Fixed Income Securities

Second Edition

Frank J. Fabozzi, Ph.D., CFA

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To my wife, Donna,
and my children, Karly, Patricia, and Francesco

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Preface

The objective of this book is to provide comprehensive coverage of the wide range of fixed income securities. This includes a description of each security and its investment features and characteristics. While the majority of *Fixed Income Securities: Second Edition* is devoted to the securities, there is also an explanation of how securities are valued, yield and yield spread measures, interest rate risk measures, tax treatment, collateralized borrowing, and an overview of fixed income portfolio management and strategies.

Chapter 1 provides an overview of the features and risks associated with fixed income securities. These features include maturity, par value, the various types of coupon rates (fixed and floating), accrued interest, yield, provisions for paying off bonds before maturity (call and refunding provisions), and options granted to bondholders (put provisions and conversion provisions). Coverage of the risks associated with investing in fixed income securities include interest rate risk, call and prepayment risk, credit risk, liquidity risk, exchange rate risk, and inflation risk.

Chapter 2 explains how fixed income securities are valued and the various measures of interest rate risk. Valuation of fixed income securities involves estimating the cash flow from a security and then computing the present value of the estimated cash flow. The difficulty of estimating the cash flow for certain types of fixed income securities is explained. The two methodologies for computing the present value of the estimated cash flow—the traditional approach (which uses only one discount rate) versus the arbitrage-free approach (which uses multiple discount rates)—is discussed and illustrated. The interest rate risk measures explained are modified duration, effective duration, dollar duration, portfolio duration, contribution to duration, spread duration for fixed-rate bonds, index and spread duration for a floating-rate security, and convexity.

Yield and yield spread measures are covered in Chapter 3. The sources of return from investing in a fixed income security are first explained. Yield measures covered are current yield, yield to maturity, yield to first call, yield to next call, yield to first par call, yield to refunding, yield to put, yield to worst, and cash flow yield. The yield spread measures explained are nominal spread, zero-volatility spread, and option-adjusted spread. The margin or spread measures for floating-rate securities covered are the spread for life and the discount margin. Each measure is not only illustrated, but the limitations are highlighted. Also in Chapter 3 is an explanation of spot rates. These rates are used for computing the present value of the estimated cash flow using the arbitrage-free approach to valuation.

Chapters 4 through 14 cover the securities. Chapter 4 explains U.S. Treasury securities. These securities include Treasury bills, fixed-rate Treasury notes and bonds, and stripped Treasury securities. Federal agency securities are covered in Chapter 5. Federal agencies are categorized as either federally related institutions (i.e., arms of the federal government) or government-sponsored enterprises

(i.e., privately owned but publicly chartered entities). The major issuer that falls into the federally related institutions category and whose securities are described in the chapter is the Tennessee Valley Authority. Government sponsored enterprises issue debentures and securities backed by loans. In Chapter 3 the various types of debentures are described. There are six government-sponsored enterprises that currently issue securities: Federal National Mortgage Association (Fannie Mae), Federal Home Loan Mortgage Corporation (Freddie Mac), Federal Home Loan Bank System, Federal Agricultural Mortgage Corporation (Farmer Mac), Federal Farm Credit System, and Student Loan Marketing Association (Sallie Mae). These entities are discussed in the chapter.

Chapter 6 covers securities issued by state and local governments, popularly referred to as municipal securities. The majority of these securities are exempt from federal income taxes and, as a result, appeal to investors that face a high marginal tax bracket. The tax provisions affecting municipal securities are discussed. The types of municipal securities include tax-backed debt (general obligation bonds, appropriation-backed obligations, dedicated tax-backed obligations, and debt obligations supported by public credit enhancement programs) and revenue bonds. Also described in Chapter 6 are hybrid municipal bond structures—insured bonds and refunded bonds—and municipal derivative securities.

Corporate debt obligations are covered in two chapters, Chapters 7 and 8. In Chapter 7 an overview of corporate bankruptcy and creditor rights is provided. After this overview there is a description of the various features of corporate debt obligations, including secured versus unsecured debt, indentures, and sinking fund provisions. The credit quality of corporate bonds are provided by organizations referred to as "rating agencies." Currently they include Fitch, Moody's Investors Service, and Standard & Poor's Corporation. These companies assess the credit quality of an issuer and cast their opinion in the form of a rating. These ratings are described in Chapter 7, along with an explanation of the rating process and the factors that are considered by rating agencies in assessing the credit risk of an issuer.

Speculative-grade corporate bonds (more popularly referred to as high-yield bonds or "junk" bonds), convertible bonds, medium-term notes, commercial paper, corporate bank loans, and preferred stock are described in Chapter 8. Default and recovery statistics, as well as the rights of creditors in bankruptcy versus what actually takes place in a bankruptcy, are also explained.

In Chapters 9, 10, and 11, securities backed by residential mortgages are described. These securities are popularly referred to as mortgage-backed securities. As explained in Chapter 9, the difficulty in analyzing any mortgage-backed security is due to prepayments. An investor who purchases a mortgage-backed security is exposed to prepayment risk. Chapter 9 describes various mortgage designs and the creation of the basic type of mortgage-backed product, the passthrough security. The passthrough securities issued by a federally related institution, the Government National Mortgage Association (Ginnie Mae), and

two government-sponsored enterprises (Fannie Mae and Freddie Mac) are referred to as agency passthrough securities. Passthrough securities backed by residential mortgages that are issued by any entity other than Ginnie Mae, Fannie Mae, or Freddie Mac are referred to as nonagency passthrough securities. The focus in Chapter 9 is on agency passthrough securities. Passthrough securities backed by agricultural real estate are issued by Farmer Mac and are referred to as agricultural mortgage-backed securities.

From a mortgage passthrough security, two derivative mortgage-backed securities can be created—stripped mortgage-backed securities and collateralized mortgage obligations (CMOs). Stripped mortgage-backed securities include principal-only mortgage strips and interest-only mortgage strips. These securities and their risk characteristics are discussed in Chapter 9. In Chapter 10, CMOs that are issued by Fannie Mae, Freddie Mac, or Ginnie Mae are described, as well as the motivation for creating these securities. There are many types of CMO products created. These securities or bond classes are referred to as "tranches." They include sequential-pay tranches, accrual tranches, floating-rate tranches, inverse floating-rate tranches, planned amortization class tranches, support tranches, support tranches with schedules, and notional IO tranches. Each type of tranche is explained, as well as the exposure of each tranche type to prepayment risk.

In Chapter 11, nonagency mortgage-backed securities are covered. While both agency and nonagency mortgage-backed securities expose investors to prepayment risk, nonagency mortgage-backed securities also expose investors to credit risk. As a result, to obtain a rating for the tranches in a nonagency mortgage-backed security, it is necessary for the issuer to enhance the credit quality of the issue. The various ways in which a nonagency mortgage-backed security are credit enhanced and the important role of the servicer are described in the chapter.

Asset-backed securities are securities backed by a pool of loans or receivables. While technically mortgage-backed securities are asset-backed securities, in the United States there is a separation between the two. In Chapter 12, the features of asset-backed securities are explained—credit enhancement, amortizing versus nonamortizing assets, floating rate versus fixed rate, passthrough versus paythrough, and optional clean-up call provisions. Then several types of products are reviewed—home equity loan-backed securities, manufactured housing-backed securities, commercial mortgage-backed securities, auto loan-backed securities, SBA loan-backed securities, and credit card receivable-backed securities. The unique risks associated with investing in asset-backed securities are asset risks, structural risks, the risks associated with the legal structure, and the risks associated with third-party providers. These risks are explained in the chapter.

A major sector of the asset-backed securities market is the market for collateralized debt obligations (CDOs). These are securities backed by a pool of debt obligations consisting of one or more of the following: high-yield corporate bonds, emerging market bonds, bank loans, special situation loans, distressed debt, or tranches of asset-backed or mortgage-backed deals. When a CDO includes only

bonds as collateral, the issue is referred to as a collateralized bond obligation; a CDO is referred to as a collateralized loan obligation if the collateral consists of only loans. Chapter 13 describes CDOs—their structure and the types of transactions (arbitrage versus balance sheet), and cash flow versus market value transactions.

Chapter 14 reviews the various types of international bonds. The chapter begins with foreign exchange rates and a classification of trading blocs. Then the different types of international bonds are described: foreign bonds, Eurobonds, and global bonds. Coverage of central government securities includes the methods of distribution, special structures in emerging market government bonds, accrued interest and market conventions, and credit risk.

An investor seeking to borrow funds to invest in the bond market can do so by means of a collateralized loan. This means that the collateral for the loan is a bond that is owned or one that is being purchased with the borrowed funds. The most common mechanism used by institutional investors is the repurchase agreement. A specialized type of repurchase agreement used for passthrough securities is the dollar roll. For retail investors, the most common type of collateralized borrowing is the purchase of securities on margin. In Chapter 15, these various forms of collateralized borrowing are explained. Since a collateralized borrowing may result in leveraging a portfolio, the chapter begins with the principles of leverage—the advantages and disadvantages of using leverage. Securities lending is a way in which an entity can borrow securities and is described in the chapter.

The federal income tax treatment of transactions in the fixed income securities market are reviewed in Chapter 16. Specifically, the following are covered: different definitions of income as specified in the tax code, tax basis, capital gain or loss, and tax treatment of capital gain or loss. The tax law dealing with the treatment of interest income is complex when securities are not purchased at par value. The rules are described in the chapter.

Chapters 17 and 18 provide an overview of fixed income portfolio management for institutional investors. An overview of the investment management process is provided in Chapter 17. The five steps in this process are (1) setting investment objectives, (2) establishing investment policy, (3) selecting the portfolio strategy, (4) selecting the assets, and (5) measuring and evaluating performance. In the discussion of the fifth step, there is coverage of the various methodologies for measuring the performance of a portfolio manager—arithmetic average rate of return, time-weighted rate of return, and dollar-weighted rate of return. The various types of bond indexes—broad-based U.S. bond market indexes, specialized U.S. bond market indexes, and global and international bond indexes—are then reviewed. The chapter concludes with a framework that should be used by portfolio managers in assessing the potential performance of a portfolio, total return.

An overview of fixed income portfolio strategies is the subject of Chapter 18. The strategy pursued by a manager will either be an active or passive strategy. The decision as to whether to pursue an active or passive strategy will be based on whether the manager (or client) believes that the bond market or a sector

of the bond market is price efficient. Consequently, the chapter begins with the concept of the pricing efficiency of a market and its implications for portfolio strategy selection. Then a classification of strategies that a portfolio manager can pursue given a benchmark, as suggested by Kenneth Volpert of the Vanguard Group, is provided—pure bond indexing, enhanced indexing/matching primary risk factors, enhanced indexing/minor risk factor mismatches, active management/large risk factor mismatches, and active management/full-blown active. The primary risk factors associated with an index are explained. Value-added strategies are then described—strategic strategies (interest rate expectations strategies, yield curve strategies, and inter- and intra-sector allocation strategies) and tactical strategies. The motivation for international bond investing is then provided, as well as a framework for formulating a strategy for international bond investing. The chapter concludes with a description of strategies that institutional investors employ to manage a portfolio where the objective is to satisfy liabilities. These strategies are referred to as structured portfolio strategies and include immunization and cash flow matching.

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Frank J. Fabozzi

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Chapter 1

Features and Risks of Fixed Income Securities

In its simplest form, a fixed income security is a financial obligation of an entity that promises to pay a specified sum of money at specified future dates. The entity that promises to make the payment is called the *issuer* of the security. Some examples of issuers are the U.S. government or a foreign government, a state or local government entity, a domestic or foreign corporation, and a supranational institution such as the World Bank.

Fixed income securities fall into two general categories: debt obligations and preferred stock. In the case of a debt obligation, the issuer is called the *borrower*. The investor who purchases such a fixed income security is said to be the *lender* or *creditor*. The promised payments that the issuer agrees to make at the specified dates consist of two components: interest payments and repayment of the amount borrowed. Fixed income securities that are debt obligations include bonds, mortgage-backed securities, and asset-backed securities.

In contrast to a fixed income security that represents a debt obligation, preferred stock represents an ownership interest in a corporation. The payments that are made to the preferred stockholder include dividends and repayment of a fixed amount to retire the obligation. The dividends paid represent a distribution of the corporation's profit. Unlike investors who own a corporation's common stock, investors who own the preferred stock can only realize a contractually fixed dividend payment. Moreover, the payments that must be made to preferred stockholders have priority over the payments that a corporation pays to common stockholders. In the case of a liquidation of a corporation, preferred stockholders are given preference over common stockholders. Consequently, preferred stock is a form of equity that has characteristics similar to bonds.

Prior to the 1980s, fixed income securities were simple investment products. Holding aside default by the issuer, the investor knew how much interest would be received periodically and when the amount borrowed would be repaid. Moreover, most investors purchased these securities with the intent of holding them to their maturity date. Beginning in the 1980s, the fixed income world changed. First, fixed income securities became more complex. There are features in many fixed income securities that make it difficult to determine when the amount borrowed will be repaid. For some securities it is difficult to project the amount of interest that will be received periodically. Second, the hold-to-maturity investor has been replaced by the institutional investor who actively trades fixed income securities.

The purpose of this book is to explain the wide range of fixed income securities and their investment characteristics. The major focus is on fixed income securities that are debt obligations. While fixed income securities include more than bonds, we will frequently use the terms *fixed income securities* and *bonds* interchangeably.

FEATURES OF BONDS

The promises of the issuer and the rights of the bondholders are set forth in great detail in the *indenture*. Bondholders would have great difficulty in determining from time to time whether the issuer was keeping all the promises made in the indenture. This problem is resolved for the most part by bringing in a *trustee* as a third party to the contract. The indenture is made out to the trustee as a representative of the interests of the bondholders; that is, a trustee acts in a fiduciary capacity for bondholders. A trustee is a bond or trust company with a trust department whose officers are experts in performing the functions of a trustee.

Maturity

The *term to maturity* of a bond is the number of years over which the issuer has promised to meet the conditions of the obligation. The maturity of a bond refers to the date that the debt will cease to exist, at which time the issuer will redeem the bond by paying the amount borrowed. The maturity date of a bond is always identified when describing a bond. For example, a description of a bond might state "due 12/1/2020."

The practice in the bond market is to refer to the "term to maturity" of a bond as simply its "maturity" or "term." As we explain later, there may be provisions in the indenture that allow either the issuer or bondholder to alter a bond's term to maturity.

Generally, bonds with a maturity between 1 and 5 years are considered "short-term." Bonds with a maturity between 5 and 12 years are viewed as "intermediate-term," and "long-term" bonds are those with a maturity of more than 12 years.

There are bonds of every maturity. Typically, the longest maturity is 30 years. However, Walt Disney Co. issued bonds in July 1993 with a maturity date of 7/15/2093, making them 100-year bonds at the time of issuance. In December 1993, the Tennessee Valley Authority issued bonds that mature on 12/15/2043, making them 50-year bonds.

There are three reasons why the term to maturity of a bond is important. The most obvious is that it indicates the time period over which the bondholder can expect to receive interest payments and the number of years before the principal will be paid in full. The second reason is that the yield on a bond depends on it. This will be explained in Chapter 4. Finally, the price of a bond will fluctuate over its life as interest rates in the market change. The price volatility of a bond is

dependent on its maturity. More specifically, as explained later, with all other factors constant, the longer the maturity of a bond, the greater the price volatility resulting from a change in interest rates.

Par Value

The *par value* of a bond is the amount that the issuer agrees to repay the bondholder by the maturity date. This amount is also referred to as the *principal*, *face value, redemption value*, or *maturity value*. Bonds can have any par value.

Because bonds can have a different par value, the practice is to quote the price of a bond as a percentage of its par value. A value of 100 means 100% of par value. So, for example, if a bond has a par value of $1,000 and the issue is selling for $900, this bond would be said to be selling at 90. If a bond with a par value of $5,000 is selling for $5,500, the bond is said to be selling for 110. The reason why a bond sells above or below its par value is explained in Chapter 3.

Coupon Rate

The *coupon rate*, also called the *nominal rate*, is the interest rate that the issuer agrees to pay each year. The annual amount of the interest payment made to bondholders during the term of the bond is called the *coupon*. The coupon is determined by multiplying the coupon rate by the par value of the bond. For example, a bond with an 8% coupon rate and a par value of $1,000 will pay annual interest of $80.

When describing a bond of an issuer, the coupon rate is indicated along with the maturity date. For example, the expression "6s of 12/1/2020" means a bond with a 6% coupon rate maturing on 12/1/2020.

In the United States, the usual practice is for the issuer to pay the coupon in two semiannual installments. Mortgage-backed securities and asset-backed securities typically pay interest monthly. For bonds issued in some markets outside the United States, coupon payments are made only once per year.

In addition to indicating the coupon payments that the investor should expect to receive over the term of the bond, the coupon rate also affects the bond's price sensitivity to changes in market interest rates. As illustrated later, all other factors constant, the higher the coupon rate, the less the price will change in response to a change in market interest rates.

Zero-Coupon Bonds

Not all bonds make periodic coupon payments. Bonds that are not contracted to make periodic coupon payments are called *zero-coupon bonds*. The holder of a zero-coupon bond realizes interest by buying the bond substantially below its par value. Interest then is paid at the maturity date, with the interest being the difference between the par value and the price paid for the bond. So, for example, if an investor purchases a zero-coupon bond for 70, the interest is 30. This is the difference between the par value (100) and the price paid (70).

The reason for the issuance of zero-coupon bonds is explained in Chapter 3.

There is another type of fixed income security that does not pay interest until the maturity date. This type has contractual coupon payments, but those payments are accrued and distributed along with the maturity value at the maturity date. These instruments are called *accrued coupon instruments* or *accrual securities*. There are municipal bonds and certain types of mortgage-backed securities that have this characteristic.

Floating-Rate Securities

The coupon rate on a bond need not be fixed over the bond's life. *Floating-rate securities*, sometimes called *variable-rate securities*, have coupon payments that reset periodically according to some *reference rate*. The typical formula for the coupon rate at the dates when the coupon rate is reset is:

Reference rate + Quoted margin

The *quoted margin* is the additional amount that the issuer agrees to pay above the reference rate. For example, suppose that the reference rate is the 1-month London interbank offered rate (LIBOR).[1] Suppose that the quoted margin is 100 basis points. Then the coupon reset formula is:

1-month LIBOR + 100 basis points

So, if 1-month LIBOR on the coupon reset date is 5%, the coupon rate is reset for that period at 6% (5% plus 100 basis points).

The quoted margin need not be a positive value. The quoted margin could be subtracted from the reference rate. For example, the reference rate could be the yield on a 5-year Treasury security and the coupon rate could reset every 6 months based on the following coupon reset formula:

5-year Treasury yield – 90 basis points

So, if the 5-year Treasury yield is 7% on the coupon reset date, the coupon rate is 6.1% (7% minus 90 basis points).

The reference rate for most floating-rate securities is an interest rate or an interest rate index. There are some issues where this is not the case. Instead, the reference rate is some financial index such as the return on the Standard & Poor's 500 or a nonfinancial index such as the price of a commodity. Through financial engineering, issuers have been able to structure floating-rate securities with almost any reference rate. In several countries, there are government bonds whose coupon reset formula is tied to an inflation index. As explained in Chapter 4, in 1997 the U.S. government began issuing such bonds.

[1] LIBOR is the interest rate at which major international banks offer each other on Eurodollar certificates of deposit (CDs) with given maturities. The maturities range from overnight to 5 years. Reference to "1-month LIBOR" means the interest rate that major international banks are offering to pay to other such banks on a CD that matures in 1 month.

Caps and Floors A floating-rate security may have a restriction on the maximum coupon rate that will be paid at a reset date. The maximum coupon rate is called a *cap*. For example, suppose for our hypothetical floating-rate security whose coupon rate formula is 1-month LIBOR plus 100 basis points, there is a cap of 11%. If 1-month LIBOR is 10.5% at a coupon reset date, then the coupon reset formula would give a value of 11.5%. However, the cap restricts the coupon rate to 11%. Thus, for our hypothetical security, once 1-month LIBOR exceeds 10%, the coupon rate is capped at 11%.

Because a cap restricts the coupon rate from increasing, a cap is an unattractive feature for the investor. In contrast, there could be a minimum coupon rate specified for a floating-rate security. The minimum coupon rate is called a *floor*. If the coupon reset formula produces a coupon rate that is below the floor, the floor is paid instead. Thus, a floor is an attractive feature for the investor.

Inverse Floaters Typically, the coupon reset formula on floating-rate securities is such that the coupon rate increases when the reference rate increases, and decreases when the reference rate decreases. There are issues whose coupon rate moves in the opposite direction from the change in the reference rate. Such issues are called *inverse floaters* or *reverse floaters*. A general formula for an inverse floater is:

$$K - L \times (\text{Reference rate})$$

For example, suppose that for a particular inverse floater K is 12% and L is 1. Then the coupon reset formula would be:

$$12\% - \text{Reference rate}$$

Suppose that the reference rate is 1-month LIBOR, then the coupon reset formula would be:

$$12\% - \text{1-month LIBOR}$$

If in some month 1-month LIBOR at the coupon reset date is 5%, the coupon rate for the period is 7%. If in the next month 1-month LIBOR declines to 4.5%, the coupon rate increases to 7.5%.

Notice that if 1-month LIBOR exceeded 12%, then the coupon reset formula would produce a negative coupon rate. To prevent this, there is a floor imposed on the coupon rate. Typically, the floor is zero. While not explicitly stated, there is a cap on the inverse floater. This occurs if 1-month LIBOR is zero. In that unlikely event, the maximum coupon rate is 12% for our hypothetical inverse floater. In general, it will be the value of K in the coupon reset formula for an inverse floater.

Suppose instead that the coupon reset formula for an inverse floater whose reference rate is 1-month LIBOR is as follows:

$$28\% - 3 \times (\text{1-month LIBOR})$$

If 1-month LIBOR at a reset date is 5%, then the coupon rate for that month is 13%. If in the next month 1-month LIBOR declines to 4%, the coupon rate increases to 16%. Thus, a decline in 1-month LIBOR of 100 basis points increases the coupon rate by 300 basis points.[2] This is because the value for *L* in the coupon reset formula is 3. Assuming neither the cap nor the floor is reached, for each one basis point change in 1-month LIBOR the coupon rate changes by three basis points.

Range Notes A *range note* is a floating-rate security whose coupon rate is equal to the reference rate as long as the reference rate is within a certain range at the reset date. If the reference rate is outside of the range, the coupon rate is zero for that period.

For example, a 3-year range note might specify that the reference rate is 1-year LIBOR and that the coupon rate resets every year. The coupon rate for the year will be 1-year LIBOR as long as 1-year LIBOR at the coupon reset date falls within the range as specified below:

	Year 1	Year 2	Year 3
Lower limit of range	4.5%	5.25%	6.00%
Upper limit of range	5.5%	6.75%	7.50%

If 1-year LIBOR is outside of the range, the coupon rate is zero. For example, if in Year 1 1-year LIBOR is 5% at the coupon reset date, the coupon rate for the year is 5%. However, if 1-year LIBOR is 6%, the coupon rate for the year is zero since 1-year LIBOR is greater than the upper limit for Year 1 of 5.5%.

Step-Up Notes

There are securities that have a coupon rate that increases over time. These securities are called *step-up notes* because the coupon rate "steps up" over time. For example, a 5-year step-up note might have a coupon rate that is 5% for the first 2 years and 6% for the last 3 years. Or, the step-up note could call for a 5% coupon rate for the first 2 years, 5.5% for the third and fourth years, and 6% for the fifth year. When there is only one change (or step up), as in our first example, the issue is referred to as a *single step-up note*. When there is more than one increase, as in our second example, the issue is referred to as a *multiple step-up note*.

Ratchet Bonds

A *ratchet bond* has a coupon rate that adjusts periodically at a fixed margin over a reference rate. However, it can only adjust downward based on a coupon formula. Once the coupon rate is adjusted down, it cannot be readjusted up if the reference rate subsequently increases. This type of bond was first introduced to the bond market in 1998 by the Tennessee Valley Authority.

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[2] A basis point is equal to 0.0001 or 0.01%. Thus, 100 basis points are equal to 1%.

Deferred Coupon Bonds

There are issues whose coupon payment is deferred for a specified number of years. That is, there is no coupon payment for the deferred period and then a lump sum payment at some specified date and coupon payments until maturity.

Accrued Interest

Bond issuers do not disburse coupon interest payments every day. Instead, typically in the United States coupon interest is paid every 6 months. In some countries, interest is paid annually. For mortgage-backed and asset-backed securities, interest is usually paid monthly. The coupon interest payment is made to the bondholder of record. Thus, if an investor sells a bond between coupon payments and the buyer holds it until the next coupon payment, then the entire coupon interest earned for the period will be paid to the buyer of the bond since the buyer will be the holder of record. The seller of the bond gives up the interest from the time of the last coupon payment to the time until the bond is sold. The amount of interest over this period that will be received by the buyer even though it was earned by the seller is called *accrued interest*.

In the United States and in many countries, the bond buyer must pay the bond seller the accrued interest. The amount that the buyer pays the seller is the agreed-upon price for the bond plus accrued interest. This amount is called the *dirty price*. The agreed-upon bond price without accrued interest is called the *clean price*.

A bond in which the buyer must pay the seller accrued interest is said to be trading *cum-coupon*. If the buyer forgoes the next coupon payment, the bond is said to be trading *ex-coupon*. In the United States, bonds are always traded cum-coupon. There are bond markets outside the United States where bonds are traded ex-coupon for a certain period before the coupon payment date.

There are exceptions to the rule that the bond buyer must pay the bond seller accrued interest. The most important exception is when the issuer has not fulfilled its promise to make the periodic payments. In this case, the issuer is said to be in default. In such instances, the bond's price is sold without accrued interest and is said to be traded *flat*.

Calculating Accrued Interest When calculating accrued interest, three pieces of information are needed: (1) the number of days in the accrued interest period, (2) the number of days in the coupon period, and (3) the dollar amount of the coupon payment. The number of days in the accrued interest period represents the number of days over which the investor has earned interest. Given these values, the accrued interest (AI) assuming semiannual payments is calculated as follows:

$$\text{AI} = \frac{\text{Annual coupon}}{2} \times \frac{\text{Days in AI period}}{\text{Days in coupon period}}$$

For example, suppose that (1) there are 50 days in the accrued interest period, (2) there are 183 days in a coupon period, and (3) the annual coupon per $100 of par value is $8. Then the accrued interest is:

$$AI = \frac{\$8}{2} \times \frac{50}{183} = \$1.0929$$

It is not simple to determine the number of days in the accrued interest period and the number of days in the coupon period. The calculation begins with the determination of three key dates: trade date, settlement date, and value date. The *trade date* is the date on which the transaction is executed. The *settlement date* is the date a transaction is completed. The settlement date varies by the type of bond. For example, for Treasury securities, settlement is the next business day after the trade date; for corporate bonds it is normally 5 business days after the trade date. The *value date* is usually, but not always, the same as the settlement date. Unlike the settlement date, the value date is not constrained to fall on a business day.

Interest accrues on a bond from and including the date of the previous coupon up to but *excluding* the value date.[3] However, this may differ slightly in some non-U.S. markets. For example, in some countries interest accrues up to and *including* the value date. For a newly issued security, there is no previous coupon payment. Instead, the interest accrues from a date called the *dated date*.

The number of days in the accrued interest period and the number of days in the coupon period may not be simply the actual number of calendar days between two dates because there is a market convention for each type of security that specifies how to determine the number of days between two dates. These conventions are called *day count conventions*. We'll discuss these conventions in the appendix to the next chapter.

Yield

The most common measure to describe the *potential* return from investing in a fixed income security is its *yield*. A security's yield takes into consideration that the investor earns a return from the coupon payments and any capital gain or loss from holding the security. It also recognizes that an investor has the opportunity to reinvest any cash flow and therefore can earn interest on reinvesting those cash flows while the bond is held.

We will postpone our discussion of how to calculate a security's yield until Chapter 3. There we will see the different types of yields that can be calculated for fixed income securities. More important, we will see the limitations of using yield measures as an indication of the potential return that can be realized by investing in a fixed income security.

Provisions for Paying off Bonds

The issuer of a bond agrees to repay the principal by the stated maturity date. The issuer can agree to repay the entire amount borrowed in one lump sum payment at the maturity date. That is, the issuer is not required to make any principal repayments prior to the maturity date. Such bonds are said to have a *bullet maturity.*

[3] This is the definition used by the International Securities Market Association (ISMA).

There are bond issues that consist of a series of blocks of securities maturing in sequence. The blocks of securities are said to be *serial bonds*. The coupon rate for each block can be different. Bonds issued by municipalities are sometimes issued as serial bonds. For example, a $250 million par issue of The Port Authority of New York and New Jersey, Special Project Bonds, Series 4 issued on May 1, 1996, had the following serial bonds:

Installment	Par Amount	Coupon (%)	Maturity Date
First	$5,400,000	6.25	October 1, 1999
Second	6,800,000	6.50	October 1, 2001
Third	52,200,000	7.00	October 1, 2007
Fourth	48,600,000	6.75	October 1, 2011
Fifth	137,000,000	6.75	October 1, 2019

One type of corporate bond in which there are serial bonds is an equipment trust certificate. An investor in a serial bond knows when the bonds will mature.

Fixed income securities backed by pools of loans (mortgage-backed securities and asset-backed securities) often have a schedule of principal repayments. Such fixed income securities are said to be *amortizing securities*. For many loans, the payments are structured so that when the last loan payment is made, the entire amount owed is fully paid off.

Another example of an amortizing feature is a bond that has a sinking fund provision. This provision for repayment of a bond may be designed to liquidate all of an issue by the maturity date, or it may be arranged to repay only a part of the total by the maturity date. We discuss this provision later in this section.

Many issues have a call provision granting the issuer an option to retire all or part of the issue prior to the stated maturity date. Some issues specify that the issuer must retire a predetermined amount of the issue periodically. Various types of call provisions are discussed as follows.

Call and Refunding Provisions

An issuer generally wants the right to retire a bond issue prior to the stated maturity date because it recognizes that at some time in the future the general level of interest rates may fall sufficiently below the issue's coupon rate so that redeeming the issue and replacing it with another issue with a lower coupon rate would be economically beneficial. This right is a disadvantage to the bondholder since proceeds received must be reinvested at a lower interest rate. As a result, an issuer who wants to include this right as part of a bond offering must compensate the bondholder when the issue is sold by offering a higher coupon rate, or equivalently, accepting a lower price than if the right is not included.

The right of the issuer to retire the issue prior to the stated maturity date is referred to as a *call option*. If an issuer exercises this right, the issuer is said to "call the bond." The price that the issuer must pay to retire the issue is referred to as the *call price*. Typically, there is not one call price but a *call schedule,* which sets forth a call price based on when the issuer can exercise the call option.

When a bond is issued, typically the issuer may not call the bond for a number of years. That is, the issue is said to have a *deferred call*. The date at which the bond may first be called is referred to as the *first call date*. The first call date for the Walt Disney 7.55s due 7/15/2093 (the 100-year bonds) is 7/15/2023. For the 50-year Tennessee Valley Authority 6⅞s due 12/15/2043, the first call date is 12/15/2003.

Bonds can be called in whole (the entire issue) or in part (only a portion). When less than the entire issue is called, the specific bonds to be called are selected randomly or on a pro rata basis. When bonds are selected randomly, the serial number of the certificates called is published in *The Wall Street Journal* and major metropolitan dailies.

Call Schedule Generally, the call schedule is such that the call price at the first call date is a premium over the par value and scaled down to the par value over time. The date at which the issue is first callable at par value is referred to as the *first par call date.*

For example, the Becton Dickinson & Co. 8.70s due 1/15/2025 bonds were issued on 1/10/95. The first par call date is 1/15/2015. Thus, at issuance this corporate bond had a 10-year deferred call. The call schedule for this issue is as follows:

If redeemed during the 12 months beginning January 15:	Call price
2005	103.949
2006	103.554
2007	103.159
2008	102.764
2009	102.369
2010	101.975
2011	101.580
2012	101.185
2013	100.790
2014	100.395
2015 and thereafter	100.000

The $150 million Anheuser Busch Company 8⅝s due 12/1/2016 issued 11/20/1986 also had a 10-year deferred call and the following call schedule:

If redeemed during the 12 months beginning December 1:	Call price
1996	104.313
1997	103.881
1998	103.450
1999	103.019
2000	102.588
2001	102.156
2002	101.725
2003	101.294
2004	100.863
2005	100.431
2006 and thereafter	100.000

Not all issues have a call schedule in which the call price starts out as a premium over par. There are issues where the call price at the first call date and subsequent call dates is par value. In such cases, the first call date is the same as the first par call date. For example, the first par call date for the U.S. Treasury 12¾s due 11/15/2010 issued on 11/07/1980 is 11/15/2005, and this date is the first call date.

There are three call schedules for zero-coupon bonds found in the market. The first is a call schedule for which the call price is below par value at the first call date and scales up to par value over time. The Baker Hughes Inc. 0s due 5/5/2008, which had an initial sale price of about 58.088 at issuance on 4/28/1993, has the following call schedule:

If redeemed during the 12 months beginning May 5:	Call price
1998	70.683
1999	73.178
2000	75.762
2001	78.437
2002	81.206
2003	84.073
2004	87.042
2005	90.115
2006	93.296
2007	96.590

The second type of call schedule for a zero-coupon bond is one in which the call price at the first call date is above par and scales down to par. An example is the Bell Cable Media PLC 0s due 7/15/2004 that were initially sold at 54.2748 on 7/15/1994 with the following call schedule:

If redeemed during the 12 months beginning July 15:	Call price
1999	104.480
2000	102.990
2001	101.490
2002	100.000
2003	100.000

The third type of call schedule for a zero-coupon bond is one in which the call price is par value at the first call date and any subsequent call date.

Regular versus Special Redemption Prices The call prices in the call schedule are called the *regular* or *general redemption prices*. There are also *special redemption prices* for debt redeemed through the sinking fund and through other provisions, and the proceeds from the confiscation of property through the right of eminent domain. The special redemption price is usually par value, but in the case of some utility issues it initially may be the public offering price, which is amortized down to par value (if a premium) over the life of the bonds.

Noncallable versus Nonrefundable Bonds If a bond issue does not have any protection against early call, then it is said to be a *currently callable issue*. But most new bond issues, even if currently callable, usually have some restrictions against certain types of early redemption. The most common restriction is prohibiting the *refunding* of the bonds for a certain number of years. Refunding a bond issue means redeeming bonds with funds obtained through the sale of a new bond issue.

Many investors are confused by the terms *noncallable* and *nonrefundable*. Call protection is much more absolute than refunding protection. While there may be certain exceptions to absolute or complete call protection in some cases, it still provides greater assurance against premature and unwanted redemption than does refunding protection. Refunding prohibition merely prevents redemption only from certain sources of funds, namely the proceeds of other debt issues sold at a lower cost of money. The bondholder is only protected if interest rates decline, and the borrower can obtain lower-cost money to pay off the debt.

Beginning in early 1986, a number of industrial companies issued long-term debt with extended call protection, not refunding protection. A number are noncallable for the issue's life, such as Dow Chemical Company's 8⅝s due in 2006 and Atlantic Richfield's 9⅞s due in 2016. The prospectuses for both issues expressly prohibit redemption prior to maturity. These *noncallable-for-life issues* are referred to as *bullet bonds*.

Prepayments

For amortizing securities that are backed by loans and have a schedule of principal repayments, individual borrowers typically have the option to pay off all or part of their loan prior to the scheduled date. Any principal repayment prior to the scheduled date is called a *prepayment*. The right of borrowers to prepay is called the *prepayment option*.

Basically, the prepayment option is the same as a call option. However, unlike a call option, there is not a call price that depends on when the borrower pays off the issue. Typically, the price at which a loan is prepaid is par value.

Sinking Fund Provision

An indenture may require the issuer to retire a specified portion of an issue each year. This is referred to as a *sinking fund requirement*. The alleged purpose of the sinking fund provision is to reduce credit risk. This kind of provision for repayment of debt may be designed to liquidate all of a bond issue by the maturity date, or it may be arranged to pay only a part of the total by the end of the term. If only a part is paid, the remainder is called a *balloon maturity.* The $150 million Ingersoll Rand 7.20s issue due 6/1/2025 and issued on 6/5/1995 with a sinking fund schedule that begins on 6/1/2006 is an example of an issue with a balloon maturity. Each year the issuer must retire $7.5 million.

Generally, the issuer may satisfy the sinking fund requirement by either (1) making a cash payment of the face amount of the bonds to be retired to the trustee, who then calls the bonds for redemption using a lottery, or (2) delivering

to the trustee bonds purchased in the open market that have a total par value equal to the amount that must be retired. If the bonds are retired using the first method, interest payments stop at the redemption date.

Usually, the periodic payments required for sinking fund purposes will be the same for each period. A few indentures might permit variable periodic payments, where payments change according to certain prescribed conditions set forth in the indenture. Many indentures include a provision that grants the issuer the option to retire more than the amount stipulated for sinking fund retirement. This is referred to as an *accelerated sinking fund provision*. For example, the Anheuser Busch 8⅝s due 12/1/2016, whose call schedule was presented earlier, has a sinking fund requirement of $7.5 million per annum beginning on 12/01/1997. The issuer is permitted to retire up to $15 million each year.

Usually the sinking fund call price is the par value if the bonds were originally sold at par. When issued at a price in excess of par, the call price generally starts at the issuance price and scales down to par as the issue approaches maturity.

There is a difference between the amortizing feature for a bond with a sinking fund provision and the regularly scheduled principal repayment for a mortgage-backed and an asset-backed security. The owner of a mortgage-backed security and an asset-backed security knows that, assuming no default, there will be principal repayments. In contrast, the owner of a bond with a sinking fund provision is not assured that his or her particular holding will be called to satisfy the sinking fund requirement.

Options Granted to Bondholders

It is common for a bond issue to include a provision in the indenture that gives either the bondholder and/or the issuer an option to take some action against the other party. The most common type of option embedded in a bond is a call feature, which was discussed earlier. This option is granted to the issuer. There are two options that can be granted to the bondholder: the right to put the issue and the right to convert the issue.

Put Provision

An issue with a *put provision* included in the indenture grants the bondholder the right to sell the issue back to the issuer at a specified price on designated dates. The specified price is called the *put price*. Typically, a bond is putable at par if it is issued at or close to par value. For a zero-coupon bond, the put price is below par.

The advantage of the put provision to the bondholder is that if after the issue date market rates rise above the issue's coupon rate, the bondholder can force the issuer to redeem the bond at the put price and then reinvest the proceeds at the prevailing higher rate.

Conversion Privilege

A *convertible bond* is an issue giving the bondholder the right to exchange the bond for a specified number of shares of common stock. Such a feature allows the

bondholder to take advantage of favorable movements in the price of the issuer's common stock. An *exchangeable bond* allows the bondholder to exchange the issue for a specified number of shares of common stock of a corporation different from the issuer of the bond. These bonds are discussed in Chapter 7.

Currency Denomination

The payments that the issuer makes to the bondholder can be in any currency. For bonds issued in the United States, the issuer typically makes both coupon payments and principal repayments in U.S. dollars. However, there is nothing that forces the issuer to make payments in U.S dollars. The indenture can specify that the issuer may make payments in some other specified currency. For example, payments may be made in Japanese yen.

An issue in which payments to bondholders are in U.S. dollars is called a *dollar-denominated issue*. A *nondollar-denominated issue* is one in which payments are not denominated in U.S. dollars. There are some issues whose coupon payments are in one currency and whose principal payment is in another currency. An issue with this characteristic is called a *dual-currency issue*.

Some issues allow either the issuer or the bondholder the right to select the currency in which a payment will be paid. This option effectively gives the party with the right to choose the currency the opportunity to benefit from a favorable exchange rate movement.

RISKS ASSOCIATED WITH INVESTING IN FIXED INCOME SECURITIES

Bonds may expose an investor to one or more of the following risks: (1) interest rate risk; (2) call and prepayment risk; (3) credit risk; (4) liquidity risk; (5) exchange rate or currency risk; and (6) inflation or purchasing power risk. While these risks are discussed further in later chapters, we describe them briefly as follows. There are additional risks that are discussed in later chapters. Some of the risks discussed in later chapters pertain to the risks associated with fixed income portfolio strategies.

Interest Rate Risk

The price of a typical fixed income security will change in the opposite direction from a change in interest rates. That is, when interest rates rise, a fixed income security's price will fall; when interest rates fall, a fixed income security's price will rise. For example, consider a 6% 20-year bond. If the yield investors require to buy this bond is 6%, the price of this bond would be $100. However, if the required yield increased to 6.5%, the price of this bond would decline to $94.4479. Thus, for a 50 basis point increase in yield, the bond's price declines by 5.55%. If, instead, the yield declines from 6% to 5.5%, the bond's price will rise by 6.02% to $106.0195.