5 The Behavior of Interest Rates

Learning Objectives

- Identify the factors that affect the demand for assets.
- Draw the demand and supply curves for the bond market, and identify the equilibrium interest rate.
- List and describe the factors that affect the equilibrium interest rate in the bond market.
- Describe the connection between the bond market and the money market through the liquidity preference framework.
- List and describe the factors that affect the money market and the equilibrium interest rate.
- Identify and illustrate the effects on the interest rate of changes in money growth over time.

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%. They fell below 1% in 2003, rose to 5% in 2007, and then fell to close to zero in 2008 and for many years afterward. 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 simply as "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. We make use of supply and demand analysis for bond markets and markets for money to examine how interest rates change.

To derive a demand curve for assets such as 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 *portfolio theory*, an economic theory that 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*, which is defined as 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 one 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. Faced with 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

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 an ExxonMobil bond, for example, has a return of 15% half the time and 5% the other half, 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 ExxonMobil bond rises relative to expected returns on alternative assets, then, holding everything else constant, it becomes more desirable to purchase the ExxonMobil bond, and the quantity demanded increases. This can occur in either of two ways: (1) when the expected return on the ExxonMobil bond rises while the return on an alternative asset—say, stock in Google—remains unchanged or (2) when the return on the alternative asset, the Google stock, falls while the return on the ExxonMobil 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.***

Risk

The degree of risk or uncertainty of an asset's returns also affects 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, making its expected return 10%, while Feet-on-the-Ground stock has a fixed return of 10%. Fly-by-Night stock has uncertainty associated with its returns and so has greater risk than Feet-on-the-Ground stock, whose return is a sure thing.

[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, the Companion Website at http://www.pearsonglobaleditions.com/Mishkin contains an appendix to this chapter describing models of asset pricing. This appendix also describes how diversification lowers the overall risk of a portfolio and includes a discussion of systematic risk and basic asset pricing models, such as the capital asset pricing model and the arbitrage pricing theory.

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 associated with 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 with many buyers, and 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 the quantity demanded will be.***

Theory of Portfolio Choice

All the determining factors we have just discussed can be assembled into the **theory of portfolio choice**, which tells us how much of an asset people will want to hold in their portfolios. It states that, holding all 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.

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 effects of decreases in the variables on the quantity demanded would be the opposite of those indicated in the rightmost column.

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 so that we can better understand how the prices of bonds are determined. Thanks to our knowledge from Chapter 4 of how interest rates are measured, we know that each bond price is associated with a particular level of the interest rate. Specifically, the negative relationship between bond prices and interest rates means that when a bond's price rises, its interest rate falls, and vice versa.

The first step in our 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 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 and simplify our analysis, let's 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 saw 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

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

where
i = interest rate = yield to maturity
R^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 are

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

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.

At a price of $900, the interest rate and expected return are

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

Because the expected return is higher, with all other economic variables (such as income, expected returns on other assets, risk, and liquidity) held constant, the quantity demanded of these bonds will be higher, as predicted by portfolio theory. 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, we see that if the bond price is $850 (interest rate and expected return = 17.6%), the quantity of bonds demanded (point C)

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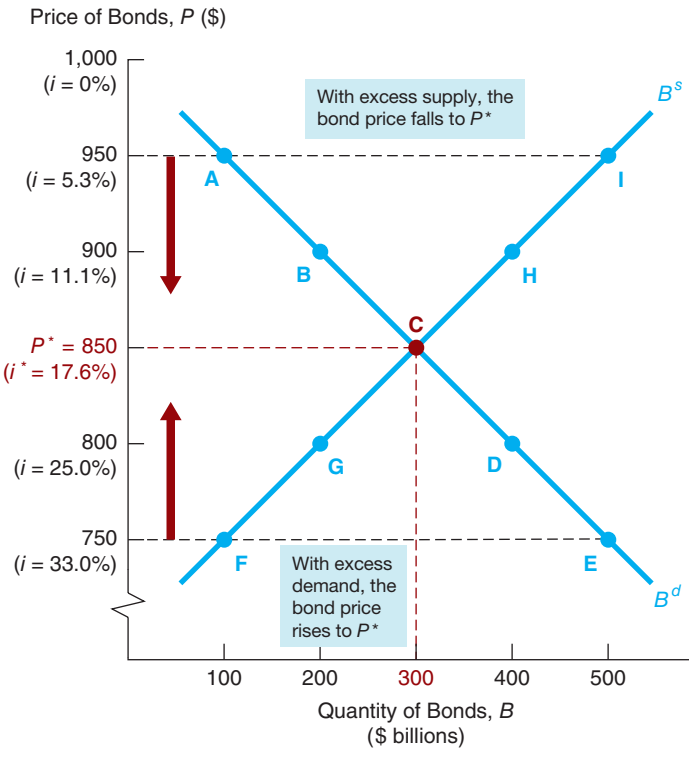
FIGURE 1
Supply and Demand for Bonds

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 $i^* = 17.6\%$.



will be greater than at point B. Similarly, at the even 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]

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.

In Figure 1, 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

[2]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.

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 lower interest rates and 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 the market tends to head toward them. We can see this 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, as shown by the downward arrow in the figure at the bond price of $950. As long as the bond price remains above the equilibrium price, an excess supply of bonds will continue to be available, and the price of bonds will continue to fall. This decline will stop only when the price has reached the equilibrium price of $850, the price at which 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, so the price of bonds will be driven up, as illustrated by the upward arrow in the figure at the bond price of $750. Only when the excess demand for bonds is eliminated by the bond 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 vertical axis of Figure 1 corresponds to a particular value of the interest rate, 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 an excess supply of bonds results. 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%, an excess demand for bonds occurs, and the bond price rises, 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 vertical axis and quantity on the horizontal axis. Because the interest rate that corresponds to each bond price is also marked on the 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 all kinds of bonds, whether a discount bond or a coupon bond.

An important feature of the analysis here is that supply and demand are always described in terms of *stocks* (amounts at a given point in time) of assets, not in terms of *flows*. The **asset market approach** for understanding behavior in financial markets—which emphasizes stocks of assets, rather than flows, in determining asset prices—is 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.

[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 the Companion Website at http://www.pearsonglobaleditions.com/Mishkin, shows how the asset market approach can be applied to understanding the behavior of commodity markets—in particular, the gold market. The analysis of the bond market that we have developed here has another interpretation that uses a different terminology and framework involving the supply and demand for loanable funds. This loanable funds framework is discussed in a third appendix to this chapter, which is also available on the book's website.

Shifts in the Demand for Bonds

The theory of portfolio choice, which we developed at the beginning of the chapter, provides a framework for deciding which factors will cause the demand curve for bonds to shift. These factors include changes in the following 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's look at some examples. (As a study aid, Table 2 summarizes the effects of changes in these factors on the bond demand curve.)

Wealth When the economy is growing rapidly in a business cycle expansion and wealth is increasing, the quantity of bonds demanded at each bond price (or interest rate) increases, as shown in Figure 2. To see how this works, consider point B on the initial demand curve for bonds, B_1^d. With higher wealth, the quantity of bonds demanded at the same price must rise, to point B'. Similarly, for point D, the higher wealth causes the quantity demanded at the same bond price to rise to point D'. Continuing with this reasoning for every point on the initial demand curve B_1^d, we can see that the demand curve shifts to the right from B_1^d to B_2^d, as indicated by the arrows.

We can conclude that ***in a business cycle expansion with growing wealth, the demand for bonds rises and the demand curve for bonds shifts to the right.*** Applying the same reasoning, ***in a recession, when income and wealth are falling, the demand for bonds falls, and the demand curve shifts to the left.***

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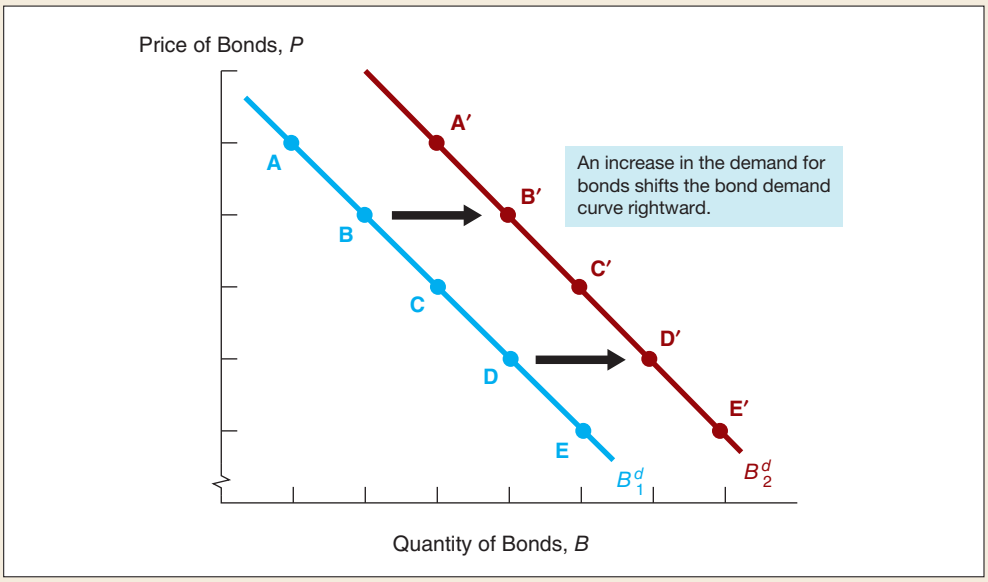
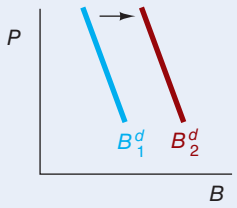
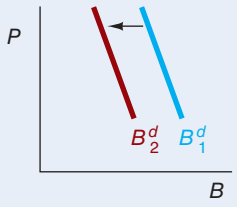
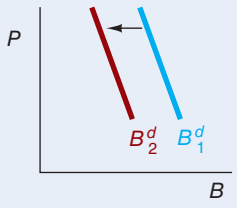
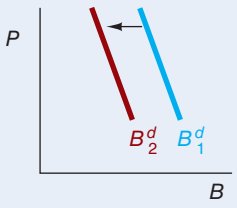
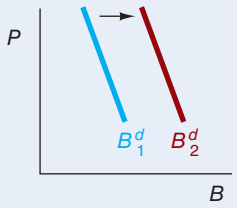
FIGURE 2
Shift in the Demand Curve for Bonds
When the demand for bonds increases, the demand curve shifts to the right as shown.



SUMMARY TABLE 2

Factors That Shift the Demand Curve for Bonds

Variable	Change in Variable	Change in Quantity Demanded at Each Bond Price	Shift in Demand Curve
Wealth	↑	↑	
Expected interest rate	↑	↓	
Expected inflation	↑	↓	
Riskiness of bonds relative to other assets	↑	↓	
Liquidity of bonds relative to other assets	↑	↑	

Note: Only increases in the variables are shown. The effects of decreases in the variables on demand would be the opposite of those indicated in the remaining columns.

Another factor that affects wealth is the public's propensity to save. If households save more, wealth increases and, as we have seen, the demand for bonds rises and the demand curve for bonds shifts to the right. Conversely, if people save less, wealth and the demand for bonds fall, and the demand curve shifts to the left.

Expected Returns For a one-year discount bond and a one-year holding period, the expected return and the interest rate are identical, so nothing other than today's interest rate affects the expected return.

For bonds with maturities of greater than one year, the expected return may differ from the interest rate. For example, we saw in Chapter 4, Table 2, that a rise in the interest rate on a long-term bond from 10% to 20% would lead to a sharp decline in price and a very large negative return. Hence, if people began to think that interest rates would be higher next year than they had originally anticipated, the expected return today on long-term bonds would fall, and the quantity demanded would fall at each interest rate. ***Higher expected future interest rates lower the expected return for long-term bonds, decrease the demand, and shift the demand curve to the left.***

By contrast, an expectation of lower future interest rates would mean that long-term bond prices would be expected to rise more than originally anticipated, and the resulting higher expected return today would raise the quantity demanded at each bond price and interest rate. ***Lower expected future interest rates increase the demand for long-term bonds and shift the demand curve to the right*** (as in Figure 2).

Changes in expected returns on other assets can also shift the demand curve for bonds. If people suddenly become more optimistic about the stock market and begin to expect higher stock prices in the future, both expected capital gains and expected returns on stocks will rise. With the expected return on bonds held constant, the expected return on bonds today relative to stocks will fall, lowering the demand for bonds and shifting the demand curve to the left. ***An increase in expected return on alternative assets lowers the demand for bonds and shifts the demand curve to the left.***

A change in expected inflation is likely to alter expected returns on physical assets (also called *real assets*), such as automobiles and houses, which affect the demand for bonds. An increase in expected inflation from, say, 5% to 10% will lead to higher prices on cars and houses in the future and hence higher nominal capital gains. The resulting rise in the expected returns today on these real assets will lead to a fall in the expected return on bonds relative to the expected return on real assets today and thus cause the demand for bonds to fall. Alternatively, we can think of the rise in expected inflation as lowering the real interest rate on bonds, and thus the resulting decline in the relative expected return on bonds will cause the demand for bonds to fall. ***An increase in the expected rate of inflation lowers the expected return on bonds, causing their demand to decline and the demand curve to shift to the left.***

Risk If prices in the bond market become more volatile, the risk associated with bonds increases, and bonds become a less attractive asset. ***An increase in the riskiness of bonds causes the demand for bonds to fall and the demand curve to shift to the left.***

Conversely, an increase in the volatility of prices in another asset market, such as the stock market, would make bonds more attractive. ***An increase in the riskiness of alternative assets causes the demand for bonds to rise and the demand curve to shift to the right*** (as in Figure 2).

Liquidity If more people started trading in the bond market, and as a result it became easier to sell bonds quickly, the increase in their liquidity would cause the quantity of bonds demanded at each interest rate to rise. ***Increased liquidity of bonds results in an increased demand for bonds, and the demand curve shifts to the right*** (see Figure 2).

Similarly, increased liquidity of alternative assets lowers the demand for bonds and shifts the demand curve to the left. The reduction of brokerage commissions for trading common stocks that occurred when the fixed-rate commission structure was abolished in 1975, for example, increased the liquidity of stocks relative to bonds, and the resulting lower demand for bonds shifted the demand curve to the left.

Shifts in the Supply of Bonds

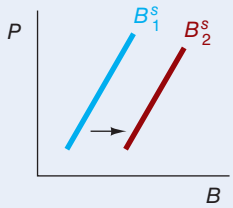
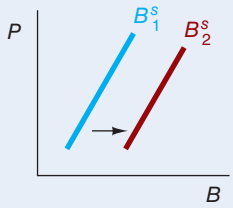
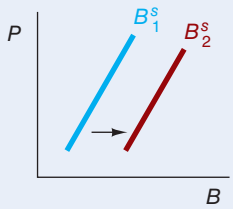
Certain factors can cause the supply curve for bonds to shift. Among these factors are:

1. Expected profitability of investment opportunities
2. Expected inflation
3. Government budget deficits

We will look at how the supply curve shifts when each of these factors changes (all others remaining constant). (As a study aid, Table 3 summarizes the effects of changes in these factors on the bond supply curve.)

SUMMARY TABLE 3

Factors That Shift the Supply of Bonds

Variable	Change in Variable	Change in Quantity Supplied at Each Bond Price	Shift in Supply Curve
Profitability of investments	↑	↑	
Expected inflation	↑	↑	
Government deficit	↑	↑	

Note: Only increases in the variables are shown. The effects of decreases in the variables on the supply would be the opposite of those indicated in the remaining columns.

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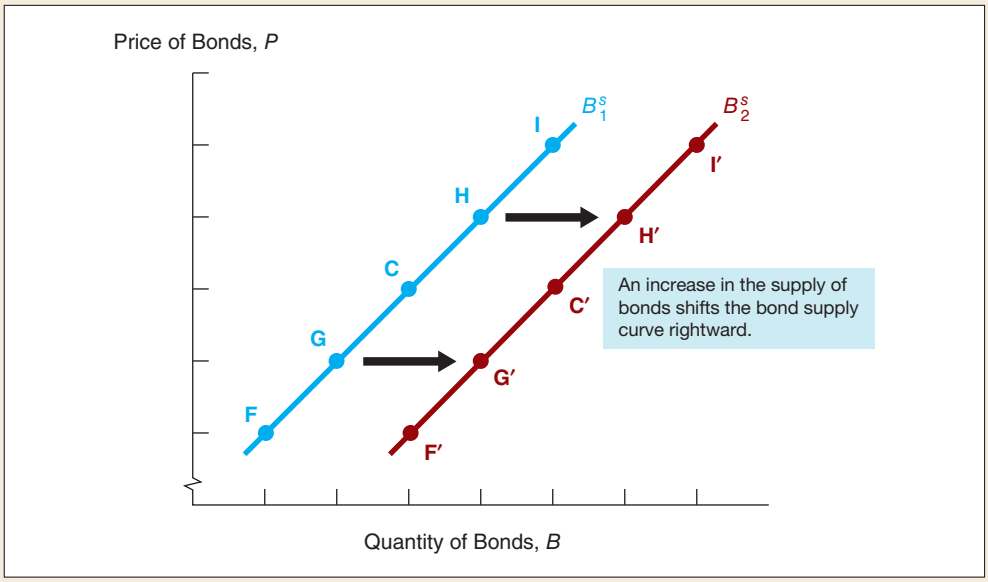
FIGURE 3
Shift in the Supply Curve for Bonds
When the supply of bonds increases, the supply curve shifts to the right.



Expected Profitability of Investment Opportunities When opportunities for profitable plant and equipment investments are plentiful, firms are more willing to borrow to finance these investments. When the economy is growing rapidly, as in a business cycle expansion, investment opportunities that are expected to be profitable abound, and the quantity of bonds supplied at any given bond price increases (see Figure 3). ***Therefore, in a business cycle expansion, the supply of bonds increases and the supply curve shifts to the right. Likewise, in a recession, when far fewer profitable investment opportunities are expected, the supply of bonds falls and the supply curve shifts to the left.***

Expected Inflation As we saw in Chapter 4, the real cost of borrowing is most accurately measured by the real interest rate, which equals the (nominal) interest rate minus the expected inflation rate. For a given interest rate (and bond price), when expected inflation increases, the real cost of borrowing falls; hence, the quantity of bonds supplied increases at any given bond price. ***An increase in expected inflation causes the supply of bonds to increase and the supply curve to shift to the right*** (see Figure 3) ***and a decrease in expected inflation causes the supply of bonds to decrease and the supply curve to shift to the left.***

Government Budget Deficits The activities of the government can influence the supply of bonds in several ways. The U.S. Treasury issues bonds to finance government deficits, caused by gaps between the government's expenditures and its revenues. When these deficits are large, the Treasury sells more bonds, and the quantity of bonds supplied at each bond price increases. ***Higher government deficits increase the supply of bonds and shift the supply curve to the right*** (see Figure 3). ***On the other hand, government surpluses, as occurred in the late 1990s, decrease the supply of bonds and shift the supply curve to the left.***

State and local governments and other government agencies also issue bonds to finance their expenditures, and this can affect the supply of bonds as well. We will see in later chapters that the conduct of monetary policy involves the purchase and sale of bonds, which in turn influences the supply of bonds.

We now can use our knowledge of how supply and demand curves shift to analyze how the equilibrium interest rate can change. The best way to do this is to pursue several applications that are particularly relevant to our understanding of how monetary policy affects interest rates. In studying these applications, keep two things in mind:

1. When we examine the effect of a variable change, remember we are assuming that all other variables are unchanged; that is, we are making use of the *ceteris paribus* assumption.
2. Remember that the interest rate is negatively related to the bond price, so when the equilibrium bond price rises, the equilibrium interest rate falls. Conversely, if the equilibrium bond price moves downward, the equilibrium interest rate rises.

APPLICATION Changes in the Interest Rate Due to Expected Inflation: The Fisher Effect

We have already done most of the work necessary to evaluate how a change in expected inflation affects the nominal interest rate, in that we have already analyzed how a change in expected inflation shifts the supply and demand curves. Figure 4 shows the effect on the equilibrium interest rate of an increase in expected inflation.

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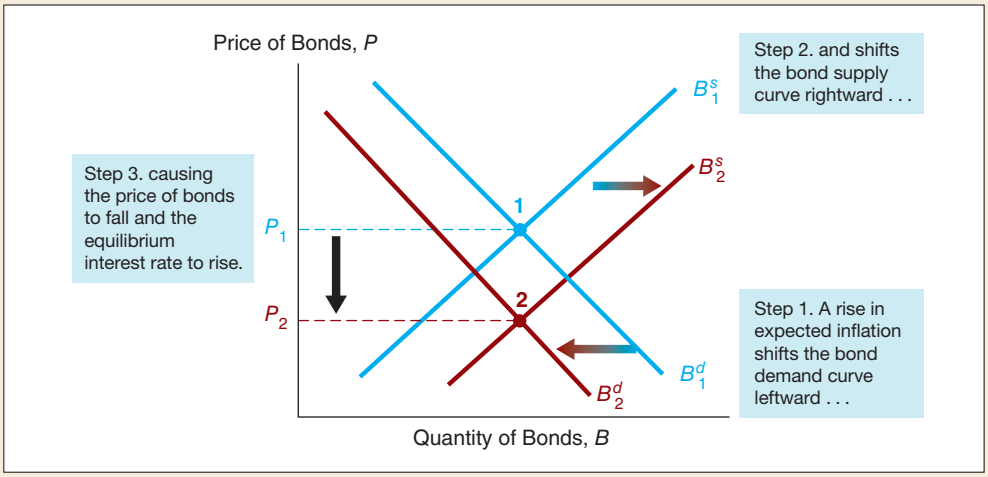
FIGURE 4
Response to a Change in Expected Inflation

When expected inflation rises, the supply curve shifts from B_1^s to B_2^s, and the demand curve shifts from B_1^d to B_2^d. The equilibrium moves from point 1 to point 2, causing the equilibrium bond price to fall from P_1 to P_2 and the equilibrium interest rate to rise.



Suppose that expected inflation is initially 5% and the initial supply and demand curves B_1^s and B_1^d intersect at point 1, where the equilibrium bond price is P_1. If expected inflation rises to 10%, the expected return on bonds relative to real assets falls for any given bond price and interest rate. As a result, the demand for bonds falls, and the demand curve shifts to the left from B_1^d to B_2^d. The rise in expected inflation also shifts the supply curve. At any given bond price and interest rate, the real cost of borrowing declines, causing the quantity of bonds supplied to increase and the supply curve to shift to the right, from B_1^s to B_2^s.

When the demand and supply curves shift in response to the change in expected inflation, the equilibrium moves from point 1 to point 2, at the intersection of B_2^d and B_2^s. The equilibrium bond price falls from P_1 to P_2 and, because the bond price is negatively related to the interest rate, this means that the interest rate rises. Note that Figure 4 has been drawn so that the equilibrium quantity of bonds remains the same at both point 1 and point 2. However, depending on the size of the shifts in the supply and demand curves, the equilibrium quantity of bonds can either rise or fall when expected inflation rises.

Our supply and demand analysis has led us to an important observation: *When expected inflation rises, interest rates will rise.* This result has been named the **Fisher effect**, after Irving Fisher, the economist who first pointed out the relationship of expected inflation to interest rates. The accuracy of this prediction is shown in Figure 5. The interest rate on three-month Treasury bills has usually moved along with the expected inflation rate. Consequently, many economists recommend that inflation must be kept low if we want to keep nominal interest rates low.

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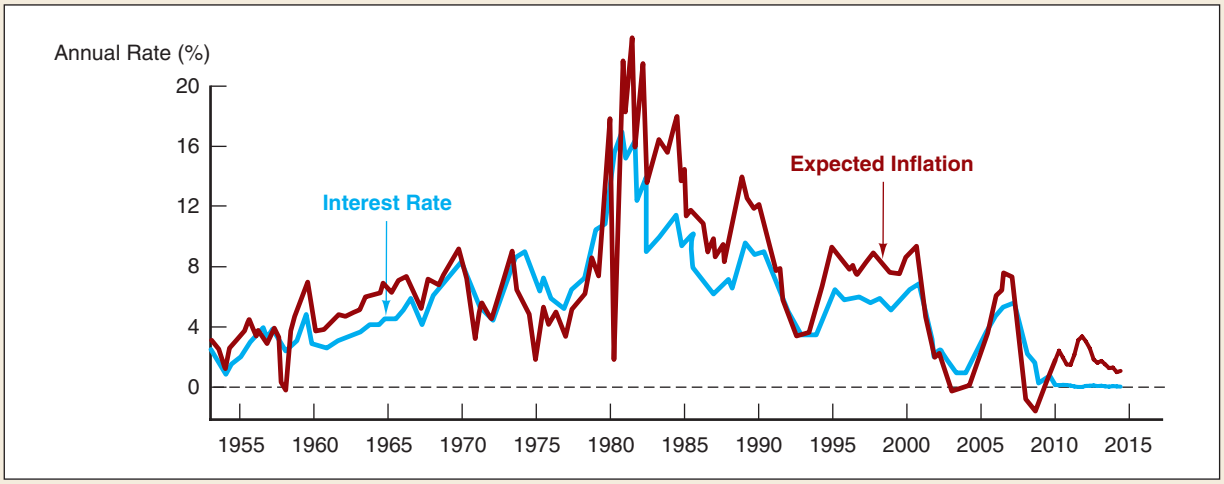

FIGURE 5 **Expected Inflation and Interest Rates (Three-Month Treasury Bills), 1953–2014**

The interest rate on three-month Treasury bills and the expected inflation rate generally move together, as the Fisher effect predicts.

Sources: **Federal Reserve Bank of St. Louis FRED database:** http://research.stlouisfed.org/fred2/. Expected inflation calculated using procedures outlined in Frederic S. Mishkin, "The Real Interest Rate: An Empirical Investigation," Carnegie-Rochester Conference Series on Public Policy 15 (1981): 151–200. These procedures involve estimating expected inflation as a function of past interest rates, inflation, and time trends.

APPLICATION Changes in the Interest Rate Due to a Business Cycle Expansion

Figure 6 analyzes the effects of a business cycle expansion on interest rates. In a business cycle expansion, the amounts of goods and services being produced in the economy increase, so national income rises. When this occurs, businesses are more willing to borrow because they are likely to have many profitable investment opportunities for which they need financing. Hence, at a given bond price, the quantity of bonds that firms want to sell (that is, the supply of bonds) will increase. This means that during a business cycle expansion, the supply curve for bonds shifts to the right (see Figure 6) from B_1^s to B_2^s.

Expansion in the economy also affects the demand for bonds. As the economy expands, wealth is likely to increase, and the theory of portfolio choice tells us that the demand for bonds will rise as well. We see this in Figure 6, where the demand curve has shifted to the right, from B_1^d to B_2^d.

Given that both the supply and demand curves have shifted to the right, we know that the new equilibrium reached at the intersection of B_2^d and B_2^s must also move to the right. However, depending on whether the supply curve shifts more than the demand curve or vice versa, the new equilibrium interest rate can either rise or fall.

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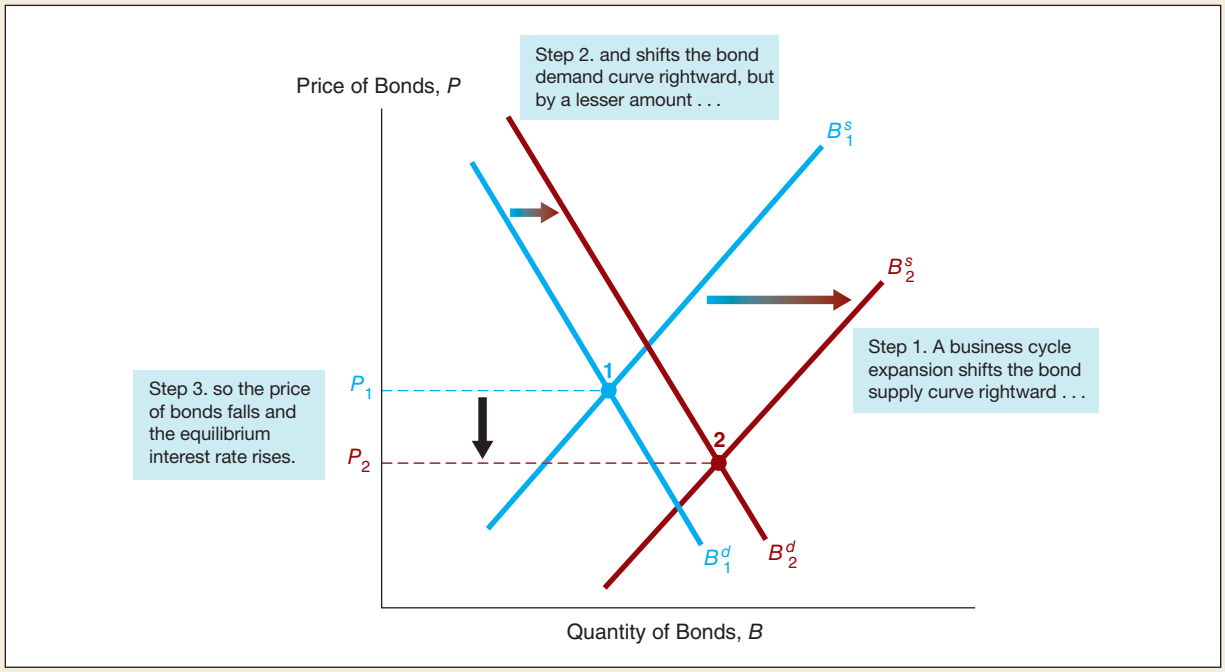

FIGURE 6 Response to a Business Cycle Expansion
In a business cycle expansion, when income and wealth are rising, the demand curve shifts rightward from B_1^d to B_2^d. If the supply curve shifts to the right more than the demand curve, as in this figure, the equilibrium bond price moves down from P_1 to P_2 and the equilibrium interest rate rises.

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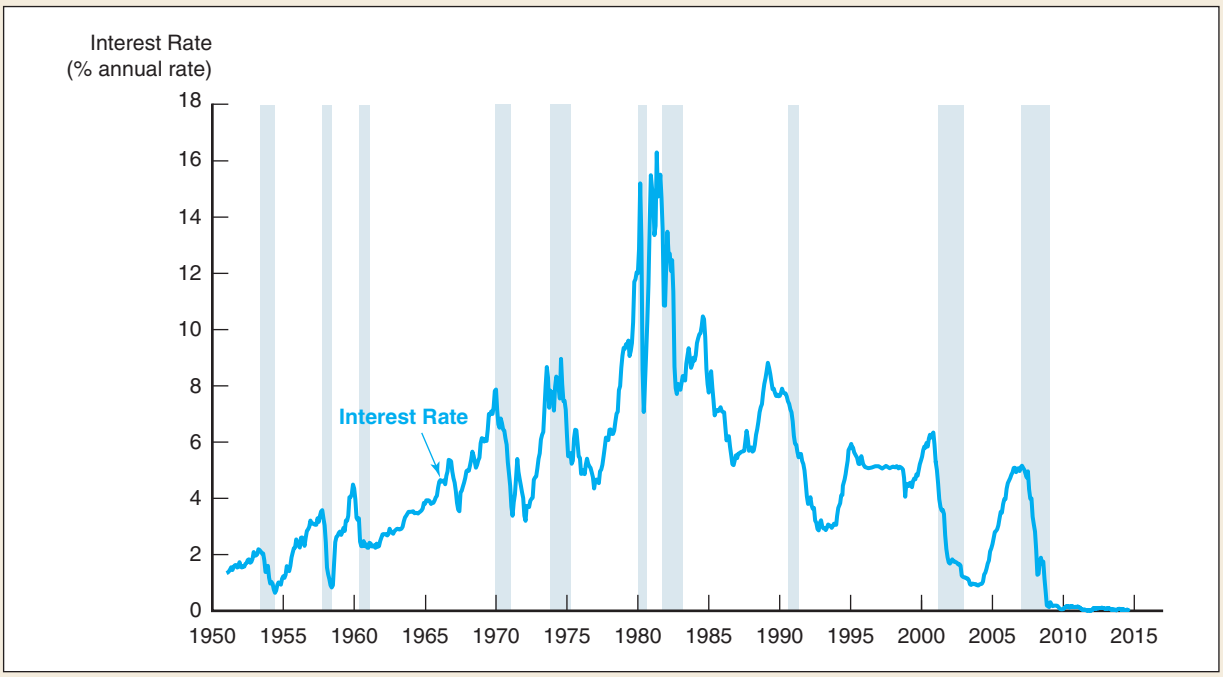

FIGURE 7 **Business Cycle and Interest Rates (Three-Month Treasury Bills), 1951–2014**
Shaded areas indicate periods of recession. The interest rate tends to rise during business cycle expansions and fall during recessions.
Source: **Federal Reserve Bank of St. Louis FRED database:** http://research.stlouisfed.org/fred2/

The supply and demand analysis used here gives us an ambiguous answer to the question of what happens to interest rates in a business cycle expansion. Figure 6 has been drawn so that the shift in the supply curve is greater than the shift in the demand curve, causing the equilibrium bond price to fall to P_2 and the equilibrium interest rate to rise. The reason the figure has been drawn such that a business cycle expansion and a rise in income lead to a higher interest rate is that this is the outcome we actually see in the data. Figure 7 plots the movement of the interest rate on three-month U.S. Treasury bills from 1951 to 2014 and indicates when the business cycle went through recessions (shaded areas). As you can see, the interest rate tends to rise during business cycle expansions and fall during recessions, as indicated by the supply and demand diagram in Figure 6.

APPLICATION Explaining Low Japanese Interest Rates

In the 1990s and early 2000s, Japanese interest rates became the lowest in the world. Indeed, in November 1998, an extraordinary event occurred: Interest rates on Japanese six-month Treasury bills even turned slightly negative! Why did Japanese interest rates drop to such low levels?

In the late 1990s and early 2000s, Japan experienced a prolonged recession, which was accompanied by deflation (a negative inflation rate). We can use these facts, along with an analysis similar to that used in the preceding applications, to explain the low Japanese interest rates.

Negative inflation caused the demand for bonds to rise because the expected return on real assets fell, thereby raising the relative expected return on bonds and in turn causing the demand curve to shift to the right. Negative inflation also raised the real interest rate and therefore the real cost of borrowing for any given nominal rate, thereby causing the supply of bonds to contract and the supply curve to shift to the left. The outcome was then exactly the opposite of that graphed in Figure 4: The rightward shift of the demand curve and leftward shift of the supply curve led to a rise in the bond price and a fall in interest rates.

The business cycle contraction and the resulting lack of profitable investment opportunities in Japan also led to lower interest rates by decreasing the supply of bonds and shifting the supply curve to the left. Although the demand curve also shifted to the left because wealth decreased during the business cycle contraction, the demand curve shifted less than the supply curve, just as we saw in the preceding application. Thus, the bond price rose and interest rates fell (the opposite outcome of that in Figure 6).

Usually we think that low interest rates are a good thing because they make it cheap to borrow. But the Japanese example shows that just as a fallacy is present in the adage "You can never be too rich or too thin" (maybe you can't be too rich, but you can certainly be too thin and thereby damage your health), a fallacy is present in always thinking that lower interest rates are better. In Japan, the low and even negative interest rates were a sign that the country was in real trouble, with falling prices and a contracting economy. Only when the Japanese economy returns to health will interest rates rise back to more normal levels. ◆

SUPPLY AND DEMAND IN THE MARKET FOR MONEY: THE LIQUIDITY PREFERENCE FRAMEWORK

An alternative model for determining the equilibrium interest rate, developed by John Maynard Keynes, is known as the **liquidity preference framework**. This framework determines the equilibrium interest rate in terms of the supply of and demand for money rather than the supply of and demand for bonds. Although the two frameworks look different, the liquidity preference analysis of the market for money is closely related to the supply and demand framework of the bond market.[4]

The starting point of Keynes's analysis is his assumption that people use two main categories of assets to store their wealth: money and bonds. Therefore, total wealth in the economy must equal the total quantity of bonds plus money in the economy, which equals the quantity of bonds supplied (B^s) plus the quantity of money supplied (M^s).

[4]Note that the term *market for money* refers to the market for the medium of exchange, money. This market differs from the *money market* referred to by finance practitioners, which, as discussed in Chapter 2, is the financial market in which short-term debt instruments are traded.

The quantity of bonds demanded (B^d) plus the quantity of money demanded (M^d) must also equal the total amount of wealth, because people cannot purchase more assets than their available resources allow. Thus the quantity of bonds and money supplied must equal the quantity of bonds and money demanded:

$$B^s + M^s = B^d + M^d \tag{2}$$

Collecting the bond terms on one side of the equation and the money terms on the other, this equation can be rewritten as

$$B^s - B^d = M^d - M^s \tag{3}$$

Equation 3 tells us that if the market for money is in equilibrium $(M^s = M^d)$, then the right-hand side of the equation equals zero, implying that $B^s = B^d$, which in turn means the bond market is also in equilibrium.

Thus we arrive at the same result whether we determine the equilibrium interest rate by equating the supply and demand for bonds or by equating the supply and demand for money. In this sense, the liquidity preference framework, which analyzes the market for money, is equivalent to a framework analyzing supply and demand in the bond market. In practice, the approaches differ because, by assuming there are only two kinds of assets, money and bonds, the liquidity preference approach implicitly ignores any effects on interest rates that arise from changes in the expected returns on real assets such as automobiles and houses. In most instances, however, both frameworks yield the same predictions.

The reason we approach the determination of interest rates using both frameworks is that the bond supply and demand framework is easier to use when analyzing the effects caused by changes in expected inflation, whereas the liquidity preference framework is easier to use when analyzing the effects caused by changes in income, the price level, and the supply of money.

Because the definition of money used by Keynes includes currency (which earns no interest) and checking account deposits (which in his time typically earned little or no interest), he assumed that money has a zero rate of return. Bonds, the only alternative asset to money in Keynes's framework, have an expected return equal to the interest rate i.[5] As this interest rate rises (holding everything else unchanged), the expected return on money falls relative to the expected return on bonds, causing a fall in the quantity of money demanded, as predicted by the theory of portfolio choice.

We can also see that the quantity of money demanded and the interest rate should be negatively related by using the concept of **opportunity cost**, which is the amount of interest (expected return) sacrificed by not holding the alternative asset—in this case, a bond. As the interest rate on bonds, i, rises, the opportunity cost of holding money rises; thus money is less desirable and the quantity of money demanded falls.

Figure 8 shows the quantity of money demanded at a number of interest rates, with all other economic variables, such as income and the price level, held constant. At an interest rate of 25%, point A shows that the quantity of money demanded is

[5]Keynes did not actually assume that the expected returns on bonds equaled the interest rate but rather argued that they were closely related. This distinction makes no appreciable difference in our analysis.

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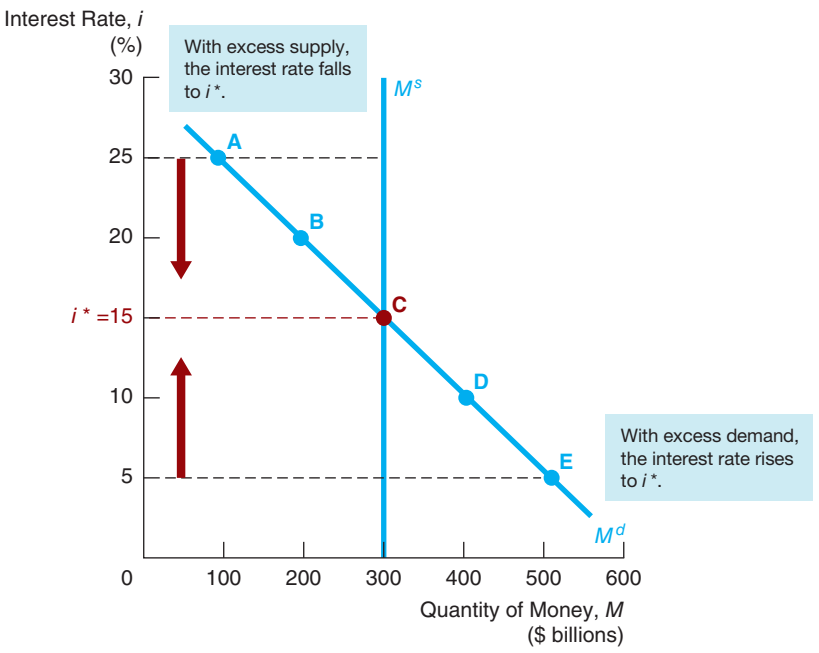
FIGURE 8
Equilibrium in the Market for Money

Equilibrium in the market for money occurs at point C, the intersection of the money demand curve M^d and the money supply curve M^s. The equilibrium interest rate is $i^* = 15\%$.



$100 billion. If the interest rate is at the lower rate of 20%, the opportunity cost of holding money is lower, and the quantity of money demanded rises to $200 billion, as indicated by the move from point A to point B. If the interest rate is even lower, the quantity of money demanded is even higher, as is indicated by points C, D, and E. The curve M^d connecting these points is the demand curve for money, and it slopes downward.

At this point in our analysis, we will assume that a central bank controls the amount of money supplied at a fixed quantity of $300 billion, so that the supply curve for money M^s in the figure is a vertical line at $300 billion. The equilibrium at which the quantity of money demanded equals the quantity of money supplied occurs at the intersection of the supply and demand curves at point C, where

$$M^d = M^s \tag{4}$$

The resulting equilibrium interest rate is $i^* = 15\%$.

We can again see that there is a tendency to approach this equilibrium rate by first looking at the relationship of money demand and supply when the interest rate is above the equilibrium interest rate. When the interest rate is 25%, the quantity of money demanded at point A is $100 billion, yet the quantity of money supplied is $300 billion. The excess supply of money means that people are holding more money than they desire, so they will try to get rid of their excess money balances by trying to buy bonds.

Accordingly, they will bid up the price of bonds. As the bond price rises, the interest rate will fall toward the equilibrium interest rate of 15%. This tendency is shown by the downward arrow drawn at the interest rate of 25%.

Likewise, if the interest rate is 5%, the quantity of money demanded at point E is $500 billion, but the quantity of money supplied is only $300 billion. An excess demand for money now exists because people want to hold more money than they currently have. To try to obtain more money, they will sell their only other asset—bonds—and the price will fall. As the price of bonds falls, the interest rate will rise toward the equilibrium rate of 15%. Only when the interest rate is at its equilibrium value will there be no tendency for it to move further, and so the interest rate will settle at this value.

CHANGES IN EQUILIBRIUM INTEREST RATES IN THE LIQUIDITY PREFERENCE FRAMEWORK

In order to use the liquidity preference framework to analyze how the equilibrium interest rate changes, we must understand what causes the demand and supply curves for money to shift.

Shifts in the Demand for Money

In Keynes's liquidity preference analysis, two factors cause the demand curve for money to shift: income and the price level.

Income Effect In Keynes's view, there were two reasons why income would affect the demand for money. First, as an economy expands and income rises, wealth increases and people want to hold more money as a store of value. Second, as the economy expands and income rises, people want to carry out more transactions using money as a medium of exchange, and so they also want to hold more money. The conclusion is that ***a higher level of income causes the demand for money at each interest rate to increase and the demand curve to shift to the right.***

Price-Level Effect Keynes took the view that people care about the amount of money they hold in real terms—that is, in terms of the goods and services it can buy. When the price level rises, the same nominal quantity of money is no longer as valuable; it cannot be used to purchase as many real goods or services. To restore their holdings of money in real terms to the former level, people will want to hold a greater nominal quantity of money, so ***a rise in the price level causes the demand for money at each interest rate to increase and the demand curve to shift to the right.***

Shifts in the Supply of Money

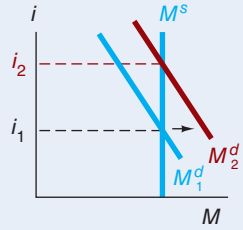
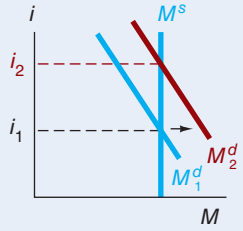
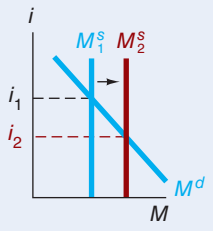
We will assume that the supply of money is completely controlled by the central bank, which in the United States is the Federal Reserve. (Actually, the process that determines the money supply is substantially more complicated, involving banks, depositors, and borrowers from banks. We will study it in more detail later in the book.) For now, all we need to know is that ***an increase in the money supply engineered by the Federal Reserve will shift the supply curve for money to the right.***

APPLICATION Changes in the Equilibrium Interest Rate Due to Changes in Income, the Price Level, or the Money Supply

To see how we can use the liquidity preference framework to analyze the movement of interest rates, we will again look at several applications that will help us evaluate the effect of monetary policy on interest rates. In going through these applications, remember to use the *ceteris paribus* assumption: When examining the effect of a change in one variable, hold all other variables constant. (As a study aid, Table 4 summarizes the shifts in the demand and supply curves for money.)

SUMMARY TABLE 4

Factors That Shift the Demand for and Supply of Money

Variable	Change in Variable	Change in Money Demand (M^d) or Supply (M^s) at Each Interest Rate	Change in Interest Rate	
Income	↑	M^d↑	↑	
Price level	↑	M^d↑	↑	
Money supply	↑	M^s↑	↓	

Note: Only increases in the variables are shown. The effects of decreases in the variables on demand and supply would be the opposite of those indicated in the remaining columns.

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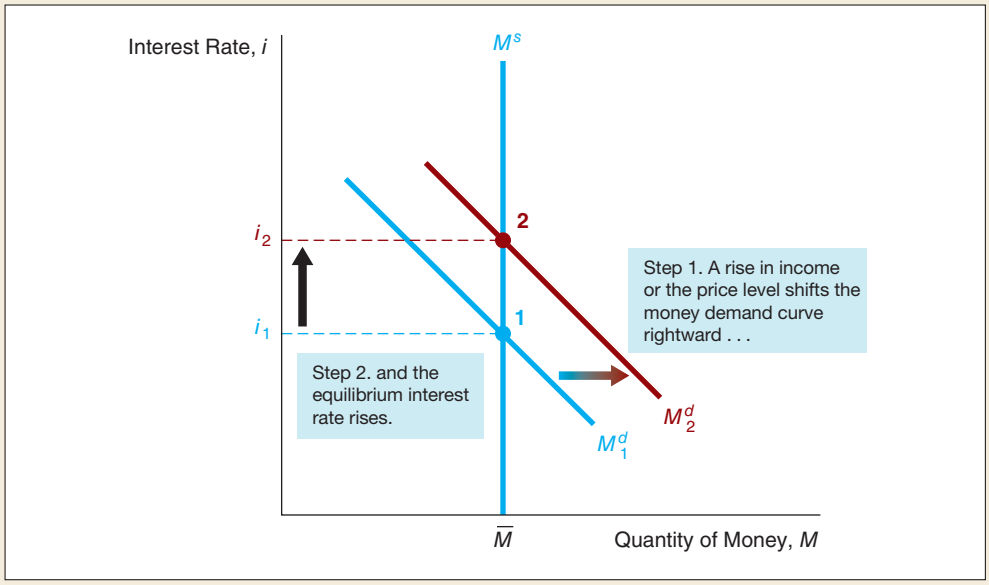
FIGURE 9
Response to a Change in Income or the Price Level

In a business cycle expansion, when income is rising, or when the price level rises, the demand curve shifts from M_1^d to M_2^d. The supply curve is fixed at $M^s = \overline{M}$. The equilibrium interest rate rises from i_1 to i_2.



Changes in Income

We have seen that when income is rising during a business cycle expansion, the demand for money will rise, shown in Figure 9 by the rightward shift in the demand curve from M_1^d to M_2^d. The new equilibrium is reached at point 2, at the intersection of the M_2^d curve with the money supply curve M^s. As you can see, the equilibrium interest rate rises from i_1 to i_2. The liquidity preference framework thus generates the conclusion that ***when income is rising during a business cycle expansion (holding other economic variables constant), interest rates will rise.*** This conclusion is unambiguous, unlike the conclusion we reached using the bond demand and supply framework.

Changes in the Price Level

When the price level rises, the value of money in terms of its purchasing power is lower. To restore their money's purchasing power in real terms to its former level, people will want to hold a greater nominal quantity of money. A higher price level shifts the demand curve for money to the right from M_1^d to M_2^d (see Figure 9). The equilibrium moves from point 1 to point 2, where the equilibrium interest rate has risen from i_1 to i_2, illustrating that ***when the price level increases, with the supply of money and other economic variables held constant, interest rates will rise.***

Changes in the Money Supply

An increase in the money supply due to expansionary monetary policy by the Federal Reserve implies that the supply curve for money will shift to the right. As shown in Figure 10 by the movement of the supply curve from M_1^s to M_2^s, the equilibrium moves

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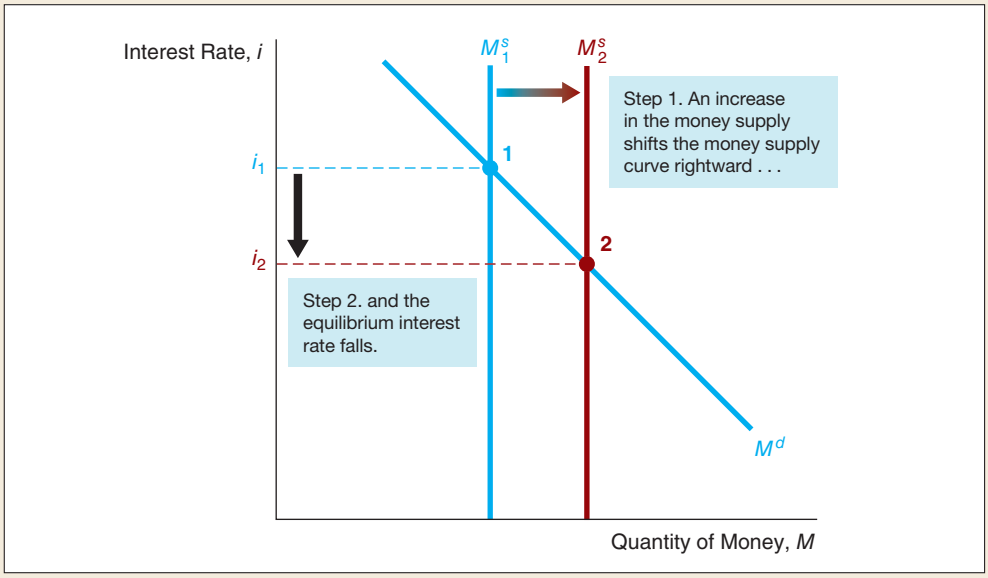

FIGURE 10
Response to a Change in the Money Supply
When the money supply increases, the supply curve shifts from M_1^s to M_2^s and the equilibrium interest rate falls from i_1 to i_2.

from point 1 down to point 2, where the M_2^s supply curve intersects with the demand curve M^d and the equilibrium interest rate has fallen from i_1 to i_2. ***When the money supply increases (everything else remaining equal), interest rates will decline***.[6]

MONEY AND INTEREST RATES

The liquidity preference analysis in Figure 10 seems to suggest that an increase in the money supply will lower interest rates. This conclusion has important policy implications because it has frequently caused politicians to call for a more rapid growth of the money supply in an effort to drive down interest rates.

But is it correct to conclude that money and interest rates should be negatively related? Might other important factors have been left out of the liquidity preference analysis in Figure 10, factors that would reverse this conclusion? We will provide answers to these questions by applying the supply and demand analysis we used in this chapter to obtain a deeper understanding of the relationship between money and interest rates.

An important criticism of the idea that an increase in the money supply lowers interest rates was raised by Milton Friedman, a Nobel laureate in economics. He acknowledged that the liquidity preference analysis was correct and called the result—that an increase

[6]This same result can be generated using the bond supply and demand framework. As we will see in Chapter 15, a central bank increases the money supply primarily by buying bonds and thereby decreasing the supply of bonds available to the public. The resulting shift to the left of the supply curve for bonds leads to an increase in the equilibrium price of bonds and a decline in the equilibrium interest rate.

in the money supply (*everything else remaining equal*) lowers interest rates—the *liquidity effect*. However, he viewed the liquidity effect as merely part of the story: An increase in the money supply might not leave "everything else equal" and will have other effects on the economy that may make interest rates rise. If these effects are substantial, it is entirely possible that when the money supply increases, interest rates might also increase.

We have already laid the groundwork for our discussion of these other effects, because we have shown how changes in income, the price level, and expected inflation influence the equilibrium interest rate.

1. *Income Effect*. An increasing money supply can cause national income and wealth to rise. Both the liquidity preference and bond supply and demand frameworks indicate that interest rates will then rise (see Figures 6 and 9). Thus ***the income effect of an increase in the money supply is a rise in interest rates in response to the higher level of income.***
2. *Price-Level Effect*. An increase in the money supply can also cause the overall price level in the economy to rise. The liquidity preference framework predicts that this will lead to a rise in interest rates. Thus ***the price-level effect from an increase in the money supply is a rise in interest rates in response to the rise in price level.***
3. *Expected-Inflation Effect*. The higher inflation rate that can result from an increase in the money supply can also affect interest rates by influencing the expected inflation rate. Specifically, an increase in the money supply may lead people to expect a higher price level in the future—and hence the expected inflation rate will be higher. The bond supply and demand framework has shown us that this increase in expected inflation will lead to a higher level of interest rates. Therefore, ***the expected-inflation effect of an increase in the money supply is a rise in interest rates in response to the rise in the expected inflation rate.***

At first glance it might appear that the price-level effect and the expected-inflation effect are the same thing. They both indicate that increases in the price level induced by an increase in the money supply will raise interest rates. However, there is a subtle difference between the two, and this is why they are discussed as two separate effects.

Suppose that a one-time increase in the money supply today leads to a rise in prices to a permanently higher level by next year. As the price level rises over the course of this year, the interest rate will rise via the price-level effect. Only at the end of the year, when the price level has risen to its peak, will the price-level effect be at a maximum.

The rising price level will also raise interest rates via the expected-inflation effect, because people will expect that inflation will be higher over the course of the year. However, when the price level stops rising next year, inflation and the expected inflation rate will return to zero. Any rise in interest rates as a result of the earlier rise in expected inflation will then be reversed. We thus see that in contrast to the price-level effect, which reaches its greatest impact next year, the expected-inflation effect will have its smallest impact (zero impact) next year. The basic difference between the two effects, then, is that the price-level effect remains even after prices have stopped rising, whereas the expected-inflation effect disappears.

An important point is that the expected-inflation effect will persist only as long as the price level continues to rise. As we will see in our discussion of monetary theory in subsequent chapters, a one-time increase in the money supply will not produce a continually rising price level; only a higher rate of money supply growth will. Thus, a higher rate of money supply growth is needed if the expected-inflation effect is to persist.

APPLICATION Does a Higher Rate of Growth of the Money Supply Lower Interest Rates?

We can now put together all the effects we have discussed to help us decide whether our analysis supports the politicians who advocate a greater rate of growth of the money supply when they feel that interest rates are too high. Of all the effects, only the liquidity effect indicates that a higher rate of money growth will cause a decline in interest rates. In contrast, the income, price-level, and expected-inflation effects indicate that interest rates will rise when money growth is higher. Which of these effects is largest, and how quickly does each take effect? The answers are critical in determining whether interest rates will rise or fall when money supply growth is increased.

Generally, the liquidity effect from greater money growth takes effect immediately, because the rising money supply leads to an immediate decline in the equilibrium interest rate. The income and price-level effects take longer to work because time is needed for the increasing money supply to raise the price level and income, which in turn raise interest rates. The expected-inflation effect, which also raises interest rates, can be slow or fast, depending on whether people adjust their expectations of inflation slowly or quickly when the money growth rate is increased.

Three possibilities are outlined in Figure 11; each shows how interest rates respond over time to an increased rate of money supply growth, starting at time T. Panel (a) shows a case in which the liquidity effect dominates the other effects so that the interest rate falls from i_1 at time T to a final level of i_2. The liquidity effect operates quickly to lower the interest rate, but as time goes by, the other effects start to reverse some of the decline. Because the liquidity effect is larger than the others, however, the interest rate never rises back to its initial level.

In panel (b), the liquidity effect is smaller than the other effects, with the expected-inflation effect operating slowly because expectations of inflation are slow to adjust upward. Initially, the liquidity effect drives down the interest rate. Then the income, price-level, and expected-inflation effects begin to raise it. Because these effects are dominant, the interest rate eventually rises above its initial level to i_2. In the short run, lower interest rates result from increased money growth, but eventually they end up climbing above the initial level.

In panel (c), the expected-inflation effect dominates and operates rapidly because people quickly raise their expectations of inflation when the rate of money growth increases. The expected-inflation effect begins immediately to overpower the liquidity effect, and the interest rate immediately starts to climb. Over time, as the income and price-level effects start to take hold, the interest rate rises even higher, and the eventual outcome is an interest rate that is substantially higher than the initial interest rate. The result shows clearly that increasing money supply growth is not the answer to reducing interest rates; rather, money growth should be *reduced* to lower interest rates!

An important issue for economic policymakers is deciding which of these three scenarios is closest to reality. If a decline in interest rates is desired, then an increase in money supply growth is called for when the liquidity effect dominates the other effects, as in panel (a). A decrease in money growth is appropriate when the other effects dominate the liquidity effect and expectations of inflation adjust rapidly, as in panel (c). If the other effects dominate the liquidity effect but expectations of inflation adjust only slowly, as in panel (b), then the decision to increase or decrease money growth depends on whether policymakers care more about what happens in the short run or in the long run.

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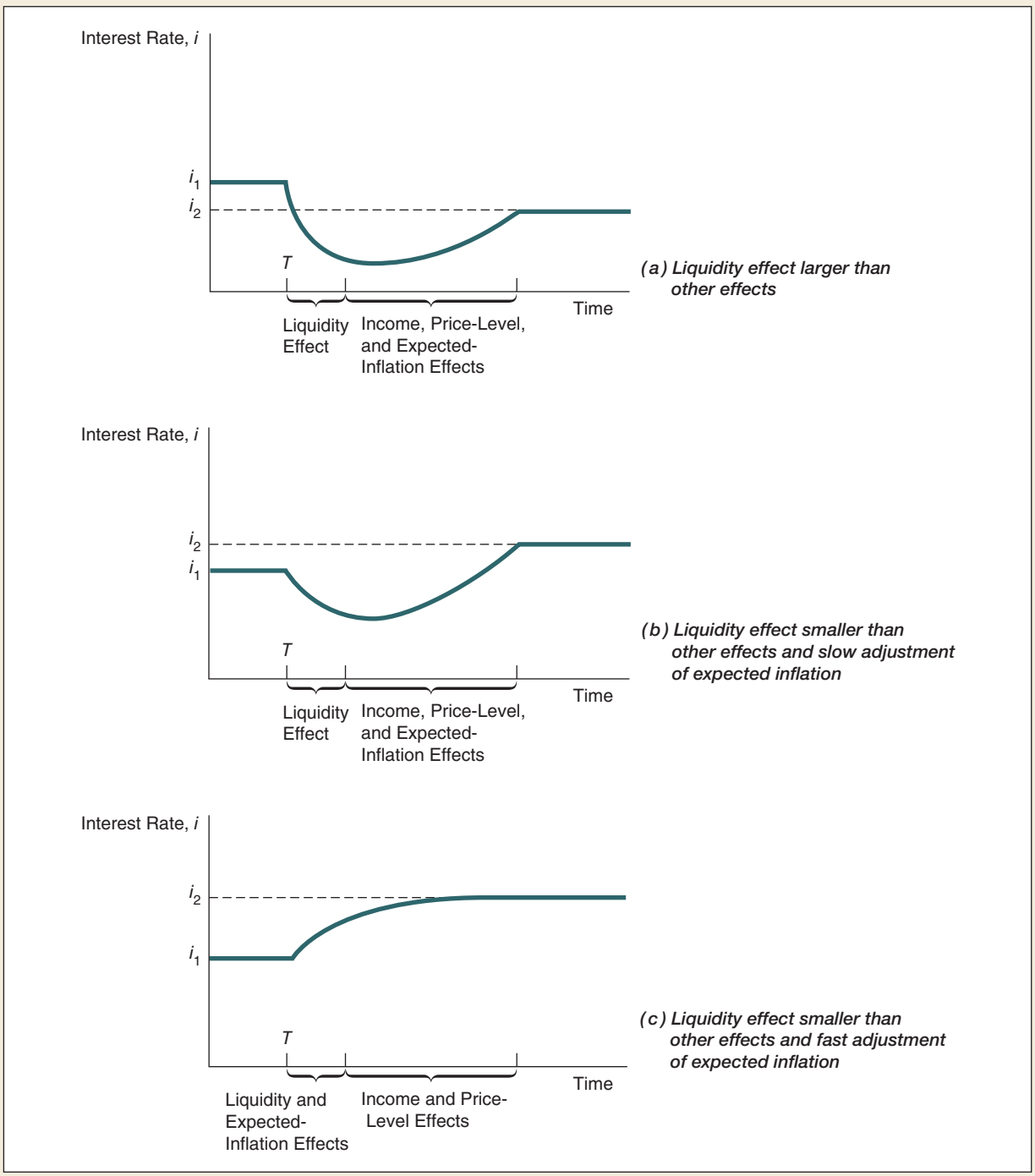

FIGURE 11 Response over Time to an Increase in Money Supply Growth
Each panel shows how interest rates respond over time to an increased rate of money supply growth, starting at time *T*.

MyEconLab Mini-lecture MyEconLab Real-time data

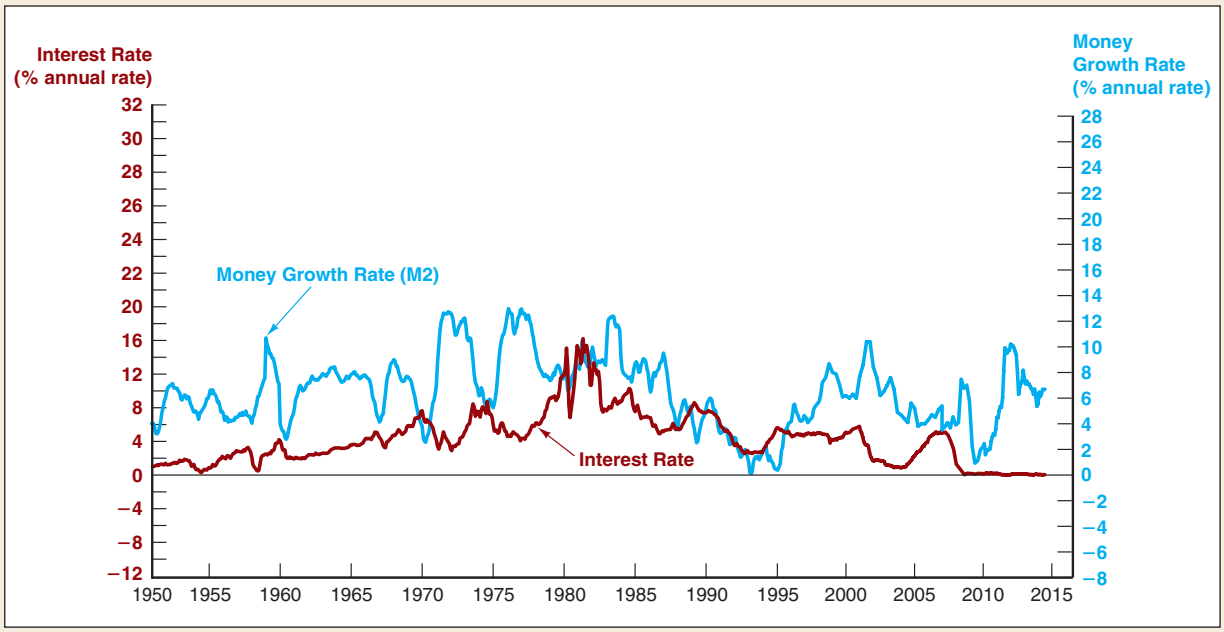

FIGURE 12 **Money Growth (M2, Annual Rate) and Interest Rates (Three-Month Treasury Bills), 1950–2014**
When the rate of money supply growth began to climb in the mid-1960s, interest rates rose, indicating that the liquidity effect was dominated by the price-level, income, and expected-inflation effects. By the 1970s, both interest rates and money growth reached levels unprecedented in the post–World War II period.
Source: **Federal Reserve Bank of St. Louis FRED database:** http://research.stlouisfed.org/fred2/

Which scenario is supported by the evidence? The relationship between interest rates and money growth from 1950 to 2014 is plotted in Figure 12. When the rate of money supply growth began to climb in the mid-1960s, interest rates rose, indicating that the liquidity effect was dominated by the price-level, income, and expected-inflation effects. By the 1970s, interest rates reached levels unprecedented in the post–World War II period, as did the rate of money supply growth.

The scenario depicted in panel (a) of Figure 11 seems doubtful, and the case for lowering interest rates by raising the rate of money growth is much weakened. Looking back at Figure 5, which shows the relationship between interest rates and expected inflation, you should not find this too surprising. The rise in the rate of money supply growth in the 1960s and 1970s is matched by a large rise in expected inflation, which would lead us to predict that the expected-inflation effect would be dominant. It is the most plausible explanation for why interest rates rose in the face of higher money growth. However, Figure 12 does not really tell us which one of the two scenarios depicted in panels (b) and (c) of Figure 11 is more accurate. It depends critically on how fast people's expectations about inflation adjust. Research done using more sophisticated methods than just looking at a graph like Figure 12 indicates that increased money growth temporarily lowers short-term interest rates and thus conforms to the scenario in panel (b). ◆

SUMMARY

1. The theory of portfolio choice tells us that the quantity demanded of an asset is (a) positively related to wealth, (b) positively related to the expected return on the asset relative to alternative assets, (c) negatively related to the riskiness of the asset relative to alternative assets, and (d) positively related to the liquidity of the asset relative to alternative assets.
2. The supply and demand analysis for bonds provides one theory of how interest rates are determined. It predicts that interest rates will change when there is a change in demand caused by changes in income (or wealth), expected returns, risk, or liquidity, or when there is a change in supply caused by changes in the attractiveness of investment opportunities, the real cost of borrowing, or the government budget.
3. An alternative theory of how interest rates are determined is provided by the liquidity preference framework, which analyzes the supply of and demand for money. It shows that interest rates will change when the demand for money changes because of alterations in income or the price level, or when the supply of money changes.
4. There are four possible effects on interest rates of an increase in the money supply: the liquidity effect, the income effect, the price-level effect, and the expected-inflation effect. The liquidity effect indicates that a rise in money supply growth will lead to a decline in interest rates; the other effects work in the opposite direction. The evidence seems to indicate that the income, price-level, and expected-inflation effects dominate the liquidity effect such that an increase in money supply growth leads to higher—rather than lower—interest rates.

KEY TERMS

asset market approach, p. 137
demand curve, p. 134
excess demand, p. 136
excess supply, p. 136
expected return, p. 132
Fisher effect, p. 144
liquidity, p. 132
liquidity preference framework, p. 147
market equilibrium, p. 136
opportunity cost, p. 148
risk, p. 132
supply curve, p. 135
theory of portfolio choice, p. 133
wealth, p. 132

QUESTIONS

Select questions are available in MyEconLab *at* http://www.myeconlab.com.

1. Explain why you would be more or less willing to buy a share of Microsoft stock in the following situations:
   a. Your wealth falls.
   b. You expect the stock to appreciate in value.
   c. The bond market becomes more liquid.
   d. You expect gold to appreciate in value.
   e. Prices in the bond market become more volatile.
2. Explain why you would be more or less willing to buy a house under the following circumstances:
   a. You just inherited $100,000.
   b. Real estate commissions fall from 6% of the sales price to 5% of the sales price.
   c. You expect Microsoft stock to double in value next year.
   d. Prices in the stock market become more volatile.
   e. You expect housing prices to fall.
3. Explain why you would be more or less willing to buy gold under the following circumstances:
   a. Gold again becomes acceptable as a medium of exchange.
   b. Prices in the gold market become more volatile.
   c. You expect inflation to rise, and gold prices tend to move with the aggregate price level.
   d. You expect interest rates to rise.
4. Explain why you would be more or less willing to buy long-term AT&T bonds under the following circumstances:
   a. Trading in these bonds increases, making them easier to sell.
   b. You expect a bear market in stocks (stock prices are expected to decline).

c. Brokerage commissions on stocks fall.

d. You expect interest rates to rise.

e. Brokerage commissions on bonds fall.

5. What will happen to the demand for Rembrandt paintings if the stock market undergoes a boom? Why?

6. "The more risk-averse people are, the more likely they are to diversify." Is this statement true, false, or uncertain? Explain your answer.

7. "No one who is risk-averse will ever buy a security that has a lower expected return, more risk, and less liquidity than another security." Is this statement true, false, or uncertain? Explain your answer.

8. What effect will a sudden increase in the volatility of gold prices have on interest rates?

9. How might a sudden increase in people's expectations of future real estate prices affect interest rates?

10. Explain what effect a large federal deficit should have on interest rates.

11. In the aftermath of the global economic crisis that started to take hold in 2008, U.S. government budget deficits increased dramatically, yet interest rates on U.S. Treasury debt fell sharply and stayed low for quite some time. Does this make sense? Why or why not?

12. Will there be an effect on interest rates if brokerage commissions on stocks fall? Explain your answer.

13. The president of the United States announces in a press conference that he will fight the higher inflation rate with a new anti-inflation program. Predict what will happen to interest rates if the public believes him.

14. Predict what will happen to interest rates if the public suddenly expects a large increase in stock prices.

15. Predict what will happen to interest rates if prices in the bond market become more volatile.

16. Would fiscal policymakers ever have reason to worry about potentially inflationary conditions? Why or why not?

17. Why should a rise in the price level (but not in expected inflation) cause interest rates to rise when the nominal money supply is fixed?

18. If the next chair of the Federal Reserve Board has a reputation for advocating an even slower rate of money growth than the current chair, what will happen to interest rates? Discuss the possible resulting situations.

19. M1 money growth in the U.S. was about 15% in 2011 and 2012, and 10% in 2013. Over the same time period, the yield on 3-month Treasury bills was close to 0%. Given these high rates of money growth, why did interest rates stay so low, rather than increase? What does this say about the income, price-level, and expected-inflation effects?

APPLIED PROBLEMS

Select applied problems are available in MyEconLab *at* http://www.myeconlab.com.

20. Suppose you visit with a financial adviser, and you are considering investing some of your wealth in one of three investment portfolios: stocks, bonds, or commodities. Your financial adviser provides you with the following table, which gives the probabilities of possible returns from each investment:

a. Which investment should you choose to maximize your expected return: stocks, bonds, or commodities?

b. If you are risk-averse and had to choose between the stock and the bond investments, which would you choose? Why?

Stocks		Bonds		Commodities	
Probability	**Return**	**Probability**	**Return**	**Probability**	**Return**
0.2	15%	0.4	15%	0.2	20%
0.3	8.3%	0.6	5%	0.25	12%
0.2	10%			0.25	6%
0.3	5%			0.2	5%
					0.10%

21. An important way in which the Federal Reserve decreases the money supply is by selling bonds to the public. Using a supply and demand analysis for bonds, show what effect this action has on interest rates. Is your answer consistent with what you would expect to find with the liquidity preference framework?

22. Using both the liquidity preference framework and the supply and demand for bonds framework, show why interest rates are procyclical (rising when the economy is expanding and falling during recessions).

23. Using both the supply and demand for bonds and liquidity preference frameworks, show how interest rates are affected when the riskiness of bonds rises. Are the results the same in the two frameworks?

24. The demand curve and supply curve for one-year discount bonds with a face value of $1,000 are represented by the following equations:

B^d: Price $= -0.8 \times$ Quantity $+ 1{,}100$

B^s: Price $=$ Quantity $+ 680$

a. What is the expected equilibrium price and quantity of bonds in this market?

b. Given your answer to part (a), what is the expected interest rate in this market?

25. The demand curve and supply curve for one-year discount bonds with a face value of $1,050 are represented by the following equations:

B^d: Price $= -0.8 \times$ Quantity $+ 1{,}160$

B^s: Price $=$ Quantity $+ 720$

Suppose that, as a result of monetary policy actions, the Federal Reserve sells 90 bonds that it holds. Assume that bond demand and money demand are held constant.

a. How does the Federal Reserve policy affect the bond supply equation?

b. Calculate the effect on the equilibrium interest rate in this market, as a result of the Federal Reserve action.

DATA ANALYSIS PROBLEMS

The Problems update with real-time data in MyEconLab and are available for practice or instructor assignment.

1. Go to the St. Louis Federal Reserve FRED database, and find data on net worth of households and nonprofits (HNONWRQ027S) and the 10-year U.S. treasury bond (GS10). For the net worth indicator, adjust the *units* setting to "Percent Change from Year Ago," and for the 10-year bond, adjust the *frequency* setting to "Quarterly."

a. What is the percent change in net worth over the most recent year of data available? All else being equal, what do you expect should happen to the price and yield on the 10-year treasury bond? Why?

b. What is the change in yield on the 10-year treasury bond over the last year of data available? Is this result consistent with your answer to part (a)? Briefly explain.

2. Go to the St. Louis Federal Reserve FRED database, and find data on the M1 money supply (M1SL) and the 10-year U.S. treasury bond rate. For the M1 money supply indicator, adjust the *units* setting to "Percent Change from Year Ago," and for the 10-year treasury bond, adjust the *frequency* setting to "Quarterly." Download the data into a spreadsheet.

a. Create a scatter plot, with money growth on the horizontal axis and the 10-year treasury rate on the vertical axis, from 2000:Q1 to the most recent quarter of data available. On the scatter plot, graph a fitted (regression) line of the data (there are several ways to do this; however, one particular chart layout has this option built in.) Based on the fitted line, are the data consistent with the liquidity effect? Briefly explain.

b. Repeat part (a), but this time compare the contemporaneous money growth rate with the interest rate four quarters later. For example, create a scatter plot comparing money growth from 2000:Q1 with the interest rate from 2001:Q1, and so on, up to the most recent pairwise data available. Compare your results to those obtained in part (a), and interpret the liquidity effect as it relates to the income, price-level, and expected-inflation effects.

c. Repeat part (a) again, except this time compare the contemporaneous money growth rate with the interest rate eight quarters later. For example, create a scatter plot comparing money growth from 2000:Q1 with the interest rate from 2002:Q1, and so on, up to the most recent pairwise data

available. Assuming the liquidity and other effects are fully incorporated into the bond market after two years, what do your results imply about the overall effect of money growth on interest rates?

d. Based on your answers to parts (a) through (c), how do the actual data on money growth and interest rates compare to the three scenarios presented in Figure 11 of this chapter?

WEB EXERCISES

1. Increasing prices erode the purchasing power of the dollar. It is interesting to compute what goods would have cost at some point in the past after adjusting for inflation. Go to http://minneapolisfed.org/index.cfm. What would a car that costs $22,000 today have cost the year you were born?

2. One of the points made in this chapter is that inflation erodes investment returns. Go to http://www.moneychimp.com/articles/econ/inflation_calculator.htm and review how changes in inflation alter your real return. What happens to the difference between the adjusted value of an investment and its inflation-adjusted value as

a. inflation increases?

b. the investment horizon lengthens?

c. expected returns increase?

WEB REFERENCES

http://www.federalreserve.gov/releases/H6/Current

The Federal Reserve reports money supply data at 4:30 p.m. every Thursday.

WEB APPENDICES

Please visit the Companion Website at http://www.pearsonglobaleditions.com/Mishkin to read the Web appendices to Chapter 5.

Appendix 1: **Models of Asset Pricing**

Appendix 2: **Applying the Asset Market Approach to a Commodity Market: The Case of Gold**

Appendix 3: **Loanable Funds Framework**