the bond price is \$850 (interest rate and expected return = 17.6%), the quantity of bonds demanded (point C) will be greater than at point B. Similarly, at the lower prices of \$800 (interest rate = 25%) and \$750 (interest rate = 33.3%), the quantity of bonds demanded will be even higher (points D and E). The curve B^d, which connects these points, is the demand curve for bonds. It has the usual downward slope, indicating that at lower prices of the bond (everything else being equal), the quantity demanded is higher.[2]

[2]Note that although our analysis indicates that the demand curve is downward-sloping, it does not imply that the curve is a straight line. For ease of exposition, however, we will draw demand curves and supply curves as straight lines.

Supply Curve

An important assumption behind the demand curve for bonds in Figure 1 is that all other economic variables besides the bond's price and interest rate are held constant. We use the same assumption in deriving a **supply curve**, which shows the relationship between the quantity supplied and the price when all other economic variables are held constant.

When the price of the bonds is \$750 (interest rate = 33.3%), point F shows that the quantity of bonds supplied is \$100 billion for the example we are considering. If the price is \$800, the interest rate is the lower rate of 25%. Because at this interest rate it is now less costly to borrow by issuing bonds, firms will be willing to borrow more through bond issues, and the quantity of bonds supplied is at the higher level of \$200 billion (point G). An even higher price of \$850, corresponding to a lower interest rate of 17.6%, results in a larger quantity of bonds supplied of \$300 billion (point C). Higher prices of \$900 and \$950 result in even greater quantities of bonds supplied (points H and I). The B^s curve, which connects these points, is the supply curve for bonds. It has the usual upward slope found in supply curves, indicating that as the price increases (everything else being equal), the quantity supplied increases.

Market Equilibrium

In economics, **market equilibrium** occurs when the amount that people are willing to buy (*demand*) equals the amount that people are willing to sell (*supply*) at a given price. In the bond market, this is achieved when the quantity of bonds demanded equals the quantity of bonds supplied:

$$B^d = B^s \tag{1}$$

In Figure 1, equilibrium occurs at point C, where the demand and supply curves intersect at a bond price of \$850 (interest rate of 17.6%) and a quantity of bonds of \$300 billion. The price of $P^* = 850$, where the quantity demanded equals the quantity supplied, is called the *equilibrium* or *market-clearing* price. Similarly, the interest rate of $i^* = 17.6\%$ that corresponds to this price is called the equilibrium or market-clearing interest rate.

The concepts of market equilibrium and equilibrium price or interest rate are useful, because there is a tendency for the market to head toward them. We can see that it does in Figure 1 by first looking at what happens when we have a bond price that is above the equilibrium price. When the price of bonds is set too high, at, say, \$950, the quantity of bonds supplied at point I is greater than the quantity of bonds demanded at point A. A situation like this, in which the quantity of bonds supplied exceeds the quantity of bonds demanded, is called a condition of **excess supply**. Because people want to sell more bonds than others want to buy, the price of the bonds will fall, and this is why the downward arrow is drawn in the figure at the bond price of \$950. As long as the bond price remains above the equilibrium price, there will continue to be an excess supply of bonds, and the price will continue to fall. This will stop only when the price has reached the equilibrium price of \$850, where the excess supply of bonds has been eliminated.

Now let's look at what happens when the price of bonds is below the equilibrium price. If the price of the bonds is set too low, at, say, \$750, the quantity demanded at point E is greater than the quantity supplied at point F. This is called a condition of **excess demand**. People now want to buy more bonds than others are willing to sell, and so the price of bonds will be driven up. This is illustrated by the upward arrow drawn in the figure at the bond price of \$750. Only when the excess demand for

bonds is eliminated by the price rising to the equilibrium level of $850 is there no further tendency for the price to rise.

We can see that the concept of equilibrium price is a useful one because it indicates where the market will settle. Because each price on the left vertical axis of Figure 1 corresponds to a value of the interest rate on the right vertical axis, the same diagram also shows that the interest rate will head toward the equilibrium interest rate of 17.6%. When the interest rate is below the equilibrium interest rate, as it is when it is at 5.3%, the price of the bond is above the equilibrium price, and there will be an excess supply of bonds. The price of the bond then falls, leading to a rise in the interest rate toward the equilibrium level. Similarly, when the interest rate is above the equilibrium level, as it is when it is at 33.3%, there is excess demand for bonds, and the bond price will rise, driving the interest rate back down to the equilibrium level of 17.6%.

Supply and Demand Analysis

Our Figure 1 is a conventional supply and demand diagram with price on the left vertical axis and quantity on the horizontal axis. Because the interest rate that corresponds to each bond price is also marked on the right vertical axis, this diagram allows us to read the equilibrium interest rate, giving us a model that describes the determination of interest rates. It is important to recognize that a supply and demand diagram like Figure 1 can be drawn for *any* type of bond because the interest rate and price of a bond are *always* negatively related for any type of bond, whether a discount bond or a coupon bond.

Loanable Funds Framework

Throughout this book we will use diagrams like Figure 1 and analyze interest rate behavior in terms of the supply and demand for bonds. However, the analysis of the bond market that we have developed here has another interpretation with a different terminology. Here we discuss this other terminology, which is couched in terms of the supply and demand for loanable funds used by some economists. We include this discussion in case you come across this other terminology, but you will not need to make use of it to understand how interest rates are determined.

One disadvantage of the diagram in Figure 1 is that interest rates run in an unusual direction on the right vertical axis: As we go up the right axis, interest rates fall. Because economists are typically more concerned with the value of interest rates than with the price of bonds, we could plot the supply of and demand for bonds on a diagram that has only a left vertical axis that provides the values of the interest rates running in the usual direction, rising as we go up the axis. Figure 2 is such a diagram, in which points A through I match the corresponding points in Figure 1.

However, making interest rates run in the "usual" direction on the vertical axis presents us with a problem. Our demand curve for bonds, points A through E, now looks peculiar because it has an upward slope. This upward slope is, however, completely consistent with our usual demand analysis, which produces a negative relationship between price and quantity. The inverse relationship between bond prices and interest rates means that in moving from point A to point B to point C, bond prices are falling and, consistent with usual demand analysis, the quantity demanded is rising. Similarly, our supply curve for bonds, points F through I, has an unusual-looking downward slope but is completely consistent with the usual view that price and the quantity supplied are positively related.

One way to give the demand curve the usual downward slope and the supply curve the usual upward slope is to rename the horizontal axis and the demand and

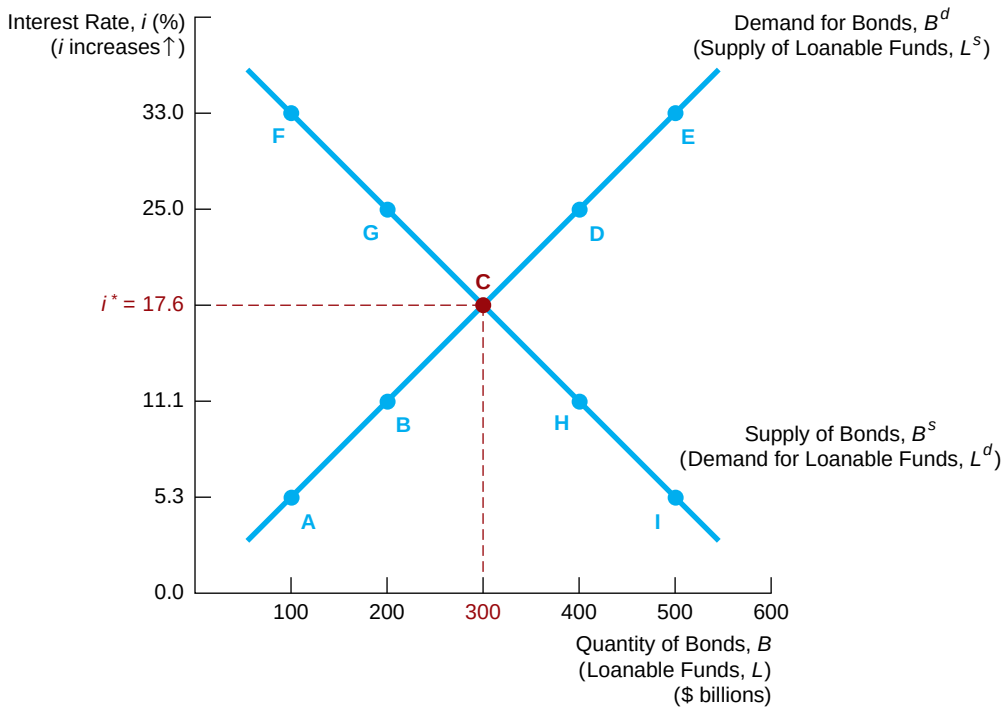

FIGURE 2 A Comparison of Terminology: Loanable Funds and Supply and Demand for Bonds
The demand for bonds is equivalent to the supply of loanable funds, and the supply of bonds is equivalent to the demand for loanable funds. (*Note:* i increases as we go up the vertical axis, in contrast to Figure 1, in which the opposite occurs.)

supply curves. Because a firm supplying bonds is in fact taking out a loan from a person buying a bond, "supplying a bond" is equivalent to "demanding a loan." Thus the supply curve for bonds can be reinterpreted as indicating the *quantity of loans demanded* for each value of the interest rate. If we rename the horizontal axis **loanable funds**, defined as the quantity of loans, the supply of bonds can be reinterpreted as the *demand for loanable funds*. Similarly, the demand curve for bonds can be reidentified as the *supply of loanable funds* because buying (demanding) a bond is equivalent to supplying a loan. Figure 2 relabels the curves and the horizontal axis using the loanable funds terminology in parentheses, and now the renamed loanable funds demand curve has the usual downward slope and the renamed loanable funds supply curve the usual upward slope.

Because supply and demand diagrams that explain how interest rates are determined in the bond market often use the loanable funds terminology, this analysis is frequently referred to as the **loanable funds framework**. However, because in later chapters describing the conduct of monetary policy we focus on how the demand for and supply of bonds is affected, we will continue to conduct supply and demand analysis in terms of bonds, as in Figure 1, rather than loanable funds. Whether the analysis is done in terms of loanable funds or in terms of the demand for and supply

of bonds, the results are the same: The two ways of analyzing the determination of interest rates are equivalent.

An important feature of the analysis here is that supply and demand are always in terms of *stocks* (amounts at a given point in time) of assets, not in terms of *flows*. This approach is somewhat different from certain loanable funds analyses, which are conducted in terms of flows (loans per year). The **asset market approach** for understanding behavior in financial markets—which emphasizes stocks of assets rather than flows in determining asset prices—is now the dominant methodology used by economists, because correctly conducting analyses in terms of flows is very tricky, especially when we encounter inflation.[3]

Changes in Equilibrium Interest Rates

We will now use the supply and demand framework for bonds to analyze why interest rates change. To avoid confusion, it is important to make the distinction between *movements along* a demand (or supply) curve and *shifts in* a demand (or supply) curve. When quantity demanded (or supplied) changes as a result of a change in the price of the bond (or, equivalently, a change in the interest rate), we have a *movement along* the demand (or supply) curve. The change in the quantity demanded when we move from point A to B to C in Figure 1, for example, is a movement along a demand curve. A *shift in* the demand (or supply) curve, by contrast, occurs when the quantity demanded (or supplied) changes *at each given price (or interest rate)* of the bond in response to a change in some other factor besides the bond's price or interest rate. When one of these factors changes, causing a shift in the demand or supply curve, there will be a new equilibrium value for the interest rate.

In the following pages, we will look at how the supply and demand curves shift in response to changes in variables, such as expected inflation and wealth, and what effects these changes have on the equilibrium value of interest rates.

Shifts in the Demand for Bonds

The theory of asset demand demonstrated at the beginning of the chapter provides a framework for deciding what factors cause the demand curve for bonds to shift. These factors include changes in four parameters:

1. Wealth
2. Expected returns on bonds relative to alternative assets
3. Risk of bonds relative to alternative assets
4. Liquidity of bonds relative to alternative assets

To see how a change in each of these factors (holding all other factors constant) can shift the demand curve, let us look at some examples. (As a study aid, Table 2 summarizes the effects of changes in these factors on the bond demand curve.)

[3]The asset market approach developed in the text is useful in understanding not only how interest rates behave but also how any asset price is determined. A second appendix to this chapter, which is on this book's web site at www.aw.com/mishkin, shows how the asset market approach can be applied to understanding the behavior of commodity markets; in particular, the gold market.