**OVERVIEW OF CONTENTS**

Chapter 1 introduces the text. Chapters 2–5 set forth the basic analytical framework necessary to understand the pricing of bonds and their investment characteristics. Chapter 6 introduces Treasury securities, Treasury derivative securities, and federal agency securities. Chapters 7–9 explain the investment characteristics and special features of U.S. corporate debt, municipal securities, and non-U.S. bonds. Chapters 10–13 focus on residential mortgage-backed securities. Chapter 14 covers commercial mortgage loans and commercial mortgage-backed securities. Chapter 15 covers asset-backed securities. Chapter 16 provides the basics of interest rate modeling. Chapter 17 explains the lattice method for valuing bonds with embedded. Chapter 18 discusses the Monte Carlo simulation model for mortgage-backed securities and asset-backed securities backed by residential loans. Chapter 19 covers the analysis of convertible bonds. Chapter 20 describes traditional credit analysis and Chapter 21 provides the basics of credit risk modeling. Chapters 22–25 discuss portfolio management. Chapter 26 covers interest-rate futures contracts while Chapter 27 covers interest-rate options. Chapter 28 examines interest-rate swaps, caps, and floors while Chapter 29 looks at credit derivatives.

**CHAPTER 1**

**INTRODUCTION**

**CHAPTER SUMMARY**

This introductory chapter will focus on the fundamental features of bond, the type of issuers, and risk faced by investors in fixed-income securities. A bond is a debt instrument requiring the issuer to repay to the lender the amount borrowed plus interest over a specified period of time. A typical (“plain vanilla”) bond issued in the United States specifies (1) a fixed date when the amount borrowed (the principal) is due, and (2) the contractual amount of interest, which typically is paid every six months. The date on which the principal is required to be repaid is called the maturity date. Assuming that the issuer does not default or redeem the issue prior to the maturity date, an investor holding this bond until the maturity date is assured of a known cash flow pattern. Since the early 1980s a wide range of bond structures has been introduced into the bond market.

**SECTORS OF THE U.S. BOND MARKET**

The U.S. bond market is divided into six sectors: U.S. Treasury sector, agency sector, municipal sector, corporate sector, asset-backed securities, and mortgage sector.

The Treasury Sector

The Treasury sector includes securities issued by the U.S. government. These securities include Treasury bills, notes, and bonds. This sector plays a key role in the valuation of securities and the determination of interest rates throughout the world.

The Agency Sector

The agency sector includes securities issued by federally related institutions and government-sponsored enterprises. The securities issued are not backed by any collateral and are referred to as agency debenture securities.

The Municipal Sector

The municipal sector is where state and local governments and their authorities raise funds. This sector is divided into two subsectors based on how the interest received by investors is taxed at the federal income tax level: the tax-exempt and taxable sectors. The municipal bond market includes two types of structures: tax-backed and revenue bonds.

The Corporate Sector

The corporate sector includes (i) securities issued by U.S. corporations and (ii) securities issued in the United States by foreign corporations. Issuers in the corporate sector issue bonds, medium-term notes, structured notes, and commercial paper. The corporate sector is divided into the investment grade and noninvestment grade sectors.

The Asset-Backed Securities Sector

In the asset-backed securities sector, a corporate issuer pools loans or receivables and uses the pool of assets as collateral for the issuance of a security.

The Mortgage Sector

The mortgage sector is the sector where securities are backed by mortgage loans. These are loans obtained by borrowers in order to purchase residential property or an entity to purchase commercial property (i.e., income-producing property). The mortgage sector is then divided into the residential mortgage sector and the commercial mortgage sector.

**OVERVIEW OF BOND FEATURES**

A more detailed treatment of bond features is presented in later chapters.

Type of Issuer

There are three issuers of bonds: the federal government and its agencies, municipal governments, and corporations (domestic and foreign).

Term to Maturity

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 principal. 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 of between one and five years are considered **short-term**. Bonds with a maturity between 5 and 12 years are viewed as **intermediate -term**, and those with a maturity of more than 12 years are called **long-term**. With all other factors constant, the longer the maturity of a bond, the greater the price volatility resulting from a change in market yields.

Principal and Coupon Rate

The **principal** of a bond is the amount that the issuer agrees to repay the bondholder at the maturity date. This amount is also referred to as the **redemption value**, **maturity value**, **par value**, or **face value**. 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 owners during the term of the bond is called the **coupon**.

The holder of a **zero-coupon bond** realizes interest by buying the bond substantially below its principal value. Interest is then paid at the maturity date, with the exact amount being the difference between the principal value and the price paid for the bond.

**Floating-rate bonds** are issues where the coupon rate resets periodically (the coupon reset date) based on a formula. The coupon reset formula has the following general form: reference rate + quoted margin. The quoted margin is the additional amount that the issuer agrees to pay above the reference rate.

An important non-interest rate index that has been used with increasing frequency is the rate of inflation. Bonds whose interest rate is tied to the rate of inflation are referred to generically as **linkers**.

The coupon on floating-rate bonds (which is dependent on an interest rate benchmark) typically rises as the benchmark rises and falls as the benchmark falls. Exceptions are **inverse floaters** whose coupon interest rate moves in the opposite direction from the change in interest rates. To reduce the burden of interest payments, firms involved in LBOs and recapitalizations, have issued **deferred-coupon bonds** that let the issuer avoid using cash to make interest payments for a specified number of years.

Amortization Feature

The principal repayment of a bond issue can call for either (1) the total principal to be repaid at maturity or (2) the principal repaid over the life of the bond. In the latter case, there is a schedule of principal repayments. This schedule is called an **amortization schedule**. For amortizing securities, a measure called the **weighted average life** or simply **average life** of a security is computed.

Embedded Options

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 provision**. This provision grants the issuer the right to retire the debt, fully or partially, before the scheduled maturity date. An issue with a **put provision** included in the indenture grants the bondholder the right to sell the issue back to the issuer at par value on designated dates.

A **convertible bond** is an issue giving the bondholder the right to exchange the bond for a specified number of shares of common stock. An **exchangeable bond** allows the bondholder to exchange the issue for a specified number of common stock shares of a corporation different from the issuer of the bond.

Describing a Bond Issue

There are hundreds of thousands of bonds issues. Most securities are identified by a nine character (letters and numbers) CUSIP number. CUSIP stands for Committee on Uniform Security Identification Procedures. The first six characters identify the issuer: the corporation, government agency, or municipality. The next two characters identify whether the issue is debt or equity and the issuer of the issue. The last character is simply a check character that allows for accuracy checking and is sometimes truncated or ignored. The CUSIP International Numbering System (CINS) is used to identify foreign securities and includes 12 characters.

**RISKS ASSOCIATED WITH INVESTING IN BONDS**

Bonds may expose an investor to one or more of the following risks: (1) interest-rate risk, (2) reinvestment risk, (3) call risk, (4) credit risk, (5) inflation risk, (6) exchange rate risk, (7) liquidity risk, (8) volatility risk, and (9) risk risk. In later chapters, other risks, such as yield curve risk, event risk, and tax risk, are also introduced.

Interest-Rate Risk

If an investor has to sell a bond prior to the maturity date, an increase in interest rates will mean the realization of a capital loss (i.e., selling the bond below the purchase price). This risk is referred to as **interest-rate risk** or **market risk**.

Reinvestment Income or Reinvestment Risk

**Reinvestment risk** is the risk that the interest rate at which interim cash flows can be reinvested will fall. Reinvestment risk is greater for longer holding periods, as well as for bonds with large, early, cash flows, such as high-coupon bonds. It should be noted that interest-rate risk and reinvestment risk have offsetting effects. That is, interest-rate risk is the risk that interest rates will rise, thereby reducing a bond’s price. In contrast, reinvestment risk is the risk that interest rates will fall.

Call Risk

**Call risk** is the risk investors have that a callable bond will be called when interest rates fall. Many bonds include a provision that allows the issuer to retire or “call” all or part of the issue before the maturity date. The issuer usually retains this right in order to have flexibility to refinance the bond in the future if the market interest rate drops below the coupon rate.

For investors, there are three disadvantages to call provisions. First, the cash flow pattern cannot be known with certainty. Second, the investor is exposed to reinvestment risk. Third, the capital appreciation potential of a bond will be reduced. Even though the investor is usually compensated for taking call risk by means of a lower price or a higher yield, it is not easy to determine if this compensation is sufficient.

Credit Risk

**Credit risk** is the risk that the issuer of a bond will fail to satisfy the terms of the obligation with respect to the timely payment of interest and repayment of the amount borrowed. This form of credit risk is called **default risk**. Market participants gauge the default risk of an issue by looking at the **default rating** or **credit rating** assigned to a bond issue by rating companies.

The yield on a bond issue is made up of two components: (1) the yield on a similar maturity Treasury issue and (2) a premium to compensate for the risks associated with the bond issue that do not exist in a Treasury issue—referred to as a spread. The part of the risk premium or spread attributable to default risk is called the **credit spread**. The risk that a bond price will decline due to an increase in the credit spread is called **credit spread risk**.

An unanticipated downgrading of an issue or issuer increases the credit spread sought by the market, resulting in a decline in the price of the issue or the issuer’s debt obligation. This risk is referred to as **downgrade risk**. Consequently, credit risk consists of three types of risk: default risk, credit spread risk, and downgrade risk.

Inflation Risk

**Inflation risk** or **purchasing-power risk** arises because of the variation in the value of cash flows from a security due to inflation, as measured in terms of purchasing power.

**ANSWERS TO QUESTIONS FOR CHAPTER 1**

(**Questions** are in bold print followed by answers.)

**1.** **What is the cash flow of a 8-year bond that pays coupon interest semiannually, has a coupon rate of 6%, and has a par value of $100,000?**

The principal or par value of a bond is the amount that the issuer agrees to repay the bondholder at the maturity date. The coupon rate multiplied by the principal of the bond provides the dollar amount of the coupon (or annual amount of the interest payment). An 8-year bond with a 6% annual coupon rate and a principal of $100,000 will pay semiannual interest of (0.06/2)($100,000) = $3,000 for 8(2) = 16 periods. Thus, the cash flow is $3,000. In addition to this periodic cash, the issuer of the bond is obligated to pay back the principal of $100,000 at the time the last $3,000 is paid.

**2.** **What is the cash flow of a 4-year bond that pays no coupon interest and has a par value of $1,000?**

There is no periodic cash flow as found in the previous problem. Thus, the only cash flow will be the principal payment of $1,000 received at the end of six years. This type of cash flow resembles a zero-coupon bond. The holder of such a bond realizes interest by buying the bond substantially below its principal value. Interest is then paid at the maturity date, with the exact amount being the difference between the principal value and the price paid for the bond.

**3. Give three reasons why the maturity of a bond is important.**

There are three reasons why the maturity of a bond is important. First, the maturity gives the time period over which the holder of the bond can expect to receive the coupon payments and the number of years before the principal will be paid in full. Second, the maturity is important because the yield on a bond depends on it. The shape of the yield curve determines how the maturity affects the yield. Third, the price of a bond will fluctuate over its life as yields in the market change. The volatility of a bond’s price is dependent on its maturity. More specifically, with all other factors constant, the longer the maturity of a bond, the greater the price volatility resulting from a change in market yields.

**4. Explain whether or not an investor can determine today what the cash flow of a floating-rate bond will be.**

Floating-rate bonds are issues where the coupon rate resets periodically based on a general formula equal to the reference rate plus the quoted margin. The reference rate is some index subject to change. The exact change is unknown and uncertain. Thus, an investor cannot determine today what the cash flow of a floating-rate bond will be in the future.

**5. Suppose that coupon reset formula for a floating-rate bond is: 1-month LIBOR + 130 basis points.**

**(a) What is the reference rate?**

The reference rate is the 1-month LIBOR.

**(b) What is the quoted margin?**

The quoted margin is the 130 basis points (or 1.30%).

**(c) Suppose that on coupon reset date that 1-month LIBOR is 2.4%. What will the coupon rate be for the period?**

The coupon reset formula is: 1-month LIBOR + 130 basis points. So, if 1-month LIBOR on the coupon reset date is 2.4%, the coupon rate is reset for that period at 2.40% + 1.30% = 3.70%..

**6. What is a deferred coupon bond?**

Deferred-coupon bonds are coupon bonds that let the issuer avoid using cash to make interest payments for a specified number of years. There are three types of deferred-coupon structures: (1) deferred-interest bonds, (2) step-up bonds, and (3) payment-in-kind bonds.

**7. What is meant by a linker?**

A linker is a bond whose interest rate is tied to the rate of inflation. The U.S. Treasury issues linkers, and they are referred to as Treasury Inflation Protection Securities (TIPS).

**8. Answer the below questions.**

**(a) What is meant by an amortizing security?**

The principal repayment of a bond issue can be for either the total principal to be repaid at maturity or for the principal to be repaid over the life of the bond. In the latter case, there is a schedule of principal repayments. This schedule is called an amortization schedule. Loans that have this amortizing feature are automobile loans and home mortgage loans. There are securities that are created from loans that have an amortization schedule. These securities will then have a schedule of periodic principal repayments. Such securities are referred to as amortizing securities.

**(b) Why is the maturity of an amortizing security not a useful measure?**

For amortizing securities, investors do not talk in terms of a bond’s maturity. This is because the stated maturity of such bonds or securities only identifies when the final principal payment will be made. For an amortized security, the repayment of the principal is made through multiple payments over its maturity and not just at the end of its term to maturity. Thus, the maturity is not a useful measure in terms of identifying when the principal is repaid.

**9. What is a bond with an embedded option?**

A bond with an embedded option is a bond that contains a provision in the indenture that gives either the bondholder and/or the issuer an option to take some action against the other party. For example, the borrower may be given the right to alter the amortization schedule for amortizing securities. An issue may also include a provision that allows the bondholder to change the maturity of a bond. An issue with a put provision included in the indenture grants the bondholder the right to sell the issue back to the issuer at par value on designated dates.

**10. What does the call provision for a bond entitle the issuer to do?**

A call provision grants the issuer the right to retire the debt, fully or partially, before the scheduled maturity date.

**11. Answer the below questions.**

**(a) What is the advantage of a call feature for an issuer?**

Inclusion of a call feature benefits bond issuers by allowing them to replace an old bond issue with a lower-interest cost issue if interest rates in the market decline. A call provision effectively allows the issuer to alter the maturity of a bond. The right to call an obligation is included in most loans and therefore in all securities created from such loans. This is because the borrower typically has the right to pay off a loan at any time, in whole or in part, prior to the stated maturity date of the loan.

**(b) What are the disadvantages of a call feature for the bondholder?**

From the bondholder’s perspective, there are three disadvantages to call provisions. First, the cash flow pattern of a callable bond is not known with certainty. Second, because the issuer will call the bonds when interest rates have dropped, the investor is exposed to reinvestment risk (i.e., the investor will have to reinvest the proceeds when the bond is called at relatively lower interest rates). Finally, the capital appreciation potential of a bond will be reduced, because the price of a callable bond may not increase much above the price at which the issuer will call the bond.

**12. What does the put provision for a bond entitle the bondholder to do?**

An issue with a put provision included in the indenture grants the bondholder the right to sell the issue back to the issuer at par value on designated dates. The advantage to the bondholder is related to the possibility that if interest rates rise after the issue date (thereby reducing a bond’s price) the bondholder can force the issuer to redeem the bond at par value.

**13. The Export Development Canada issued a bond on March 17, 2009. The terms were as follows:**

Currency of denomination: Japanese yen (JPY)

Denomination: JPY100,000,000

Maturity date: March 18, 2019, or an optional redemption date

Redemption/payment basis: Redemption at par value

Interest payment dates: March 18 and September 18 in each year

Optional redemption dates: The issuer has the right to call the instruments in whole (but not in part) at par starting on March 18, 2012

Interest rate:

Fixed rate for the first three years up to but excluding March 18, 2012: 1.5%

March 18, 2012-September 18, 2012 1.75% − 6 month JPY LIBORBBA

September 18, 2012-March 18, 2013 1.75% − 6 month JPY LIBORBBA

March 18, 2013-September 18, 2013 2.00% − 6 month JPY LIBORBBA

September 18, 2013-March 18, 2014 2.00% − 6 month JPY LIBORBBA

March 18, 2014-September 18, 2014 2.25% − 6 month JPY LIBORBBA

September 18, 2014-March 18, 2015 2.25% − 6 month JPY LIBORBBA

March 18, 2015-September 18, 2015 2.50% − 6 month JPY LIBORBBA

September 18, 2015-March 18, 2016 2.50% − 6 month JPY LIBORBBA

March 18, 2016-September 18, 2016 2.75% − 6 month JPY LIBORBBA

September 18, 2016-March 18, 2017 2.75% − 6 month JPY LIBORBBA

March 18, 2017-September 18, 2017 3.00% − 6 month JPY LIBORBBA

September 18, 2017-March 18, 2018 3.00% − 6 month JPY LIBORBBA

March 18, 2018-September 18, 2018 3.25% − 6 month JPY LIBORBBA

September 18, 2018-March 18, 2019 3.25% − 6 month JPY LIBORBBA

**Answer the below questions.**

**(a) What is meant by JPY LIBORBBA?**

The reference rate for most floating-rate securities is an interest rate or an interest rate index. The mostly widely used reference rate throughout the world is the **London Interbank Offered Rate** and referred to as LIBOR. In debt agreements LIBOR is often referred to as BBA LIBOR. The rate is reported for ten currencies including the Japanese yen (JPY). So, for example, the JPY BBA LIBOR is the rate for a LIBOR loan denominated in Japanese yens as computed by the British Bankers Association (BBA).

**(b) Describe the coupon interest characteristics of this bond.**

The characteristics are based on the floating-rate bonds, which are issues where the coupon rate resets periodically (the coupon reset date) based on a formula. The formula, referred to as the coupon reset formula, has the following general form:

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 3.5% and the quoted margin is 150 basis points. Then the coupon reset formula is

1-month LIBOR + 150 basis points = 3.5% + 1.5% = 5.0%

If the 1-month LIBOR on the coupon reset date is 3.5%, the coupon rate is reset for that period at 5.0% .

**(c) What are the risks associated with investing in this bond if the investor’s home currency is not in Japanese yen.**

From the perspective of a U.S. investor, a non-dollar-denominated bond (i.e., a bond whose payments occur in a foreign currency) has unknown U.S. dollar cash flows. The dollar cash flows are dependent on the exchange rate at the time the payments are received. For our situation, an investor purchases a bond whose payments are in Japanese yen. If the yen depreciates relative to the U.S. dollar, fewer dollars will be received. The risk of this occurring is referred to as exchange-rate or currency risk. Of course, should the yen appreciate relative to the U.S. dollar, the investor will benefit by receiving more dollars.

**14. What are a convertible bond and an exchangeable bond?**

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 common stock shares of a corporation different from the issuer of the bond.

**15. How do market participants gauge the default risk of a bond issue?**

It is common to define credit risk as the risk that the issuer of a bond will fail to satisfy the terms of the obligation with respect to the timely payment of interest and repayment of the amount borrowed. This form of credit risk is called default risk. Market participants gauge the default risk of an issue by looking at the default rating or credit rating assigned to a bond issue by one of the three rating companies—Standard & Poor’s, Moody’s, and Fitch.

**16. Comment on the following statement: Credit risk is more than the risk that an issuer will default.**

There are risks other than default that are associated with investment bonds that are also components of credit risk. Even in the absence of default, an investor is concerned that the market value of a bond issue will decline in value and/or the relative price performance of a bond issue will be worse than that of other bond issues.

The yield on a bond issue is made up of two components: (1) the yield on a similar maturity Treasury issue and (2) a premium to compensate for the risks associated with the bond issue that do not exist in a Treasury issue—referred to as a spread. The part of the risk premium or spread attributable to default risk is called the credit spread. The price performance of a non-Treasury debt obligation and its return over some investment horizon will depend on how the credit spread of a bond issue changes. If the credit spread increases—investors say that the spread has “widened”—the market price of the bond issue will decline. The risk that a bond issue will decline due to an increase in the credit spread is called credit spread risk. This risk exists for an individual bond issue, bond issues in a particular industry or economic sector, and for all bond issues in the economy not issued by the U.S. Treasury.

**17. Explain whether you agree or disagree with the following statement: “Because my bond is guaranteed by an insurance company, I have eliminated credit risk.”**

Credit risk consists of three types of risk: default risk, credit spread risk, and downgrade risk. These risks are not necessarily eliminated if there is a financial guaranty by a nongovernment third-party entity such as a private insurance company. This is because insurance companies themselves can face financial difficulties. This fact was brought home to market participants at the end of 2007 when specialized insurance companies that provide financial guarantees faced financial difficulties and the downgrading of their own credit rating. Thus, one would disagree with the statement because one’s bond guarantee is only as good as the insurance company guaranteeing it.

**18. Answer the below questions.**

**(a) What is counterparty risk?**

Counterparty risk is a form of credit risk that involves transactions between two parties in a trade. The risk to each party of a contract is that the counterparty (or other party) will not be able to live up to its contractual obligations. In financial contracts, counterparty risk is known as “default risk.”

**(b) Give two examples of transactions where one faces counterparty risk.**

For a first example of counterparty risk, consider the strategy of a borrower using the borrowed funds from a lender to purchase another asset such as a bond. In this transaction, the lender is exposed to counterparty risk. Counterparty risk is the risk that the borrower will fail to repay the loan if his bond purchase defaults. A second example of counterparty risk involves a trade in a derivative (which is an investment that derives its value from the value of an underlying asset). A derivative, such as an option or a futures contract, is traded on an exchange that becomes the ultimate counterparty to the trade as it guarantees payments on money owed to the purchaser of the derivative instrument. For derivative instruments that are over-the-counter instruments, the counterparty is an entity other than an exchange. In such trades, there is considerable concern with counterparty risk.

**19. Does an investor who purchases a zero-coupon bond face reinvestment risk?**

The calculation of the yield of a coupon paying bond assumes that the cash flows received are reinvested at the prevailing rate when the coupon payment is received. Because this rate is not known in advance it creates uncertainty and so it is called by the name of reinvestment risk to indicate there is risk or uncertainty in the reinvesting of coupon payments.

For zero-coupon bonds, unlike bonds that pay a stream of coupon payments over time, the payment is reinvested at the same rate as the coupon rate. This eliminates any risk associated with the possibility that coupon payments will be reinvested at a lower rate. However, if rates go up, then the zero coupon bond will fall in value because its “locked-in” rate is below the higher market rate.

**20. What is meant by marking a position to market?**

Marking a position to market means that periodically the market value of a portfolio must be determined. Thus, it can refer to the practice of reporting the value of assets on a market rather than book value basis. Marking to market can also refer to settling or reconciling changes in the value of futures contracts on a daily basis.

**21. What is meant by a CUSIP number, and why is it important?**

By a CUSIP number, we mean a unique number assigned to a firm’s security to identify it. Thus, its importance lies in its ability to singularly identify each security. Most securities are identified by the characters (letters and numbers) found in its CUSIP number. CUSIP stands for Committee on Uniform Security Identification Procedures. For securities that have nine characters, the first six characters identify the issuer: the corporation, government agency, or municipality. The next two characters identify whether the issue is debt or equity and the issuer of the issue. The last character is simply a check character that allows for accuracy checking and is sometimes truncated or ignored. The CUSIP International Numbering System (CINS) is used to identify foreign securities and includes 12 characters.