Fixed Income

CFA一级培训项目

讲师：洪波

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洪波

工作职称：金程首席培训师、英国纽卡斯尔大学国际金融分析硕士（优等学位）、CFA（注册金融分析师）、RFP（注册财务策划师）、香港财经分析师学会会员
教育背景：英国纽卡斯尔大学国际金融分析硕士（优等学位毕业）、上海对外贸易学院商务日语学士学位
工作背景：12年专业金融培训经验，深悉各类金融资格证书考试重点及行业热点。先后讲授CFA 一级40班次，二级20班次，三级30班次，RFP课程10次，CFRM课程5次等。授课范围广泛，包括权益投资、固定收益投资、财务报表分析、经济学、衍生品投资、投资组合、资产配置、个人理财、私募投资、企业估值、债券投资组合管理等，同时也进行客户指定专题的培训。授课深入浅出，逻辑清晰，备受学员喜爱。拥有丰富金融从业经验，服务于摩根大通证券研究部和毕德投资咨询公司，从事行业与公司的分析和研究。在收购兼并等方面为跨国公司提供财务顾问咨询服务。并为国内中小企业寻找战略投资者和机构投资者提供咨询服务。精通日语，曾创立并领导日语小组支持东京的投资银行部门和债券市场部门。
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Topic Weightings in CFA Level I

Session NO.	Content	Weightings
Study Session 1	Ethics & Professional Standards	15
Study Session 2-3	Quantitative Analysis	12
Study Session 4-5	Economics	10
Study Session 6-9	Financial Reporting and Analysis	20
Study Session 10-11	Corporate Finance	7
Study Session 12	Portfolio Management and Wealth Planning	7
Study Session 13-14	Equity Investment	10
Study Session 15-16	**Fixed Income**	**10**
Study Session 17	Derivatives	5
Study Session 18	Alternative Investments	4

Framework

Fixed Income

- SS15 Basic Concepts
  - R51 Fixed-Income Securities: Defining Elements
  - R52 Fixed-Income Markets: Issuance, Trading, and Funding
  - R53 Introduction to Fixed-Income Valuation
  - R54 Introduction to Asset-Backed Securities
- SS16 Analysis of Risk
  - R55 Understanding Fixed-Income Risk and Return
  - R56 Fundamentals of Credit Analysis

Reading 51

Fixed-Income Securities: Defining Elements

Framework

1. Basic features of a bond
2. Bond indenture
   - Legal information
   - Collateral
   - Credit enhancements
   - Covenants
   - Tax
3. Structure of a bond's cash flows
   - Principal repayment structures
   - Coupon payment structures
4. Bonds with contingency provisions
   - Callable bonds
   - Putable bonds
   - Convertible bonds

Basic Features of a Bond

- **Issuer/borrower**
  - **Supranational organizations**
    - ✓ Such as the World Bank or the European Investment Bank;
  - **Sovereign (national) governments**
    - ✓ Such as the United States or Japan
  - **Non-sovereign (local) governments**
    - ✓ Such as the state of Minnesota in the United States, the region of Catalonia in Spain, or the city of Edmonton in Canada
  - **Quasi-government entities**
    - ✓ i.e., agencies that are owned or sponsored by governments), such as postal services in many countries—for example, Correios in Brazil, La Poste in France, or Pos in Indonesia)
  - **Companies (i.e., corporate issuers)**
    - ✓ Distinction is often made between financial issuers (e.g„ banks and insurance companies) and non-financial issuers
  - **SPE/SPV**
    - ✓ Structured finance sector

Basic Features of a Bond

- **Bondholder: Suppliers of capital**
- **Maturity date:** the date when the issuer is obligated to redeem the bond by paying the outstanding principal amount.
- **Term to maturity(tenor):** the time remaining until the bond's maturity date.
  - **Money market securities**: fixed-income securities with maturities at issuance (original maturity) of one year or less;
  - **Capital market securities**: fixed-income securities with original maturities that are longer than one year;
  - **Perpetual bonds**: the consols issued by the sovereign government in the United Kingdom, which have no stated maturity date.

Basic Features of a Bond

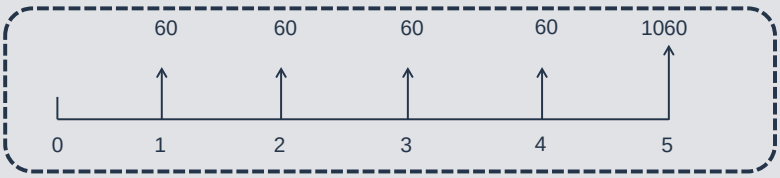
- Bondholders are exposed to **credit risk:**
  - Issuer failing to make full and timely payments of interest and/or repayments of principal.
    - ✓ From the issuer's perspective, an investment-grade credit rating generally allows easier access to bond markets, especially in conditions of limited credit, and at lower interest rates than does a non-investment-grade credit rating.

Basic Features of a Bond

- **Par value/face value/ maturity value/principal/redemption value:** Mostly are 1000.
- **Coupon rate**
  - **Plain vanilla bond/conventional bond**: pays a fixed rate of interest;
  - **Zero-coupon bond/pure discount bond**: a bond do not pay interest, they are issued at a discount to par value and redeemed at par.
- **Payments currency**
  - **Dual-currency bond**: make coupon payments in one currency and pay the par value at maturity in another currency;
  - **Currency option bond**: a combination of a single-currency bond plus a foreign currency option.

Basic Features of a Bond

- **Example：**
  6% coupon rate, 5 years matures from today, 1000 face value, **annual** payments **(how about semi-annual payments?)**



Example

- A 10-year bond was issued four years ago. The bond is denominated in U.S. dollars, offers a coupon rate of 10% with interest paid semi-annually, and is currently priced at 102% of par. The bond's:
  A. Tenor is six years.
  B. Nominal rate is 5%.
  C. Redemption value is 102% of the par value
- **Correct Answer: A**

- A bond has a par value of $100 and a coupon rate of 5%. Coupon payments are made semi-annually. The periodic interest payment is:
  A. $2.50, paid twice a year.
  B. $5.00, paid once a year.
  C. $5.00, paid twice a year.
- **Correct Answer: A**

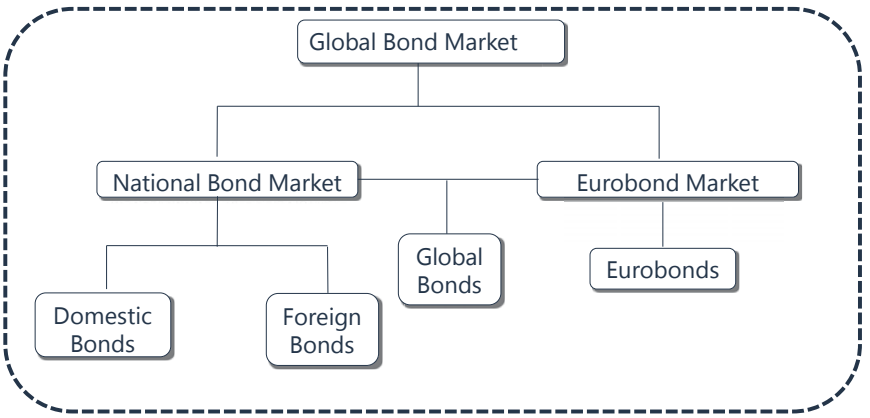
Example

- The type of bond that allows bondholders to choose the currency in which they receive each interest payment and principal repayment is a:
  A. Pure discount bond.
  B. Dual-currency bond.
  C. Currency option bond.
- **Correct Answer: C**

- A sovereign bond has a maturity of 15 years. The bond is best described as a:
  A. Perpetual bond.
  B. Pure discount bond.
  C. Capital market security.
- **Correct Answer: C**

Bond Market

- **Sectors of the bond market**



Bond Market

- **Domestic bonds:** Bonds issued by entities that are incorporated in that country.
- **Foreign bonds:** Bonds sold in a country and denominated in that country's currency by an entity from another country (foreign country) are referred to as foreign bonds.
- **Eurobonds:** Type of bond issued internationally, outside the jurisdiction of the country in whose currency the bond is denominated. Bonds issued and traded on the Eurobond market.
  - **Registered bonds**: the ownership is recorded by either name or serial number;
  - **Bearer bonds** (majority of form of Eurobonds): trustee does not keep records of the ownership of the bonds so that the ownership is evidenced by possessing the bonds.
    ✓ More attractive to those seeking to avoid taxes.
- **Global bonds:** issued simultaneously in the Eurobond market and in at least one domestic bond market.

Basic Features of a Bond

- **Trust deed:** legal contract that describes the form of the bond, the obligations of the issuer, and the rights of the bondholders.
  - Market participants frequently call this legal contract the **bond indenture**, particularly in the United States and Canada.
  - The indenture is written in the name of the issuer and references the features of the bond issue, such as
    - ✓ The principal value for each bond;
    - ✓ The interest rate or coupon rate to be paid;
    - ✓ The dates when the interest payments will be made;
    - ✓ The maturity date when the bonds will be repaid;
    - ✓ Whether the bond issue comes with any contingency provisions.

Legal and Regulatory Issues in a Trust Deed

- **Other legal and regulatory issue addressed in a trust deed include:**
  - **Legal information** regarding the funding sources for the interest payments and principal repayments;
  - **Collaterals** are assets or financial guarantees underlying the debt obligation above and beyond the issuer's promise to pay;
  - **Credit enhancements** are provisions that may be used to reduce the credit risk of the bond issue.
  - **Covenants**
  - **Tax**

Legal and Regulatory Issues in a Trust Deed

- **Legal information about issuing entities**
  - **Sovereign bonds:** are backed by the "full faith and credit" of the national government;
  - **Corporate bonds:** the issuer is usually the corporate legal entity;

Legal and Regulatory Issues in a Trust Deed

- **Securitized bonds:** is legally independent and is considered bankruptcy remote from the seller of the loans which is called **special purpose entities(SPEs)** in U.S, and **special purpose vehicles(SPVs)** in Europe.
  - ✓ SPVs is **bankruptcy remote** because the assets can provide cash flows to support the payment of the bond even if the company defaults;
  - ✓ The transfer of assets by the sponsor is considered a legal sale; once the assets have been securitized, the sponsor no longer has ownership rights;
  - ✓ Any party making claims following the bankruptcy of the sponsor would be unable to recover the assets or their proceeds.
  - ✓ Benefit of securitization:
    - ◆Lowers or removes the wall between ultimate investors and originating borrowers.
    - ◆Securitization reduces liquidity risk in the financial system
    - ◆Securitization enables innovations in investment products

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Legal and Regulatory Issues in a Trust Deed

➢ **Source of repayment proceeds:**

Types of bond	Source of repayment
Supranational organizations	• Repayment of previous loans • Paid-in capital from its members
Sovereign bonds	• Tax revenues • Print money
Non-sovereign debt	• General taxing authority of issuer • Cash flows of the financed project (revenues) • Special taxes or fees
Corporate bonds	• Cash flows from operations
Securitizations	• Cash flows generated by one or more underlying financial assets.

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Legal and Regulatory Issues in a Trust Deed

➢ **Asset or collateral backing:** a way **to reduce credit risk**.
- **Unsecured bonds**: have no collateral; bondholders have only a general claim on the issuer's assets and cash flows;
- **Secured bonds**:
  - ✓ Are backed by assets or financial guarantees pledged to ensure debt repayment in the case of default.
- Unsecured bonds are paid after secured bonds in the event of default;
- In many jurisdictions, **debentures** are unsecured bonds, with no collateral backing assigned to the bondholders.

➢ **Types of collateral backing:**

Types of bond	Collateral backing
Collateral trust bonds	• Financial assets
Equipment trust certificates	• Specific types of equipment or physical assets (e.g. railroad cards, oil drilling)
Mortgage-backed securities (MBS)	• Mortgage loans
Covered bond (Euro)	• A segregated pool of assets called a "covered pool"

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Legal and Regulatory Issues in a Trust Deed

- **Credit enhancement:** a variety of provisions used to reduce the credit risk of a bond issue.
  - **Internal credit enhancement:**
    - ✓ **Overcollateralization:** the process of posting more collateral than is needed to obtain or secure financing;
    - ✓ **Excess spread**: involves the allocation into an account of any amounts left over after paying out the interest to bondholders;
    - ✓ **Waterfall structure:** Creating more than one bond class or tranche and ordering the claim priorities for ownership or interest in an asset between the tranches. In the event of default, the proceeds from liquidating assets will first be used to repay the most senior creditors.

Legal and Regulatory Issues in a Trust Deed

- **External credit enhancement:**
  - ✓ **Surety bond & Bank guarantee**: reimburse bondholders for any losses incurred if the issuer defaults.
    - ◆**Surety bond**: issued by a rated and regulated insurance company;
    - ◆**Bank guarantee**: issued by a bank.
  - ✓ **Letter of credit**: The financial institution provides the issuer with a credit line to reimburse any cash flow shortfalls from the assets backing the issue.

Legal and Regulatory Issues in a Trust Deed

- **Limitation of External credit enhancement:**
  - ✓ The deterioration of credit quality of the guarantor will also reduce the credit quality of the covered bond.
  - ✓ Bank guarantees, surety bonds, and letters of credit expose the investor to **third- party (or counterparty) risk** — that is, the possibility that a guarantor cannot meet its obligations.
- A **cash collateral account** mitigates this concern because the issuer immediately borrows the credit-enhancement amount and then invests that amount, usually in highly rated short-term commercial paper. Because this is an actual deposit of cash rather than a pledge of cash, a downgrade of the cash collateral account provider will not necessarily result in a downgrade of the bond issue backed by that provider.

Legal and Regulatory Issues in a Trust Deed

- **Affirmative VS. negative covenants**
  - **Affirmative covenants**: are **typically administrative** in nature.
    - ✓ Frequently used affirmative covenants include what the issuer will do with the proceeds from the bond issue and **the promise of making the contractual payments.**
    - ✓ The issuer may also promise to
      - ◆Comply with all laws and regulations
      - ◆Maintain its current lines of business
      - ◆Insure and maintain its assets, and pay taxes as they come due
      - ◆These types of covenants typically do not impose additional costs to the issuer and do not materially constrain the issuer's discretion regarding how to operate its business.

Legal and Regulatory Issues in a Trust Deed

- **Negative covenants:** frequently costly and do materially constrain the issuer's potential business decisions.
  - The purpose of negative covenants is to protect bondholders from such problems as the dilution of their claims, asset withdrawals or substitutions, and suboptimal investments by the issuer. Examples of negative covenants include the following:
    - ✓ Restrictions on debt regulate the issue of additional debt.
    - ✓ **Negative pledges** prevent the issuance of debt that would be senior to or rank in priority ahead of the existing bondholders' debt.
    - ✓ **Restrictions on prior claims** protect unsecured bondholders by preventing the issuer from using assets that are **not collateralized** (called unencumbered assets) to become collateralized.
    - ✓ **Restrictions on distributions to shareholders** restrict dividends and other payments to shareholders such as share buy-backs (repurchases).
    - ✓ **Restrictions on asset disposals** set a limit on the amount of assets that can be disposed by the issuer during the bond's life.
    - ✓ **Restrictions on investments** constrain risky investments by blocking speculative investments.
    - ✓ **Restrictions on mergers and acquisitions** prevent these actions unless the company is the surviving company or unless the acquirer delivers a supplemental indenture to the trustee expressly assuming the old bonds and terms of the old indenture.

Taxation of Bond Income

- **Tax consideration:**
  - Generally speaking, the income portion of a bond investment is taxed at the **ordinary income tax rate**, which is typically the same tax rate that an individual would pay on wage or salary income.
    - ✓ **Municipal debts** is most often exempt from federal income tax and from the income tax of the state;
    - ✓ The tax status of bond income may also depend on where the bond is issued and traded.
  - **Capital gain or loss:** due to sell a coupon bond prior to maturity
    - ✓ A capital gain or loss is usually treated differently from taxable income. Very often, the tax rate for long-term capital gains is lower than the tax rate for short-term capital gains, and the tax rate for short-term capital gains is equal to the ordinary income tax rate;
    - ✓ Long-term CG: capital gains that are recognized more than 12 months after the original purchase date.

Taxation of Bond Income

- **Tax consideration:**
  - **Original issue discount (OID) bonds**: a prorated portion of the discount must be included in interest income every tax year;
    - ✓ This allows investors to increase their cost basis in the bonds so that at maturity, they face no capital gain or loss;
    - ✓ Pure-discount bonds: a portion of the discount from par at issuance is treated as **taxable interest income**.
  - Premium bonds: allow investors to deduct a prorated portion of the amount paid in excess of the bond's par value from their taxable income every tax year until maturity.

Example

- The major advantage of issuing bonds through a special purpose vehicle is:
  - A. Bankruptcy remoteness.
  - B. Beneficial tax treatments.
  - C. Greater liquidity and lower issuing costs.
- **Correct Answer: A**

- A bond issued by Sony in Japan, denominated in U.S. dollars but registered with the SEC, and sold to an institutional investor in the Middle East, is most likely an example of:
  - A. Eurobond
  - B. Global bond
  - C. Foreign bond
- **Correct Answer: A**

Example

- An investor in a country with an original issue discount tax provision purchases a 20-year zero-coupon bond at a deep discount to par value. The investor plans to hold the bond until the maturity date. The investor will most likely report:
  - A. A capital gain at maturity.
  - B. A tax deduction in the year the bond is purchased.
  - C. Taxable income from the bond every year until maturity.

- **Correct Answer: C**

Cash Flow Structure

- **Principal repayment structures**
  - **Plain vanilla bond/bullet bonds**: periodic interest payments and principal is paid at maturity.
    - ✓ Balloon payment: it is required at maturity to retire the bond's outstanding principal amount.

- Example: principal=$1,000, maturity=5 years, coupon rate=6%, discount rate=6%, annual payment.

Bullet Bond

Year	Investor Cash Flows	Interest Payment	Principal Repayment	Outstanding Principal at the End of the Year
0	–$1,000.00			$1,000.00
1	60.00	$60.00	$0.00	1,000.00
2	60.00	60.00	0.00	1,000.00
3	60.00	60.00	0.00	1,000.00
4	60.00	60.00	0.00	1,000.00
5	1,060.00	60.00	1,000.00	0.00

Cash Flow Structure

- **Amortizing loan:** means the gradual reduction of the amount borrowed over time.
  - ✓ **Fully amortizing:** the sum of all the scheduled principal repayments during the mortgage's life is such that when the last mortgage payment is made, the loan is fully repaid.
  - ✓ **Partially amortizing:** the sum of all the scheduled principal repayments is less than the amount borrowed.

Fully Amortized Bond

Year	Investor Cash Flows	Interest Payment	Principal Repayment	Outstanding Principal at the End of the Year
0	–$1,000.00			
1	237.40	$60.00	$177.40	$822.60
2	237.40	49.36	188.04	634.56
3	237.40	38.07	199.32	435.24
4	237.40	26.11	211.28	223.96
5	237.40	13.44	223.96	0.00

Partially Amortized Bond

Year	Investor Cash Flows	Interest Payment	Principal Repayment	Outstanding Principal at the End of the Year
0	–$1,000.00			
1	201.92	$60.00	$141.92	$858.08
2	201.92	51.48	150.43	707.65
3	201.92	42.46	159.46	548.19
4	201.92	32.89	169.03	379.17
5	401.92	22.75	379.17	0.00

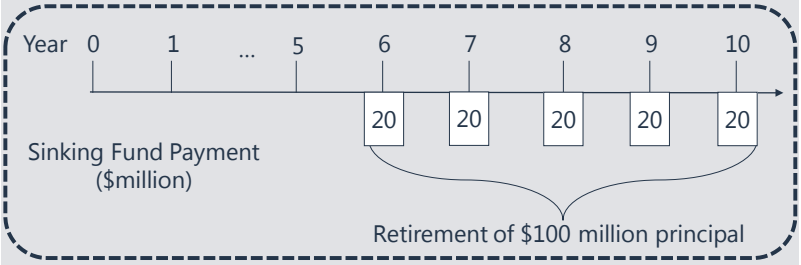
Cash Flow Structure

- The sinking fund provision is used to reduce the **credit risk** of the bondholder.
- **Sinking fund provision:** requires the issuer to retire a portion of a bond issue at specific times during the bonds' life.
  - **Doubling option / accelerated sinking fund:** Some indentures, however, allow issuers to use a doubling option to repurchase double the required number of bonds.

Cash Flow Structure

➢ **Example:**

ABC Inc. issue a 10-year bond with a par value of $100 million. The bond has a sinking fund provision, which requires that ABC Inc. retire $20 million of the principal every year beginning in the sixth year.



Cash Flow Structure

➢ **Sinking fund arrangement:**

- Originally, a sinking fund was a specified cash reserve that was segregated from the rest of the issuer's business for the purpose of repaying the principal.
- More generally today, a sinking fund arrangement specifies the portion of the bond's principal outstanding, perhaps 5%, that must be repaid each year throughout the bond's life or after a specified date.
  - ✓ Typically, the issuer will forward repayment proceeds to the bond's trustee. The trustee will then either redeem bonds to this value or **select by lottery the serial numbers** of bonds to be paid off.
  - ✓ Another type of sinking fund arrangement operates by **redeeming a steadily increasing amount** of the bond's notional principal (total amount) each year.

Cash Flow Structure

➢ **Sinking fund arrangement:**

- ✓ Another common variation is for the bond issue to include a call provision. The issuer can usually **repurchase the bonds at the market price, at par, or at a specified sinking fund price**, whichever is the lowest.
  - ◆ The bonds to be retired are selected at **random based on serial number** to allocate the burden of the call provision fairly among bondholders.
    - ☐ The issuer can repurchase only a small portion of the bond issue.
    - ☐ Some indentures, however, **allow issuers to use a doubling option to repurchase double the required number of bonds**.

Cash Flow Structure

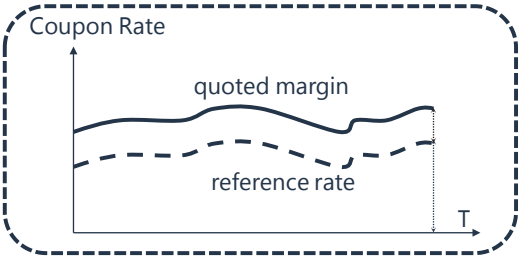
- **Advantages and disadvantages of sinking fund provision**
  - **Advantages**: less credit risk due to the periodic redemptions of the principal
  - **Disadvantages**: more reinvestment risk. when interest rate decreases, the market price is greater than the redemption price
    - ✓ First, investors face **reinvestment risk**, the risk associated with having to reinvest cash flows at an interest rate that may be lower than the current yield to maturity.
      - ◆ If the serial number of an investor's bonds is selected, the bonds will be repaid and the investor will have to reinvest the proceeds. If market interest rates have fallen since the investor purchased the bonds, he or she probably will not be able to purchase a bond offering the same return.
    - ✓ Another potential disadvantage for investors occurs if the issuer has the option to **repurchase** bonds **at below market prices**.
      - ◆For example, an issuer could exercise a call option to buy back bonds at par on bonds priced above par. In this case, investors would suffer a loss.

Cash Flow Structure

- **Coupon payment structures**
  - Floating-rate notes
  - Deferred coupon bonds
  - Step-up coupon bonds
  - Credit-linked coupon bonds
  - Payment-in-kind coupon bonds
  - Index-linked bonds

Cash Flow Structure

- **Floating-Rate Notes (FRN)**



Coupon rate = reference rate ± quoted margin

- Such as:
  - LIBOR;
  - U.S. Treasury yield

- It is a constant value.
- It is often quoted in basis point.
- Occasionally, the spread is not fixe, called **variable-rate note.**

Cash Flow Structure

- The most widely used reference rate for floating-rate bonds is the London Interbank Offer Rate (LIBOR).
  - LIBOR are published daily for several currencies and for maturities of one day (overnight rates) to one year.
  - There is no single "LIBOR rate" but rather a set of rates, such as "30-day U.S. dollar LIBOR" or "90-day Swiss franc LIBOR".
  - The interbank offered rates are also used as reference rates for other debt instruments including mortgages, derivatives such as interest rate and currency swaps, and many other financial contracts and products.

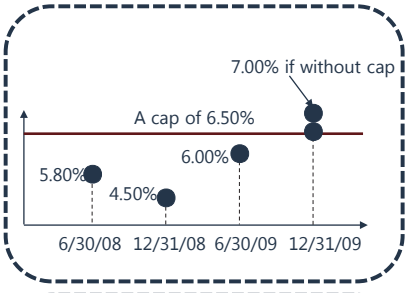
Cash Flow Structure

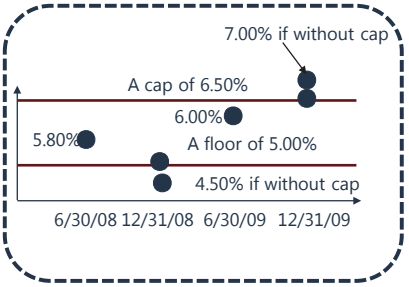
- The coupon rate determined at the ***coupon reset date*** is the rate that the issuer promises to pay at the next coupon date.
  - The new 1-year rate at that time will determine the rate of interest paid at the end of the next year. Most floater pay quarterly and are based on a quarterly (90-day) reference rate.
  - The reference rate must match the frequency with which the coupon rate on the bond is reset.

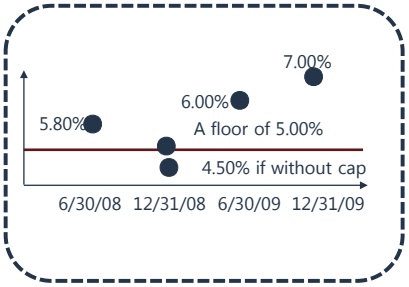
- **Example:** Assume that the coupon rate of a FRN that makes semi-annual interest payments in June and December is expressed as the six-month Libor + 150 bps. Suppose that in December 20X0, the six-month Libor is 3.25%.
  - The interest rate that will apply to the payment due in June 20X1 will be 4.75% (=3.25% + 1.50%).

Cash Flow Structure

- The upper limit is called the cap.
- The lower limit is called the floor.
- When a floating-rate security has both a upper limit and a lower limit, the feature is called a collar.







Cash Flow Structure

- **Variable-rate note:** Similar to a floating-rate note, except that the spread is variable rather than constant.
- **Inverse floaters (**also called ***reverse floaters*****)** have coupon rates that move in the opposite direction from the change in the reference rate.
- When the reference rate increases, the coupon rate decreases and vice versa.

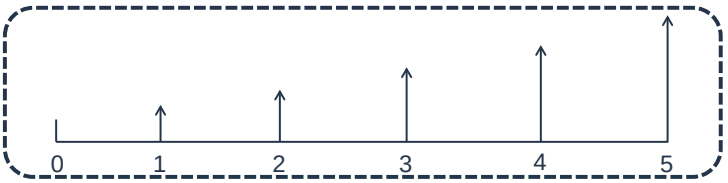
- Example: An inverse floater's coupon rate = 15% -2 × (3-month LIBOR). Suppose the 3-month LIBOR is 3%, then the coupon rate for the next interest.

  Payment period is: Coupon rate = 15% - 2 ×3%=9%

- Inverse floaters with a coupon leverage greater than zero but lower than one are called ***deleveraged inverse floaters*** (0-1). Inverse floaters with a coupon leverage greater than one are called ***leveraged inverse floaters*** (>1)**.**

Cash Flow Structure

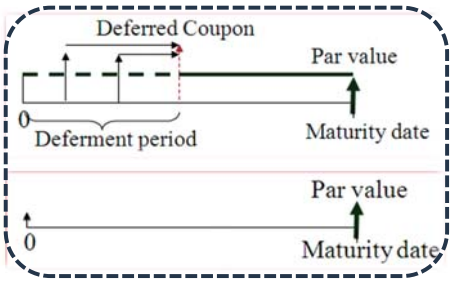
- **Step-up coupon bonds:** may be fixed or floating, increases by specified margins at specified dates.



- The step-up coupon allows bondholders to receive a higher coupon, in line with the higher market interest rates. When interest rates decrease or remain stable, the step-up feature acts as an incentive for the issuer to call the bond before the spread increases and the interest expense rises.
- New higher coupon rate > market yield of the call price → call the bonds
- An increase in bond coupon rates can be viewed as a *protection against the increase in market interest rates* which is due to the decrease in issuer's credit rating.

Cash Flow Structure

- **Deferred coupon bonds/split coupon bond:** interest payments are deferred for a specified number of years.
  - Also common in project financing when the assets being developed do not generate any income during the development phase;
  - Have tax advantages in some jurisdictions.
- **Zero-coupon bonds:** no periodic coupon payments; always be traded at a discount—— one type of deferred coupon bond.



Cash Flow Structure

- **Credit-linked coupon bond:** has a coupon that changes when the bond's credit rating changes.
- **Pay-in-kind (PIK) bond:** allows the issuer to pay interest in the form of additional amounts of the bond issue rather than as a cash payment.
- **Equity-linked notes (ELN):** no periodic interest payments, and the payment at maturity is based on an equity index.
- **Index-linked bond:** has its coupon payments and/or principal repayment linked to a specified index.)
  - Inflation linked bonds/ linkers: are an example of index-linked bonds.
  - If it will pay equal to or more than its original face value at maturity, even when the index has decreases, which is called **principal protected bonds**

Cash Flow Structure

- **Different structure of inflation-index bonds:**
  - **Index-annuity bonds**: are fully amortized bonds, in contrast to interest-indexed and capital-indexed bonds that are non-amortizing coupon bonds;
  - **Indexed zero-coupon bonds**: The principal amount to be repaid at maturity increases in line with increases in the price index during the bond's life;
  - **Interest-indexed bonds**: pay a fixed nominal principal amount at maturity, and the inflation adjustment applies to the interest payments only;
  - **Capital-indexed bonds**: pay a fixed coupon rate but it is applied to a principal amount that increases in line with increases in the index during the bond's life.

Cash Flow Structure

- TIPS: pay semiannual coupons, at maturity
  - If adjusted par value (per bond) is greater than $1,000 at maturity, the holder receives the adjusted par value as the maturity payment.
  - If the adjusted par value is less than $1,000 (due to deflation), holders receive $1,000 at maturity as this is the minimum repayment amount.

$$TIPS\ coupon\ payment = \inf lation\text{-}adjusted\ par\ value \times \frac{stated\ coupon\ rate}{2}$$

Example

- Consider a $1,000 par value TIPS with a 10% coupon rate. The CPI for the first half year is 3%, and the CPI for the second half year is 4% (both 3% and 4% are annual rates).

$$Coupon_1 = \$1000 \times (1+1.5\%) \times 10\% \div 2 = \$50.75$$
$$Coupon_2 = \$1000 \times (1+1.5\%) \times (1+2\%) \times 10\% \div 2 = \$51.77$$

Example

- A company has issued a floating-rate note with a coupon rate equal to the three-month Libor + 65 basis points. Interest payments are made quarterly on 31 March, 30 June, 30 September, and 31 December. On 31 March and 30 June, the three-month Libor is 1.55% and 1.35%, respectively. The coupon rate for the interest payment made on 30 June is:
  A. 2.00%
  B. 2.10%
  C. 2.20%

- **Correct Answer：C**

Example

- Assume a hypothetical country, Lemuria, where the national government has issued 20-year capital-indexed bonds linked to the domestic Consumer Price Index (CPI). Lemuria's economy has been free of inflation until the most recent six months, when the CPI increased. Following the increase in inflation:
  A. the principal amount remains unchanged but the coupon rate increases.
  B. the coupon rate remains unchanged but the principal amount increases.
  C. the coupon payment remains unchanged but the principal amount increases.

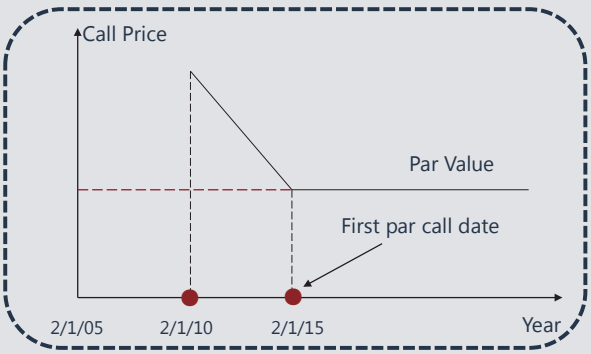
- **Correct Answer：B**

Bonds with Embedded Options

- **Call provisions are beneficial to the issuer.**
  - Callable bond offers a higher yield (lower price) than identical noncallable bond
    - ✓ **Value callable bond = value of identical noncallable bond - call option value**
  - **Deferred call**: call provisions have a deferment period; that is, the issuer may not call the bond for a number of years until a specified first call date is reached.
- **Call price:** the price at which the issuer may retire the bond.
- **Call premium:** the amount by which the call price is above par.
- **First par call date:** the date at which the issue is first callable at par value

Example

- A 20-year bond was issued on 2/1/2005.
- The first call date is 2/1/2010, and the call price is $105.
- Then, the call price declines by $1 a year till it reaches $100 on 2/1/2015 (the first par call date).



Bonds with Embedded Options

- **If interest rates fall**
  - Issuer can retire the bond paying high coupon rate, and replace it with lower coupon bonds.
  - When the bond is called, the proceeds can only be reinvested at a lower interest rate.
- **Three styles of exercise for callable bonds:**
  - **American style**: sometimes referred to as continuously callable, for which the issuer has the right to call a bond at any time starting on the first call date;
  - **European style**: the issuer has the right to call a bond only once on the call date;
  - **Bermuda style**: the issuer has the right to call bonds on specified dates following the call protection period.
- **The reinvestment risk of callable bond.**
- **The price appreciation of callable bond.**

Bonds with Embedded Options

- **Make-whole call provision**: requires the issuer to make a lump-sum payment to the bondholders based on the present value of the future coupon payments and principal repayment not paid because of the bond being redeemed early.
  - There are not an upper limit on the bond value for make-whole provision when interest rates fall.

Bonds with Embedded Options

- **Putable bonds are beneficial to the bondholders.**
  - Putable bonds have a lower yield and higher price than similar non-putable bonds.
    - ✓ **Value of putable bonds**
    - **= value of an identical nonputable bonds + put option value**
  - If interest rates rise
    - ✓ The bondholders can sell the bond back to the issuer and get cash.
    - ✓ When the bond is put, the proceeds can be reinvested at a higher interest rate.

Bonds with Embedded Options

- **Convertible bonds are beneficial to the bondholders.**
- **Key terms of conversion provision:**
  - Conversion price: share price when the convertible bond can be converted into shares.
  - Conversion ratio: the number of common shares each bond can be converted into.
    - ✓ Conversion ratio = par value / conversion price
  - Conversion value: value of conversion bond if converted right now.
    - ✓ Conversion value = market price of stock X conversion ratio
  - Conversion premium: difference between the convertible bond's price and conversion value
  - Conversion parity:
    - ✓ At parity: Conversion value = convertible bond's price
    - ✓ Above parity: conversion value > convertible bond's price
    - ✓ Below parity: conversion value < convertible bond's price

Example

- Assume that a convertible bond issued in the U.S. has a par value of $1,000,000 and is currently priced at $1,100,000. The underlying share price is $40,000 and the conversion ratio is 25:1. The conversion condition for this bond is:
  A. Parity
  B. Above parity
  C. Below parity

- **Correct Answer： C**
  - The conversion value of the bond is $40,000×25=$1,000,000. The price of the convertible bond is $1,100,000. Thus, the conversion value of the bond is less than the bond's price, and this condition is referred to as below parity.
    Below parity: conversion value < convertible bond's price

Bonds with Embedded Options

- Convertible bond is a hybrid security with both debt and equity features (referred to as hybrid security). It gives bondholders the right to exchange the bond for a specified number of common shares in the issuing company.
  - If share prices increase
    - ✓ Bondholders can exchange the bond for a specific number of shares of issue company.
  - If share prices decrease
    - ✓ Bondholders can still receive coupon and principal payment of the straight bond.
    - ✓ The value of straight bond is the lowest price of the convertible bond.
- Two main advantages of issuer:
  - Reduce interest expense
  - Reduce debt when conversion option is exercised

Bonds with Embedded Options

- Generally, early conversion would eliminate the yield advantage of continuing to hold the convertible bond; investors would typically receive in dividends less than they would receive in coupon payments. For this reason, it is common to find convertible bonds that are also callable by the issuer on a set of specified dates.
  - If the convertible bond includes a *call provision* and the conversion value is above the convertible bond price, the issuer may force the bondholders to convert their bonds into common shares before maturity.
  - For this reason, callable convertible bonds have to offer a higher yield and sell at a lower price than otherwise similar non-callable convertible bonds.

Bonds with Embedded Options

- **Warrants are beneficial to the bondholders**
  - Warrants is actually not an embedded option but rather an "attached" option.
  - Entitles the bondholder to buy the underlying stock of the issuing company at a fixed exercise price until the expiration date.
  - If Common share value of issuing company is *greater than* the fixed exercise price, the bondholder can buy the share *at the fixed exercise price* and still hold the bond.
  - The bond with warrants can be more attractive.

Bonds with Embedded Options

- **Contingent convertible bonds ("CoCos")**
  - Conversion is automatic if a specified event occurs;
  - Several European banks have been issuing a type of convertible bond called contingent convertible bonds.
  - **Example:**
    - ✓ When the bank's core Tier 1 capital ratio (a measure of the bank's proportion of core equity capital available to absorb losses) falls below the minimum requirement, the CoCos immediately convert into equity, automatically recapitalizing the bank, lightening the debt burden, and reducing the risk of default.

Bonds with Embedded Options

Embedded options favor the **issuers:**
- The right to call the issue.
- The prepayment option.
- Accelerated sinking fund provision.
- The cap on a floater.

Embedded options favor the **bondholders:**
- Conversion provisions.
- The put option.
- The floor on a floater.

Example

➢ Do embedded options designed to **benefit bond issuers** (borrowers) include the:

	Accelerated sinking fund provision?	Floor on a floater?
A.	No	No
B.	No	Yes
C.	Yes	No

➢ **Correct answer: C**

Reading 52

Fixed-Income Markets: Issuance, Trading, and Funding

Framework

1. Classification of fixed-income markets
2. Issuing & Trading
3. Funding

Classification of Global Fixed-Income Markets

- **By type of issuer:**
  - Government and government-related sector
    - ✓ Supranational (international) organizations
    - ✓ Sovereign (national) governments
    - ✓ Non-sovereign (local) governments
    - ✓ Quasi-government entities
  - Corporate sector
    - ✓ Financial company
    - ✓ Non-financial company
  - Securitized sector
    - ✓ securitization

Classification of Global Fixed-Income Markets

- **Classification of fixed-income markets by type of issuer**

Exhibit 1 Global Debt and Equity Outstanding by Sector at the End of December 2010

Sector	Amount (US$ trillions)	Weight	Compound Annual Growth Rate 1990–2009	Annual Growth Rate 2009–2010
Stock markets	$54	26%	7.2%	5.6%
Bonds issued by governments	41	19	7.8	11.9
Bonds issued by financial companies	42	20	9.5	–3.3
Bonds issued by nonfinancial companies	10	5	6.7	9.7
Securitized debt instruments	15	7	12.7	–5.6
Bank loans	49	23	4.1	5.9

Classification of Global Fixed-Income Markets

- **By credit quality:**
  - Investment grade
    - ✓ Baa3 or above by Moody's Investors Service
    - ✓ BBB- or above by Standard & Poor's (S&P) and Fitch Ratings
  - Non-investment grade/high yield
    - ✓ Below investment grade
- **By original maturity:**
  - Money market securities
  - Capital market securities
- **By coupon structure:**
  - Floating-rate bonds
  - Fixed-rate bonds

Classification of Global Fixed-Income Markets

- **By currency**
  - Domestic bonds
  - Foreign bonds
  - Eurobonds
  - Global bonds
- **By geography**
  - Developed market
  - Emerging market
    - ✓ Emerging market bonds have higher yields than developed market
- **By other classification**
  - Indexing
  - Taxable statue

Classification of Global Fixed-Income Markets

- **Classification by currency denomination**

Exhibit 3 Amounts of International Bonds Outstanding by Currency Denomination at the End of December 2011

Currency	Amount (US$ billions)	Weight
Euro (EUR)	$9,665.9	46.0%
U.S. Dollar (USD)	6,900.8	32.9
British Pound Sterling (GBP)	2,052.3	9.8
Japanese Yen (JPY)	762.0	3.6
Swiss Franc (CHF)	393.4	1.9
Australian Dollar (AUD)	317.2	1.5
Canadian Dollar (CAD)	313.1	1.5
Swedish Krona (SEK)	103.0	0.5
Norwegian Krone (NOK)	86.4	0.4
Hong Kong Dollar (HKD)	63.5	0.3
Yuan Renminbi (CNY)	38.9	0.2
Other Currencies	305.0	1.5
Total	**21,001.5**	**100.0%**

Classification of Global Fixed-Income Markets

- **Classification by Geography**

Exhibit 4 Amount of Bonds Outstanding by Residence of Issuer and Type of Issuer at the End of December 2011 (US$ billions)

	All Issuers		Government		Financial		Non-Financial	
Country	Amount	Global Weight	Amount	Sector Weight	Amount	Sector Weight	Amount	Sector Weight
United States	$33,582	40%	$12,954	39%	$14,938	44%	$5,690	17%
Japan	15,700	19	11,552	74	3,111	20	1,038	7
United Kingdom	5,275	6	2,040	39	2,537	48	699	13
Germany	4,383	5	2,079	47	2,175	50	129	3
France	4,382	5	1,910	44	1,947	44	525	12
Italy	3,686	4	2,078	56	1,492	40	116	3
Spain	2,307	3	871	38	1,416	61	19	1
Netherlands	2,246	3	401	18	1,730	77	116	5
Canada	1,899	2	1,178	62	399	21	322	17
Australia	1,847	2	479	26	1,186	64	182	10
Rest of the world	8,748	10	3,184	36	4,830	55	734	8
Total	**$84,055**	**100%**	**$38,726**	**46%**	**$35,761**	**43%**	**$9,570**	**11%**

Fixed-Income Indices

- **Fixed-income indices:** a multi-purpose tool used by investors and managers to describe a given bond market or sector, as well as to evaluate the performance of investments and investment managers.
  - Index construction: security selection and index weighting
- Major types of fixed-income indices
  - **Barclays Capital Global Aggregate Bond Index**: represents a broad-based measure of the global investment-grade fixed-rate bond market.
  - **J.P Morgan Emerging Market Bond Index**: used to describe the emerging market
  - **FTSE Bond Index Series**: set up to provide coverage of different classes of securities related to the government and corporate bond markets.

Investors in fixed-income securities

- Major categories of bond investors include central banks, institutional investors, and retail investors.
- The first two typically invest directly in fixed-income securities. In contrast, retail investors often invest indirectly through fixed-income mutual funds or exchange traded funds (ETFs).
  - **Central banks** use open market operations to implement monetary policy. Open market operations refer to the purchase or sale of bonds, usually sovereign bonds issued by the national government.
  - **Institutional investors**, including pension funds, some hedge funds, charitable foundations and endowments, insurance companies, and banks, represent the largest groups of investors in fixed-income securities.
  - Another major group of investors is **sovereign wealth funds**, which are state-owned investment funds that tend to have very long investment horizons and aim to preserve or create wealth for future generations.
  - **Retail investors** often invest heavily in fixed-income securities because of the attractiveness of relatively stable prices and steady income production.

Primary Market

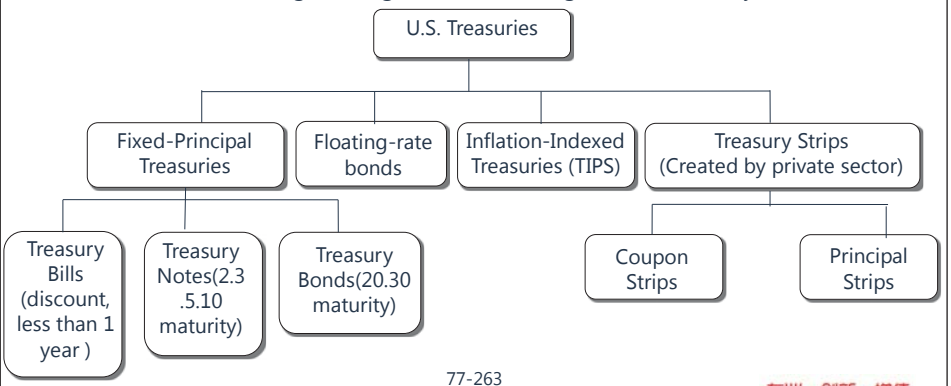
- **Primary market:** Primary bond markets are markets in which issuers initially sell bonds to investors to raise capital.
  - **Public offering**: Investment banks play a critical role in bond issuance by assisting the issuer in accessing the primary market and by providing an array of financial services;
    - ✓ **Underwritten offering**: with the investment bank or syndicate purchasing the entire issue and selling the bonds to dealers;
      - ◆**Grey market** ("when issued" market): is a forward market for bonds about to be issued.)
    - ✓ **Best efforts offering**: the investment bank only serves as a broker;
    - ✓ **Auction**: commonly used by issuing government debts;
    - ✓ **Shelf registration**: allows certain authorized issuers to offer additional bonds to the general public without having to prepare a new and separate offering circular for each bond issue.
  - **Private placement**: sale of an entire issue to a qualified investor or a group of investors, which are typically large institutions.

Secondary Markets

- **Secondary markets: trade of previously issued bonds.**
  - **Exchange market**: transaction must obey the rules imposed by the exchange.
  - **OTC Dealer Market** (largest): dealers post bid and ask price.
    - ✓ Spread between bid and ask prices are narrower (wider) for liquid (less liquid) issues
  - **Electronic Trading Network** (growth)
- **Trade settlement**:
  - Corporate bonds: third trading day after trade date (T+3).
  - Government bonds: the nest trading day after the trade date(T+1).
  - Money market securities: on the day of trade date.

Characteristics of Different Kinds of Bonds

- **Sovereign bonds:** issued by national governments and backed by their tax power.
  - High credit ratings and essentially *free of default risk*.
  - Denominated in the local currency or a foreign currency.
    - ✓ Credit ratings are higher for a sovereign's local currency bonds



Characteristics of Different Kinds of Bonds

- **Treasury Strips:** zero coupon securities of various maturities.
  - Coupon Strips (denoted as ci): created from coupon payments stripped from the original security.
  - Principal Strips: bond (maturities of 20-30years) and note (maturities of 2.3.5 and 10 years) principal payment with the coupons stripped off.

Example

- Which of the following statements regarding U.S. Treasury issues is FALSE?
  - A. Investment bankers strip the coupons from Treasury notes and bonds to create synthetic zero-coupon bonds.
  - B. A 5-year Treasury note could be stripped into 11 different zero coupon securities.
  - C. The U.S. Treasury issues **zero coupon notes**, but not bonds.

- **Correct Answer: C**
  - The Treasury does not issue zero-coupon notes or bonds. That is why STRIPS were created.

Characteristics of Different Kinds of Bonds

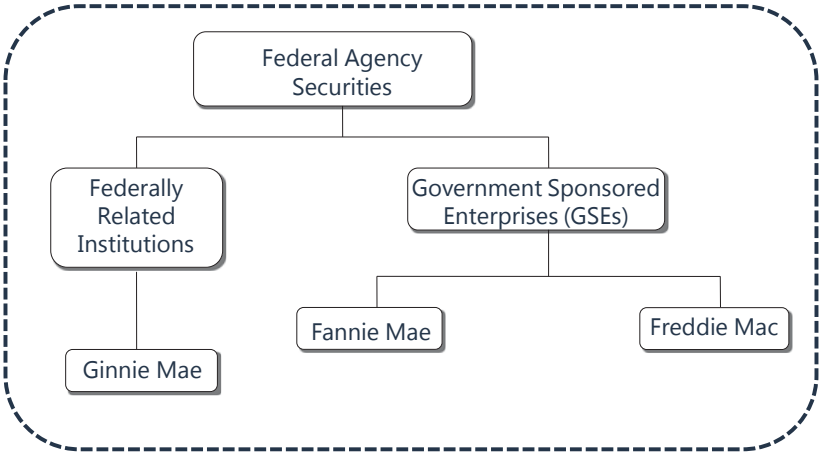
- **On-the-Run Issues**
  - Most Recently Auctioned
  - More Actively Traded
  - More Liquid
- **Off-the-Run Issues:** replaced by a more recently auctioned issue.
- Market prices of on-the-run issues provide better information about current market yields.

Characteristics of Different Kinds of Bonds

- **Nonsovereign government bonds:** issued by governments *below the national level*.
  - *High credit quality*, but lower than sovereign bonds
- **Municipal bond (in the U.S.)**
  - **GO (general obligation)/Tax-Backed Debt :** Support by taxing power of local government
    - ✓ Almost no credit risk
    - ✓ Require voter approval
  - **Revenue Bonds**
    - ✓ Supported only through revenues generated by projects.
    - ✓ Involve more risk, provide higher yield.

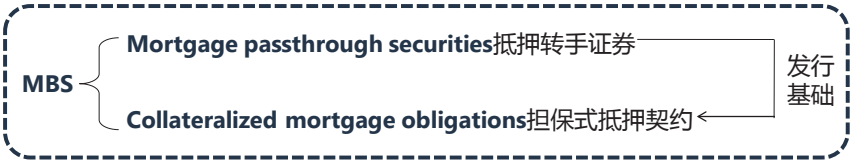
Characteristics of Different Kinds of Bonds

- **Agency/quasi-government bonds:** issued by *entities created by national government* and may be explicitly or implicitly backed by government.



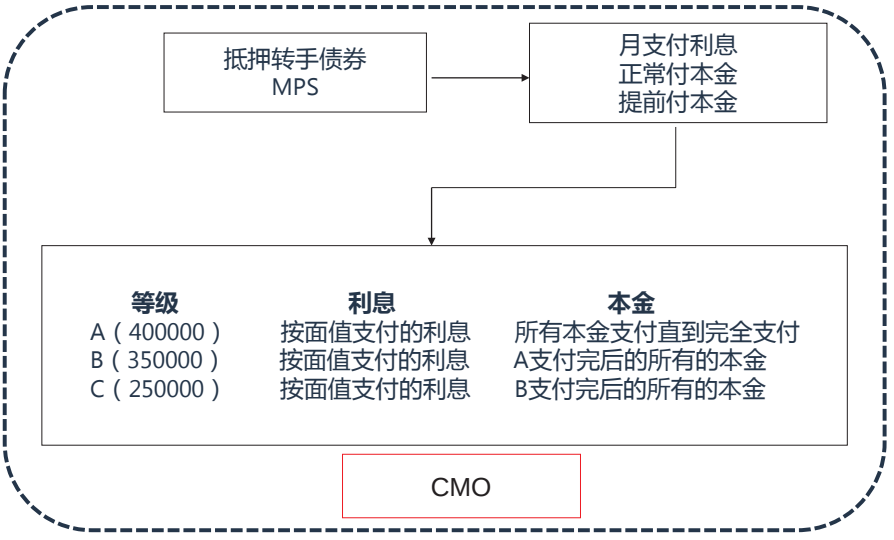
Characteristics of Different Kinds of Bonds

- **Mortgage-Backed Securities**



- **Mortgage passthrough securities:** created when one or more holders of mortgages form a collection of mortgages and sell shares or participation certificates in the pool.
- **Collateralized Mortgage Obligations:** created from mortgage passthrough certificates and referred as derivative mortgage-backed securities.

Characteristics of Different Kinds of Bonds



Characteristics of Different Kinds of Bonds

- **Supranational bonds:** issued by supranational agencies (multilateral agencies) that operate across national.
  - Highly rated supranational agencies, such as the World Bank, frequently issue large-size bond issues that are often used as benchmarks issues when there is no liquid sovereign bond available;
  - E.g. World bank, the IMF, the Asian Development Bank.

Types of Corporation Debts

- **Bank debt: bilateral loan & syndicated loan**
  - **Bilateral loan**: is a loan from a single lender to a single borrower.
  - **Syndicated loan**: is a loan from a group of lenders, called the "syndicate," to a single borrower.

Types of Corporation Debts

- **Commercial paper:** short term, unsecured, low rate (issued by corporations of high credit quality) debt.
  - Exempt from registration, directly placed (sold directly by issuer) or dealer placed (sold to investor through agents/brokers);
  - There is very little secondary trading of commercial paper;
  - *Reissued or rolled over* when it matures.
  - **Rollover risk**: a risk that the issuer will be unable to issue new paper at maturity;
  - **Backup lines of credit/ liquidity enhancement/backup liquidity lines**: a type of credit enhancement provided by a bank to a issuer of commercial paper to ensure that the issuer will have access to sufficient liquidity to repay maturing commercial paper if rolled over is not available.

Types of Corporation Debts

- **U.S commercial paper Vs. Eurocommercial paper**

Feature	U.S commercial paper	Eurocommercial paper
Currency	U.S dollar	Any currency
Maturity	Overnight to 270 days	Overnight to 364 days
Interest	Discount basis (pure discount security)	Interest-bearing basis (add-on yield)
Settlement	T+0	T+2
Negotiable	Can be sold to another	Can be sold to another

Types of Corporation Debts

- **Corporate bonds**
  - **Serial bond issue**: with several maturity dates (known at issuance) and can be redeemed periodically.
  - **Term maturity structure**: all the bonds maturing on the same date.
- **Medium-term notes (MTNs):**
  - Various maturities(9 months to 100 years);
  - Life insurance companies, pension funds, and banks are among the largest buyers of MTNs because they can customize the bond issue to their needs and stipulate the amount and characteristics of the securities they want to purchase.
    - ✓ E.g. structured security: combination of the derivative and notes

Short-Term Funding Alternatives

- **Customer deposits**
  - **Checking accounts**: have immediate access to the funds in their deposit accounts and use the funds as a form of payment for transactions;
  - **Saving accounts**: pay interest and allow depositors to accumulate wealth in a very liquid form;
  - **Money market mutual funds**: an intermediate between checking and saving accounts, pay interest.
- **Negotiable CDs**: CDs are available in domestic bond markets as well as in the Eurobond market. Most CDs have maturities shorter than one year and pay interest at maturity.
- **Central bank funds market**: banks may buy or sell excess reserves deposited at central bank funds rates with their central banks.
  - The interest rates at which central bank funds are bought (i.e., borrowed) and sold (i.e., lent) are short-term interest rates determined by the markets but influenced by the central bank's open market operations.
- **Interbank funds**: are unsecured loaned between banks for periods of one day to a year.

Repurchase Agreement

- **Repurchase (repo) Agreement:** is the sale of a security with a simultaneous agreement by the seller to buy the same security back from the purchaser at an agreed-on price and future date.
  - **Repurchase price**: the price at which the seller buys back from the buyer , usually higher than the original selling price due to the implicit interest paid to the buyer.
  - **Repo rate**: is the interest rate on a repurchase agreement. The repo rate is lower when:
    - ✓ Repo term is shorter;
    - ✓ Credit quality of the collateral security is higher;
    - ✓ Collateral security is delivered to the lender;
    - ✓ Interest rate for alternative sources of funds are lower.

Repurchase Agreement

- **Repo margin/haircut**: the difference between the market value of the security used as collateral and the value of the loan. The repo margin is lower when:
  - ✓ Repo term is shorter;
  - ✓ Credit quality of the collateral security is higher;
  - ✓ Credit quality of the borrower is higher;
  - ✓ Collateral security is in high demand or low supply.

Example

- A firm enters to a repo agreement that is selling a 5%, 10-year bond with a par value of $5 million. The market value of the bond is $4,800,000. It is sold at $4,600,000 and will be repurchased 90 days later for $4,680,000. Calculate the repo rate and repo margin.

- **Correct answer:**
  - Repo rate = (4,680,000 – 4,600,000) / 4,600,000 = 1.74%
  - Repo margin = (4,800,000 - 4,600,000) / 4,800,000 = 4.17%

Repurchase Agreement

- **Credit risk** is present even if the collateral is a highly rated sovereign bond.
  - **Lender**: When the price of the collateral has fallen
  - **Borrower**: When the price of the collateral has risen
- **Repurchase (repo) Agreement**
  - Repurchase agreements are not regulated by the Federal Reserve;
  - Collateral position of the lender in a repo is better in the event of bankruptcy of the dealer; (liquidity)
  - **Overnight repo**: the term of a repurchase agreement is one day;
  - **Term repo**: the agreement is for more than one day.
- **Reverse repo agreement:** a repurchase agreement is viewed through the lens of the cash lending counterparty.

Structured financial instruments

- **Structured financial instruments** represent a broad sector of financial instruments. This sector includes asset backed securities (ABS) , collateralized debt obligations (CDOs) and other structured financial instruments such as
  - Capital protected instruments;
  - Yield enhancement instruments;
  - Participation instruments;
  - Leveraged instruments.

Structured financial instruments

- **Capital Protected Instruments**
- The combination of the zero coupon bond and the call option can be prepackaged as a structured financial instrument called a **guarantee certificate.**
  - The zero-coupon bond provides the investor capital protection; at maturity, the investor will receive 100% of the capital invested even if the call option expires worthless. The call option provides upside potential if the price of the underlying asset rises and a limited downside if the price of the underlying asset falls.
- Capital protected instruments offer different levels of capital protection. A guarantee certificate offers full capital protection. Other structured financial instruments may offer only partial capital protection.

Structured financial instruments

- **Yield Enhancement Instruments**
  - Yield enhancement refers to increasing risk exposure in the hope of realizing a higher expected return. A **credit linked note (CLN)** is an example of a yield enhancement instrument;
  - Specifically, it is a type of bond that pays regular coupons but whose redemption value depends on the occurrence of a well-defined credit event, such as a rating downgrade or the default of an underlying asset;
  - A CLN allows the issuer to transfer the effect of a particular credit event to investors. Thus, the issuer is the protection buyer and the investor is the protection seller.

Structured financial instruments

- **Participation Instruments**
  - As the name suggests, a participation instrument is one that allows investors to participate in the return of an underlying asset. **Floating-rate bonds** can be viewed as a type of participation instrument.
- Most participation instruments are designed to give investors indirect exposure to a particular index or asset price.
- Many structured products sold to individuals are participation instruments linked to an equity index. In contrast to capital protected instruments that offer equity exposure, these participation instruments usually **do not offer capital protection**.

Structured financial instruments

- **Leveraged Instruments**
  - Leveraged instruments are structured financial instruments created to magnify returns and offer the possibility of high payoffs from small investments. An **inverse floater** is an example of a leveraged instrument
  - Inverse floater coupon rate = C – (L × R);
    - ✓ where C is the maximum coupon rate reached if the reference rate is equal to zero, L is the coupon leverage, and R is the reference rate on the reset date.
  - Inverse floaters with a coupon leverage greater than zero but lower than one are called deleveraged inverse floaters. Inverse floaters with a coupon leverage greater than one are called leveraged inverse floaters.

Reading 53

Introduction to Fixed-Income Valuation

Framework

1. Bond valuation
2. Yield-to-maturity
3. The value change attributable to the passage of time
4. Pricing bonds with spot rate
5. Full price, clean price, accrued interest
6. Matrix pricing
7. Yield measure
8. Yield curve
9. Yield spread

Bond Valuation Process

- The general procedure for valuing fixed-income securities is to take the present values of all the expected cash flows and add them up to get the value of the security.
  - Estimate the cash flows
  - Determinate the appropriate discount rate
  - Calculate the present value of the estimated cash flows

$$P=\sum_{t=1}^{n}\frac{C_t}{(1+r)^t}+\frac{B}{(1+r)^n}$$

Example

- An investor buys a 25-year, 10 percent annual pay bond for $900 planning to sell the bond **in 5 years** when he estimates **yields will be 9** percent. What is the estimate of the future price of this bond?
  A. $964.
  B. $1,091.
  C. $1,000.

- **Correct answer: B**
  - ✓ This is a Present Value problem 5 years in the future. Input into your calculator:
    N = 20, PMT = 100, FV = 1000, I/Y = 9
    CPT PV = 1,091.28
    The $900 purchase price is a distracter for this problem.

Bond Valuation Process

- **Value of a zero-coupon bond**

$$\text{bond value}=\frac{\text{maturity value}}{(1+\frac{i}{2})^{\text{number of years}\times 2}}$$

- **Example:** To find the value of **a 8-year**, **$1000** face value zero-coupon bond with a yield to maturity of **8 percent**.
- **Correct Answer:**

  N=8×2=16; FV=1000; I/Y=8/2=4; PMT=0; CPT→PV=533.9082

Yield to Maturity (YTM)

- Internal rate of return, implied market discount rate
- Critical **assumptions**:
  - hold the bond until maturity
  - full, timely coupon, principal payments (no default)
  - coupons are reinvested at original YTM
- Calculation: iteration, back out
  - **Annual -coupon bond**

$$bond\ \ price=\frac{CPN_1}{(1+YTM)}+\frac{CPN_2}{(1+YTM)^2}+\ldots+\frac{CPN_N+Par}{(1+YTM)^N}$$

  - **Semiannual-coupon bond:**

$$bond\ \ price=\frac{CPN_1}{(1+YTM/2)}+\frac{CPN_2}{(1+YTM/2)^2}+\ldots+\frac{CPN_{2N}+Par}{(1+YTM/2)^{2N}}$$

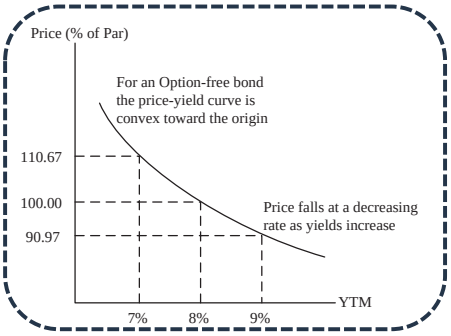
Example

- Assuming a bond sells for **$1,051.54**. This bond has **3 years** to maturity, pays a 10**% annual coupon**. What is the bond's yield to maturity (YTM)?
  - A. 8%.
  - B. 10%.
  - C. 12%.

- **Correct Answer: A**
  - N = 3, PMT = 100, PV = -1,051.54, FV = 1,000, CPT → I/Y=8%
  - YTM=8%

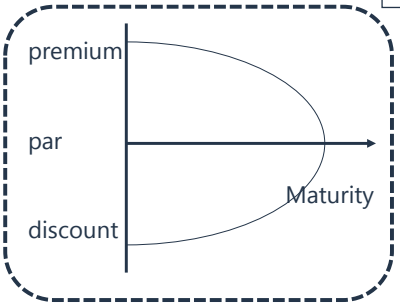
Relationships Between Price and Yield

- A bond's price and YTM are *inversely related*.
- A bond will be priced at a *discount (premium)* to par value if coupon rate is *less (more)* than its YTM.
- For a given change in yield, the percentage price increase is *greater* than the percentage price decrease.



Relationships Between Price and Time

Par value = $1000, Maturity = 3 years, coupon rate =4%, semi-annual payment.



Time of Maturity	YTM=2%	YTM=4%	YTM=6%
3.0 years	1057.95	$1,000.00	945.83
2.5	1048.53	1,000.00	954.20
2	1039.02	1,000.00	962.83
1.0	1019.70	1,000.00	980.87
0.5	1009.90	1,000.00	990.29
0	1,000.00	1,000.00	1,000.00

- Example: 3-year bond, coupon rate 10%, semi-annual, par 1000, buy at 8% today, after one-year, the rate change to 7%, the value change attributable to the passage of time?
- **Correct Answer:** $\Delta P_t = P_1(8\%) - P_0(8\%)$

Example

- An analyst gathered the following information about two option-free bonds that each have a par value of $1,000:

	Bond 1	Bond 2
Time to maturity	5 years	10 years
Annual coupon rate	5.0%	7.0%
Discount rate today	6,0%	6.5%

If the discount rate does not change for either bond, one year from today, which of the following most likely describes the change in price for each bond?

A. Both Bond 1 and Bond 2 will decrease.
B. Both Bond 1 and Bond 2 will increase.
C. Bond 1 will increase and Bond 2 will decrease.

- **Correct Answer: C**

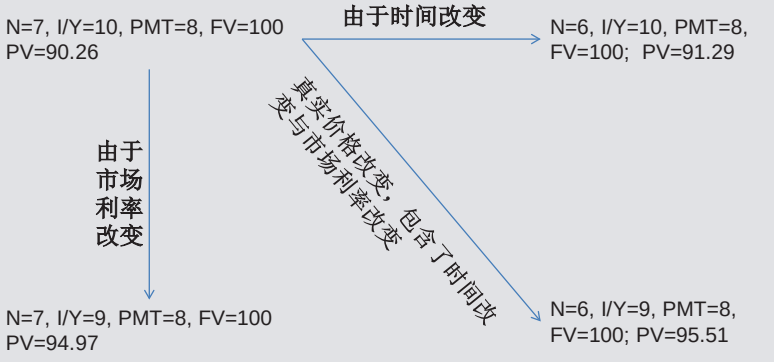
Example

- An 8% coupon bond with a par value of $100 matures in 6 years and is selling at $95.51 with a yield of 9%. Exactly one year ago this bond sold at a price of $90.26 with a yield of 10%. The bond pays annual interest. The change in price **attributable to the change in maturity** is closest to:

A. $0.54.
B. $1.03.
C. $4.22.

- **Correct Answer: B**
  - The change in price attributable to moving to maturity = $91.29 - $90.26 = $1.03

Example



Valuation with Spot Rates

- **Spot rates**: are market discount rates for single payments to be made in the future.
- **The no-arbitrage price** of a bond is calculated using spot rates:

$$\text{no-arbitrage price}=\frac{\text{CPN}_1}{(1+S_1)}+\frac{\text{CPN}_2}{(1+S_2)^2}+\cdots\cdots+\frac{\text{CPN}_N+\text{Par}}{(1+S_N)^N}$$

Example

- A 3-year bond offers a 10% coupon rate with interest paid annually. Assuming the following sequence of spot rates, the price of the bond is closest to:

Time-to-Maturity	Spot Rates
1 year	8.0%
2 years	9.0%
3 years	9.5%

A. 96.98

B. 101.46

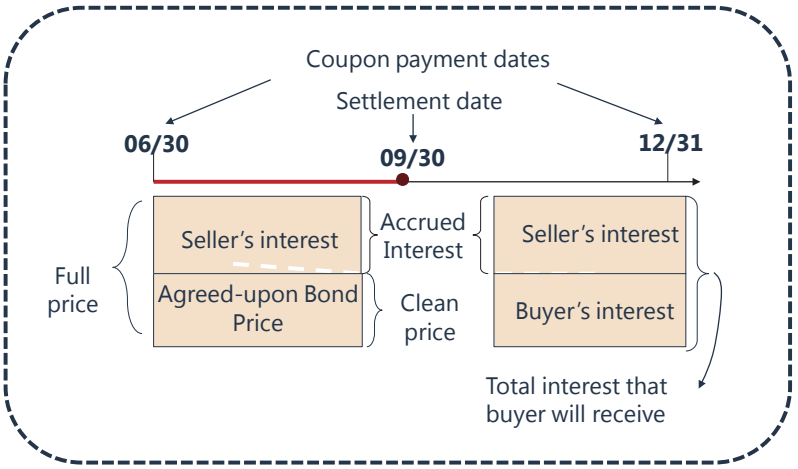
C. 102.95

- **Correct Answer: B**

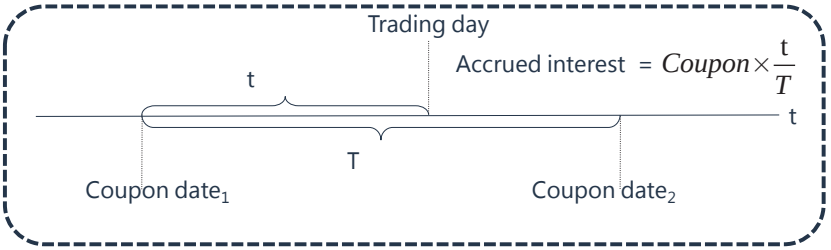
Full Price, Clean Price, Accrued Interest

- **Accrued Interest:** the interest received by the seller when a bond trades between coupon dates.
- **Clean(flat) Price:** the agreed upon price of the bond.
- **Full Price (or dirty price):** the amount that the buyer pays to the seller, which equals the clean price plus any accrued interest.
  - **Full Price = Clean Price +Accrued Interest**

Full Price, Clean Price, Accrued Interest



Accrued Interest



- **Example:**

  3-year bond, coupon rate 10%, par 1000,（semiannual）buy at 8%, the period between the settlement date and the next coupon period is **58 days**，there are **183 days** in the coupon period, what is accrued interest?

- **Correct Answer:**

  AI=（1000 X 0.1/2）X（1-58/183）=50 X（1-0.3169）=34.155

Full Price, Clean Price, Accrued Interest

$$PV^{Full} = \frac{PMT}{(1+r)^{1-t/T}} + \frac{PMT}{(1+r)^{2-t/T}} + \cdots + \frac{PMT+FV}{(1+r)^{N-t/T}}$$

$$PV^{Full} = [\frac{PMT}{(1+r)^{1}} + \frac{PMT}{(1+r)^{2}} + \cdots + \frac{PMT+FV}{(1+r)^{N}}] \times (1+r)^{t/T} = PV \times (1+r)^{t/T}$$

- **Example:**

  A 6% German corporate bond is priced for settlement on 18 June 2015. The bond makes semiannual coupon payments on 19 March and 19 September of each year and matures on 19 September 2026. The corporate bond uses the 30/360 day-count convention for accrued interest. Calculate the full price, the accrued interest, and the flat price per EUR100 of par value if the stated annual yields-to-maturity is 6.00%.

Full Price, Clean Price, Accrued Interest

- **Correct Answer:**
  - The price at the beginning of the period is par value, as expected, because the coupon rate and the market discount rate are equal.

$$PV = \frac{3}{(1.0300)^1} + \frac{3}{(1.0300)^2} + \ldots + \frac{3}{(1.0300)^{23}} = 100.000000$$

  - The full price on 18 June is EUR101.472251.

$$PV^{Full} = 100.000000 \times (1.0300)^{89/180} = 101.472251$$

  - The accrued interest is EUR1.483333, and the flat price is EUR99.988918.
    - ✓ AI =89/180*3=1.4833333
    - ✓ $PV^{flat} = 101.472251 - 1.483333 = 99.9889$

Matrix Pricing

- **Matrix pricing:** a method of estimating the required YTM of bonds that are *currently not traded or infrequently traded* bonds according to the yields of traded bonds with the same credit quality.
- **Linear interpolation** can be used when the maturities between the valued bond and the traded bond are different.

- **Example :** Estimate the YTM of a non-traded 5%, 4-year annual-pay bond
  - 3-year annual-pay, 4% coupon bond: YTM=3.68%
  - 6-year annual-pay, 5% coupon bond: YTM=5.17%
- **Correct Answer:**
  - Using linear interpolation:

    YTM of the non-traded bond=3.68+[(4-3)/(6-3) X (5.17-3.68)=4.18%

Yield Measures for Fixed-Rate Bonds

- Periodicity of the annual rate: an annualized and compounded yield on a fixed-rate bond depends on the assumed number of periods in the year.
  - Typically, the periodicity matches the frequency of coupon payments.
  - The periodicity of the annual market discount rate for a zero-coupon bond is arbitrary because there are no coupon payments.
- **Effective yield**: Depends on its periodicity, or annual frequency of coupon payments.

$$effective\ yield = (1 + \frac{YTM}{m})^m - 1$$

  - An effective annual rate has a periodicity of one because there is just one compounding period in the year.
    - ✓ For annual-pay bond: effective yield equal to YTM
  - Convert an **annual percentage rate** for m periods per year (APR_m), to an annual percentage rate for n per year (APR_n):

$$(1 + \frac{APR_m}{m})^m = (1 + \frac{APR_n}{n})^n$$

  - Semiannual bond basis yield(semiannual bond equivalent yield): an annual yield having a periodicity of two.
    - ✓ A semiannual bond basis yield is the yield per semiannual period times two

Yield Measures for Fixed-Rate Bonds

- Suppose a three-year, 5% semiannual coupon payment corporate bond priced at 104 per 100 of par value has a YTM of 3.582%. Convert 3.582% from a periodicity of 2 to a periodicity of 4 and 12, respectively.

- **Correct Answer:**
  - Convert 3.582% from a periodicity of 2 to a periodicity of 4:

$$(1+\frac{3.582\%}{2})^2=(1+\frac{APR_4}{4})^4, APR_4=3.566\%$$

  - Convert 3.582% from a periodicity of 2 to a periodicity of 12:

$$(1+\frac{3.582\%}{2})^2=(1+\frac{APR_{12}}{12})^{12}, APR_{12}=3.556\%$$

Yield Measures for Fixed-Rate Bonds

- **Street convention yield:** Yield measures that neglect weekends and holidays are quoted on what is called street convention.
  - The street convention yield-to-maturity is the internal rate of return on the cash flows assuming the payments are made on the scheduled dates.
- **True yield:** internal rate of return on the cash flows using the actual calendar of weekends and bank holidays.
  - The true yield is never higher than the street convention yield because weekends and holidays delay the time to payment.
  - The difference is typically small, no more than a basis point or two.

Yield Measures for Fixed-Rate Bonds

- **Current yield (income or interest yield):** not consider capital gains/loss or reinvestment income.

$$current\ yield = \frac{sum\ of\ coupon\ payment\ received\ over\ the\ year}{flat\ bond\ price}$$

- **Simple yield:** It is the sum of the coupon payments plus the straight-line amortized share of the gain or loss, divided by the flat price.

Bond Selling at:	Relationship
Par	coupon rate = current yield = yield to maturity
Discount	coupon rate＜current yield＜yield to maturity
Premium	coupon rate＞current yield＞yield to maturity

Yield Measures for Fixed-Rate Bonds

- **Yield to call (put)** is calculated as a YTM but with the number of periods until the call (put) price substituted for the number of periods to maturity and the maturity value.
- **Yield to Worst:** the worst yield outcome of any that are possible given the call provisions of the bond.
- **Option-adjusted yield:** the required market discount rate whereby the price is adjusted for the value of the embedded option.
  - For a callable bond: option-adjusted yield <YTM
  - For a putable bond: option-adjusted yield >YTM

Example

- Tony Ly is a Treasury Manager with Deeter Holdings, a large consumer products holding company. The Assistant Treasurer has asked Ly to calculate the current yield (CY) and the Yield-to-first Call (YTC) on a bond the company holds that has the following characteristics:
  - 7 years to maturity
  - $1,000 face value
  - 7.0% semi-annual coupon
  - Priced to yield 9.0 percent
  - Callable at $1,060 in two years

  If Ly calculates correctly, the CY and YTC are approximately:

	CY	YTC
A.	7.80%	15.72%
B.	7.80%	15.82%
C.	7.78%	15.72%

- **Correct Answer: B**

Yield measures for floating-rate notes

- Coupon rate = reference rate + quoted margin
  - **Quoted margin:** margin used to calculate the bond coupon payments
- Discount rate = reference rate + required margin (or discount margin)
  - **Required/discount margin**: margin required to return the FRN to its par value at each reset date.
    - ✓ Selling at par(credit unchanged): required margin = quoted margin
    - ✓ Selling at discount(downgrade of credit): quoted margin < required margin
    - ✓ Selling at premium(upgrade of credit): quoted margin > required margin

Example

- A floating-rate note has a quoted margin of +35 basis points and a required margin of +55 basis points. On its next reset date, the price of the note will be:
  - A. Equal to par value
  - B. Less than par value
  - C. Greater than par value

- **Correct Answer: B**

Example

- A two-year floating-rate note pays 6-month Libor plus 80 basis points. The floater is priced at 97 per 100 of par value. Current 6-month Libor is 1.00%. Assume a 30/360 day-count convention and evenly spaced periods. The **discount margin** for the floater in basis points (bps) is closest to:
  - A. 180 bps
  - B. 236 bps
  - C. 420 bps

- **Correct Answer: B**

Introduction to Fixed-Income Valuation

- **Yield measures for money market instruments**
  - Discount yield: (e.g., U.S. Treasury bills)

$$PV = FV \times (1 - \frac{Days}{Year} \times DR)$$

  - Add-on yield: (e.g., LIBOR, bank CD rates)

$$PV = \frac{FV}{(1 + \frac{Days}{Year} \times AOR)}$$

  - Both discount basis and add-on yields in the money market are quoted as simple annual interest and can be based on a 360-day or 365-day basis.
  - **Bond equivalent yield(investment yield) for money market security:** yield stated on a 365-day add-on rate basis.

Example: Yields for Money Market Instruments

- Assuming a treasury bill with 180 days, par value of $1,000, and discount rate of 0.9%. The market price and the add-on yield based on 365-day are:

- **Correct answer:**
  - The market price based on 365-day:

$$PV = FV \times (1 - \frac{Days}{Year} \times DR) = 1000 \times (1 - \frac{180}{365} \times 0.9\%) = 995.56$$

  - The annualized add-on yield based on a 365-day year:

$$PV = \frac{FV}{(1 + \frac{Days}{Year} \times AOR)} = \frac{1000}{1 + \frac{180}{365} \times AOR} = 995.56$$

$$AOR = 0.9043\%$$

    ✓ This add-on yield based on a 365-day year is referred to as the bond equivalent yield for money market security.

Example: Yields for Money Market Instruments

- Assuming a $1.5million certificate of deposit(CD) with 270 days and priced with add-on yield of 2.3% on 365-day a year. The payment at maturity and bond equivalent yield of the CD are:

- **Correct answer:**
  - Add-on rate for 270-day=270/365×2.3%=1.7014%;
  - At maturity, CD pay $1.5 million × (1+1.7014%)=$1,525,521;
  - The quoted rate on CD of 2.3% is bond equivalent yield.

Yield Curve

- **Yield curve** shows the term structure of interest rates by displaying yields across different maturities.
- **Spot curve:** a yield curve for single payments in the future, such as zero-coupon bonds or stripped Treasury bonds.
  - Spot curve for U.S. Treasury bonds is called the zero-curve or strip curve.
- **Yield curve for coupon bonds** shows the YTM for coupon bonds at various maturities, which can be calculated by linear interpolation
- **Par bond yield curve:** shows the coupon rates for bonds of various maturities that would result in bond prices equal to their par values.

- **Example :** Consider a 3-year annual-pay bond with spot rates of 2.6%, 3.2%, 3.9% , the coupon payment satisfies: $\frac{PMT}{1.026} + \frac{PMT}{(1.032)^2} + \frac{PMT + 100}{(1.039)^3} = 100$
- **Correct Answer**: PMT=3.86, par bond coupon rate=3.86%

- **Forward yield curve** shows the future rates for bonds or money market securities for the same maturities for annual periods in the future.

Forward Rates

- **Forward Rates:** is the interest rate on a bond or money market instrument traded in a forward market. Marginal return for extending the time-to-maturity for an additional period
  - E.g. The int. of a 1-year loan that would be made 2 years from now
  - Notation: 2y1y rate of a 1-year loan to be made 2 years from now
- **Relationship Between Forward Rates and Spot Rates**

$$(1+S_T)^T = (1+S_1)(1+1y1y)\ldots(1+(T-1)y1y)$$

- **Valuation Using Forward Rates**

$$bond\ value = \frac{CF_1}{(1+S_1)} + \frac{CF_2}{(1+S_1)(1+1y1y)} + \ldots \frac{CF_n}{(1+S_1)(1+1y1y)\ldots(1+(T-1)y1y)}$$

Example

- The spot rate of a **3-year** should be:

0y1y	0.80%
1y1y	1.12%
2y1y	3.94%

A. 1.35%.

B. 1.84%.

C. 1.94%.

- **Correct answer: C**

0y3y=[(1+0.80%)(1+1.12%)(1+3.94%)]$^{1/3}$ - 1 = 1.94%

Yield Spread

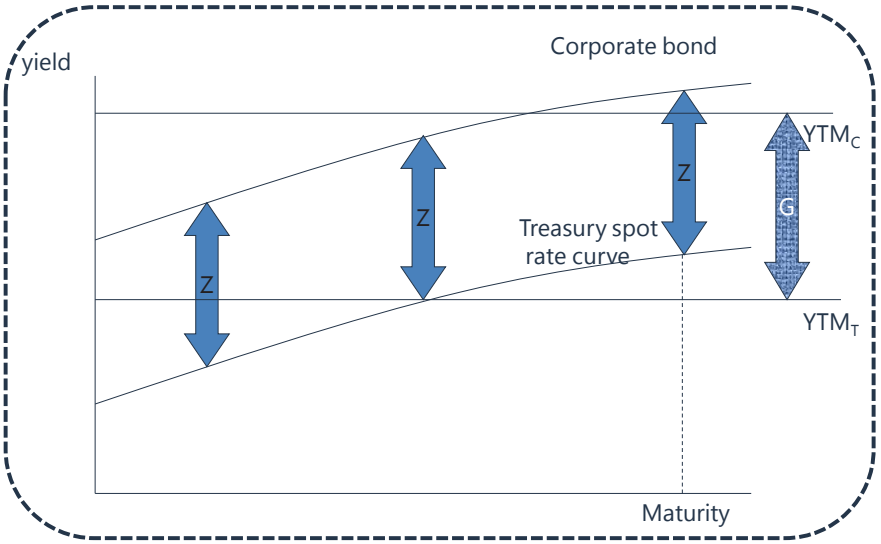
- **Benchmark spread:** the yield spread over a specific benchmark, usually measured in basis points.
  - **G-spread**: the benchmark is government bond yield
  - **Interpolated spread (I-spread)**: the benchmark is swap rate
  - **Zero-volatility spread (Z-spread)**: is based on the entire benchmark spot curve. It is the constant spread that is added to each spot rate such that the present value of the cash flows matches the price of the bond.
- **Option-adjusted spread (OAS)**: is the Z-spread minus the theoretical value of the embedded call option.
  - Callable bond: ZS > OAS
  - Putable bond: ZS < OAS

Example

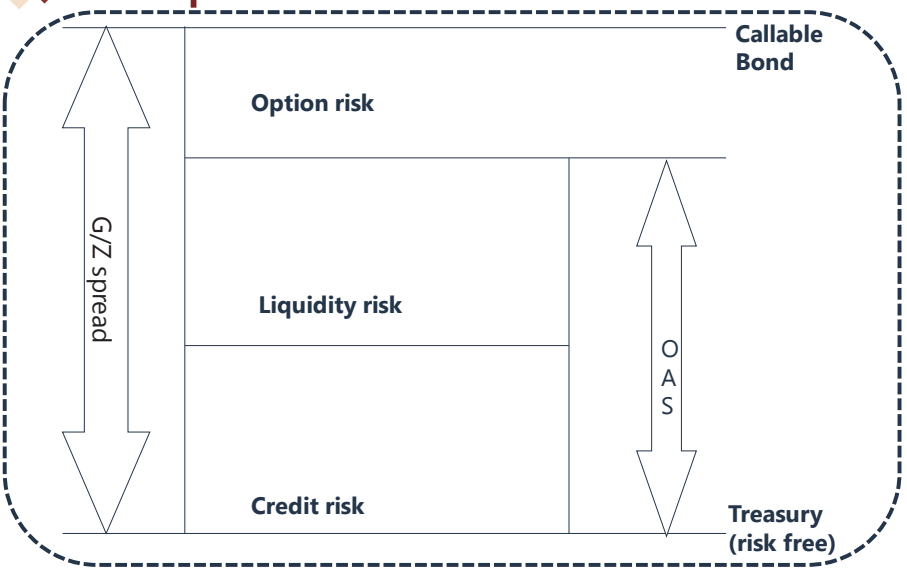
Bond	Coupon rate	Time-to-maturity	Price
U.K. Government Benchmark Bond	2%	3 years	100.25
U.K. Corporate Bond	5%	3 years	100.65

- Both bonds pay interest annually. The current three-year EUR interest rate swap benchmark is 2.12%. The G-spread in basis points (bps) on the U.K. corporate bond is closest to:
  - A. 264 bps.
  - B. 285 bps.
  - C. 300 bps .
- **Correct Answer: B**

Yield Spread



Yield Spread



Reading 54

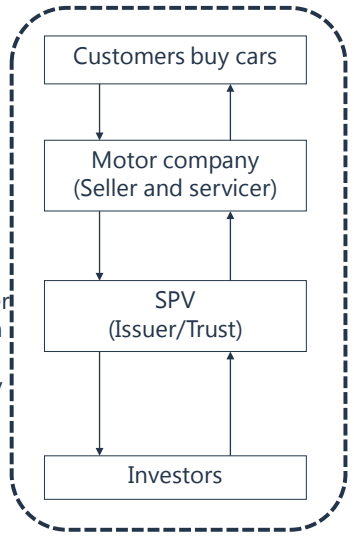
Introduction to Asset-Backed Securities

Framework

1. Securitization
2. Mortgage-Backed Securities (MBS)
   - Residential Mortgage Loans
   - RMBS
     - ✓ Agency MBS
       - ◘ MPS
       - ◘ Prepayment risk
       - ◘ Structure of CMO
     - ✓ Non-agency MBS
   - CMBS
3. Non-Mortgage-Backed Securities (ABS)
4. Collateralized Debt Obligations (CDO)

Introduction to Asset-backed Securities

- ***Asset-backed securities***:
  - Fixed income securities that are backed, or collateralized, by a **pool(collection) of** assets such as loans or receivables are referred to as **asset-backed securities**.
- Securitization:
  - A process in which relatively simple debt obligations, such as loans or bonds, are repackaged into more complex structure that involving the participation of several new entities. (moving assets from the owner of the assets into a special legal entity, then sell);
  - **Securitized assets:** Assets that are typically used to create asset backed securities, including residential mortgage loans, commercial mortgage loans, automobile loans, student loans, bank loans, and credit card debt.



Structures of Securitizations

- **Credit tranching**: Different tranches have different risk exposures
  - It is common for securitizations to include a form of internal credit enhancement called subordination.
  - In such a structure, there is more than one bond class or tranche, and the bond classes differ as to how they will share any losses resulting from defaults.
- **Time tranching:**
  - Bond classes that posses different expected maturities.
- In common, for a securitization to have structures with both credit tranching and time tranching.

Structures of Securitizations

Bond class	Par Value ($ millions)
A (Senior)	280
B (Subordinated)	50
C (Subordinated)	50
Total	380

- Credit tranching: Tranche B is first to absorb any losses.
- Time tranching: Senior tranche and subordinated tranches have different maturities.

Residential Mortgage Loans

- **Mortgage loan**
  - A mortgage is a loan that is collateralized with a specific piece of real property, either residential or commercial.
  - The interest rate on the loan is called the mortgage rate or contract rate.
  - A conventional mortgage is the most common residential mortgage. The loan is based on the creditworthiness of the borrower and is collateralized by the residential real estate that it is used to purchase.
- **Four important features of fixed-rate, level payment, fully amortized mortgage loans:**
  - The amount of the principal payment increases as time passes
  - The amount of interest decreases as time passes
  - The servicing fee also declines as time passes
  - The ability of the borrower to prepay results in prepayment risk.

Residential Mortgage Loans

- Interest rate determination: mortgage rate or contract rate
  - **Fixed rate:** the mortgage rate remains the same during the life of the mortgages.
  - **Adjustable or variable rate:** The mortgage rate is reset periodically (daily, weekly, monthly, or annually).
    - ✓ indexed-referenced ARM: the determination of the new mortgage rate for an adjustable-rate mortgage(ARM)at the reset date is based on some reference rate or index
    - ✓ reviewable ARM: rate of ARM determined at the lender's discretion(reviewable ARM).

Residential Mortgage Loans

- Interest rate determination: mortgage rate or contract rate
  - **Initial period fixed rate:** the mortgage rate is fixed for some initial period and is then adjusted.
    - ✓ Rollover or renegotiable mortgage: the adjustment calls for a fixed rate.(dominant in Canada, Denmark, Germany, the Netherlands, and Switzerland)
    - ✓ Hybrid mortgage: the mortgage starts out with a fixed rate and then becomes an adjustable rate after a specified initial term.(popular in the UK)
  - **Convertible:** the mortgage rate is initially either a fixed rate or adjustable rate. At some point, the borrower has the option to convert the mortgage into a fixed rate or an adjustable rate for the remainder of the mortgage's life.(almost half in Japan are convertible)

Residential Mortgage Loans

- **Amortization schedule**
  - Amortization loan:
    - ✓ **Fully amortizing loan:** the sum of all the scheduled principal repayments during the mortgage's life is such that when the last mortgage payment is made, the loan is fully repaid.
      - ◆Most residential mortgage loans in the United States are fully amortizing loans.
    - ✓ **Partially amortizing loan:** the sum of all the scheduled principal repayments is less than the amount borrowed.
  - **Interest-only mortgage:** if no scheduled principal repayment is specified for a certain number of years

Residential Mortgage Loans

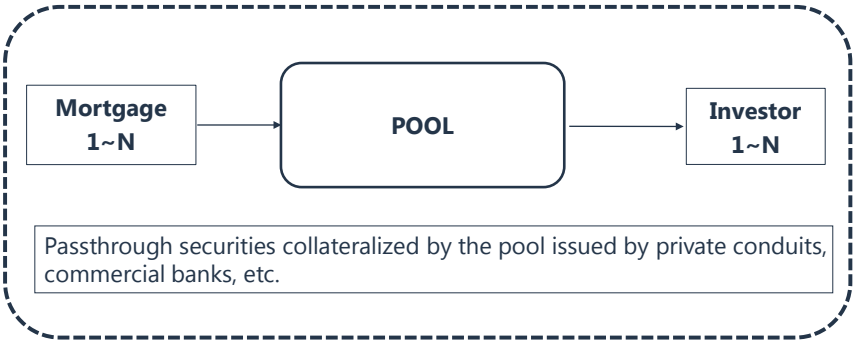
- Rights of the lender in a foreclosure
  - **Recourse loan**: the lender has a claim against the borrower for the shortfall between the amount of the mortgage balance outstanding and the proceeds received from the sale of the property.
    - ✓ Residual mortgage in most European countries are recourse loan
  - **Nonrecourse loan:** the lender does not have such a claim, so the lender can look only to the property to recover the outstanding mortgage balance.
    - ✓ In the United States, residential mortgages are typically non-recourse loans.
- **Strategic default:** the borrower has an incentive to default and allow the lender to foreclose on the property if the value of the property declines below the amount owed by the borrower, even if resources are available to continue to make mortgage payments

Residential Mortgage-Backed Securities

• Government National Mortgage Association (Ginnie Mae)	• Federal-related institution, its guarantees carries the full faith and credit of the U.S. government
• Federal Home Loan Mortgage Corporation (Freddie Mac)	• Freddie Mac and Fannie Mae are government sponsored enterprises. Their guarantee does not carry the full faith and credit of the government. • The pass-through securities issued by Fannie and Freddie are called conventional pass-through securities
• Federal National Mortgage Association (Fannie Mae)	

- **Conforming mortgage**: a loan satisfies the underwriting standards for inclusion as collateral for an agency RMBS**.**
- ***Non-conforming mortgage:*** a loan fails to satisfy the underwriting standards.

Residential Mortgage-Backed Securities



- **Pass-through rate**
  - Pass-through rate is less than the mortgage rate on the underlying pool of mortgages by servicing and guaranteeing fees
  - **Mortgage rate – Pass-though rate = Servicing fees**

Residential Mortgage-Backed Securities

- **Weighted average maturity (WAM):** the weighted maturities average of all the mortgages in the pool, each weighted by the relative outstanding mortgage balance to the value of the entire pool.
- **Weighted average coupon (WAC):** weight the mortgage rate of each mortgage loan in the pool by the percentage of the mortgage outstanding relative to the outstanding amount of all the mortgages in the pool.
- **Example – WAM and WAC**:

Loan	Outstanding Mortgage Balance	Weight in Pool	Mortgage Rate	Months Remaining
1	$125,000	22.12%	7.50 %	275
2	$85,000	15.04 %	7.20 %	260
3	$175,000	30.97 %	7.00 %	290
4	$110,000	19.47 %	7.80 %	285
5	$70,000	12.39 %	6.90 %	270
Total	**$565,000**	**100.00 %**	**7.28 %**	**279**

- **Average life** is the weighted average time until both scheduled principal payments and expected prepayments are received.

Prepayment

- **Prepayment:** any payment toward the repayment of principal that is in excess of the scheduled principal repayment.
- **Prepayment option (early repayment option):** a mortgage loan may entitle the borrower to prepay all or part of the outstanding mortgage principal prior to the scheduled due date the principal must be repaid.
- **Prepayment penalty mortgage**
  - The mortgage may stipulate some sort of monetary penalty when a borrower prepays within a certain time period after the mortgage is originated. This time period may extend for the full life of the loan.

Residential Mortgage-Backed Securities

- **Prepayment risk:** Uncertainty that the timing of the actual cash flows will be different from the scheduled cash flows as set forth in the loan agreement due to the borrowers' ability to alter payments, usually to take advantage of interest rate movements.

Residential Mortgage-Backed Securities

- **Type of prepayment risk**
  - **Contraction risk** occurs as interest rates fall, prepayment rates increase, the security will have a shorter maturity than was anticipated at the time of purchase because of refinancing at now-available lower rate.
    - ✓ The proceeds received must now be invested at lower interest rates
    - ✓ Price appreciation is not as great as that of an otherwise identical bond that does not have a prepayment or call option
    - ✓ Contraction risk occurs as mortgage rates fall, prepayment rates increase, and the average life of the pass-through security decreases.

Residential Mortgage-Backed Securities

- **Extension risk** occurs as interest rates rise, prepayment rates slow, and the security becomes longer in maturity than anticipated at the time of purchase because investors are reluctant to give up the benefits of a contractual interest rate that now looks low.
  - ✓ The value of the security has fallen because interest rates are higher
  - ✓ Income they receive can potentially reinvest is typically limited to the interest payment and scheduled principal repayments
  - ✓ Extension risk occurs as mortgage rates rise, prepayment rates slow, and the average life of the pass-through security increase

Mortgage Pass-Through Securities

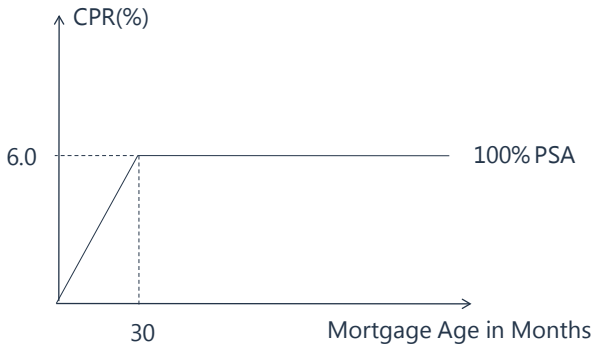
- **Prepayment rates**
  - Two industry conventions have been adopted as benchmarks for prepayment rates: the **conditional prepayment rate (CPR)** and the **Public Securities Association (PSA)** prepayment benchmark.
    - ✓ CPR is **the annual rate** at which a mortgage pool balance is assumed to be prepaid during the life of the pool.
    - ✓ The PSA prepayment benchmark assumes that the monthly prepayment rate for a mortgage pool increases as it ages, or becomes seasoned.
    - ✓ The PSA benchmark is expressed as a monthly series of CPRS.

The PSA standard benchmark:100%PSA

- CPR=0.2% for the first month after origination, increasing by 0.2% per month up to 30 months. For example, the CPR in month 14 is 2.8%.
- CPR=6% for months 30 to 360
- After 30 months, no prepayment rate is added.

Residential Mortgage-Backed Securities

100 PSA



Remember that the CPRs are expressed as annual rates.

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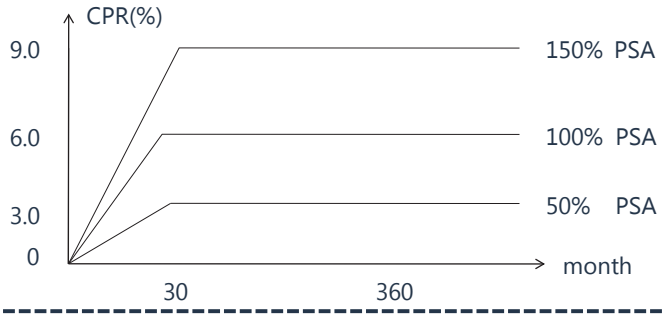
Residential Mortgage-Backed Securities



- 50% PSA: one-half of the CPR prescribed by 100% PSA
  - (prepayment rates slower than 100% PSA)
- 150% PSA: 1.5 times the CPR called for by 100% PSA
  - (prepayment rates faster than 100% PSA)

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Residential Mortgage-Backed Securities

- **Monthly prepayment rate:** single monthly mortality rate (SMM)

$$\text{SMM} = \frac{\text{Prepayment for month}}{(\text{Beginning mortgage balance for month} - \text{scheduled principal repayment for month})}$$

$$\text{SMM} = 1 - (1 - CPR)^{\frac{1}{12}}$$

- An SMM of 10% implies that 10% of a pool's beginning-of-month outstanding balance, less scheduled payments, will be prepaid during the month

Examples

1. Compute the CPR and SMM for the 25th and 35th months, assuming 100 PSA.
   - Correct answer:
     - ✓ CPR (month 25) = 6%*(25/30) = 5%
     - ✓ SMM = $1 - (1 - 0.05)^{1/12} = 0.004265$
     - ✓ CPR (month 35) = 6%
     - ✓ SMM = $1 - (1 - 0.06)^{1/12} = 0.0051$
2. Assume that you have invested in a mortgage pool with a $100,000 principal balance outstanding at the beginning of the 25th month. The scheduled monthly principal payment for month 25 is $28.61. Compute the prepayment for the 25th month.
   - Correct answer:
     - ✓ Prepayment25 = 0.004265 X ($100,000 - $28.61) = $426.38

Mortgage Pass-Through Securities

➢ **Mortgage pass-through security cash flow construction**

- The underlying pool of mortgage has a par value of US$800 million;
- The mortgages are fixed-rate, level-payment, and fully amortizing loans;
- The weighted average of the coupon rate(WAC) for the mortgage loans in the pool is 6%;
- The weighted average of the maturity (WAM) for the mortgage loans in the pool is 357 months;
- The pass-through rate (that is, the coupon rate net of servicing and other fees) is 5.5%;
- Prepayment rate assumed to be 165PSA.

Mortgage Pass-Through Securities

➢ **Cash flow construction (million)**

Month	Beginning of month mortgage balance	SMM	Mortgage payment	Net interest payment	Scheduled principal Repayment	Prepay ment	Total Principal Repayment	Cash flow
1	800	0.0011	4.810	3.67	0.810	0.88	1.69	5.36
2	798	0.0014	4.804	3.66	0.814	1.12	1.93	5.59
3	796	0.0017	4.799	3.65	0.819	1.35	2.17	5.82
...	...	...	...	...	...	...	...	...
357	0.241	0.0087	0.242	0.0011	0.241	0	0.241	0.24

Mortgage Pass-Through Securities

➢ **Cash flow construction (million)**

- Net interest payment: $\frac{Begining\ month\ of\ balance \times pass\text{-}through\ rate}{12}$
- Gross interest payment: $\frac{Begining\ of\ month\ mortgage\ balance \times WAC}{12}$
- Mortgage Payment: PV=beginning month of mortgage balance, I/Y=$\frac{6}{12}$ = 0.5, N=remaining month, FV=0, CPT → PMT
- Scheduled principal prepayment=Mortgage payment− gross interest payment
- Prepayment=(Beginning of month mortgage balance−scheduled principal repayment)× SMM
- Cash flow= Net interest payment + Total principal repayment

Mortgage Pass-Through Securities

Month 1

CPR=0.2%*4=0.8%; 165PSA = 1.65*0.8%=1.32%; SMM = 1-(1-1.32%)^(1/12)=0.0011

N=357, I/Y=6/12=0.5, PV=-800, FV=0; CPT PMT = 4.810

Net interest payment = 800*5.5%/12=3.67; Gross interest payment = 800*6%/12=4.000

Scheduled principal Repayment = Mortgage payment - Gross interest payment = 4.810-4.000 = 0.810

Prepayment = Beginning balance * SMM = 800*0.0011 = 0.88; Total Principal Repayment = Scheduled principal Repayment + Prepayment = 0.810 + 0.88 = 1.69; Cash flow = Net interest payment + Total Principal Repayment = 3.67 + 1.69 = 5.36

Month	Beginning of month mortgage balance	SMM	Mortgage payment	Net interest payment	Scheduled principal Repayment	Prepay ment	Total Principal Repayment	Cash flow
1	800	0.0011	4.810	3.67	0.810	0.88	1.69	5.36
2	798	0.0014	4.804	3.66	0.814	1.12	1.93	5.59
3	796	0.0017	4.799	3.65	0.819	1.35	2.17	5.82
...	...	...	...	...	...	...	...	...
357	0.241	0.0087	0.242	0.0011	0.241	0	0.241	0.24

Mortgage Pass-Through Securities

Month 2

CPR=0.2%*5=1%; 165PSA = 1.65*1%=1.65%; SMM = 1-(1-1.65%)^(1/12)=0.0014

N=356, I/Y=6/12=0.5, PV=-(800-1.69)=-798, FV=0; CPT PMT = 4.804

Net interest payment = 798*5.5%/12=3.66; Gross interest payment = 798*6%/12=3.99

Scheduled principal Repayment = Mortgage payment - Gross interest payment = 4.804-3.99 = 0.814

Prepayment = Beginning balance * SMM = 798*0.0014= 1.12; Total Principal Repayment = Scheduled principal Repayment + Prepayment = 0.814 + 1.12 = 1.93; Cash flow = Net interest payment + Total Principal Repayment = 3.66 + 1.93 = 5.59

Month	Beginning of month mortgage balance	SMM	Mortgage payment	Net interest payment	Scheduled principal Repayment	Prepay ment	Total Principal Repayment	Cash flow
1	800	0.0011	4.810	3.67	0.810	0.88	1.69	5.36
2	798	0.0014	4.804	3.66	0.814	1.12	1.93	5.59
3	796	0.0017	4.799	3.65	0.819	1.35	2.17	5.82
...	...	...	...	...	...	...	...	...
357	0.241	0.0087	0.242	0.0011	0.241	0	0.241	0.24

Collateralized Mortgage Obligations(CMO)

- **Creating collateralized Mortgage Obligations (CMO)**
  - **CMOs** are securities issued against pass-through securities for which the cash flow have been reallocated to different tranches.
  - Each CMO tranche represents a different mixture of contraction and extension risk.
  - Redistribution of the original passthrough securities' cash flows does not eliminate contraction and extension risk.

Collateralized Mortgage Obligations(CMO)

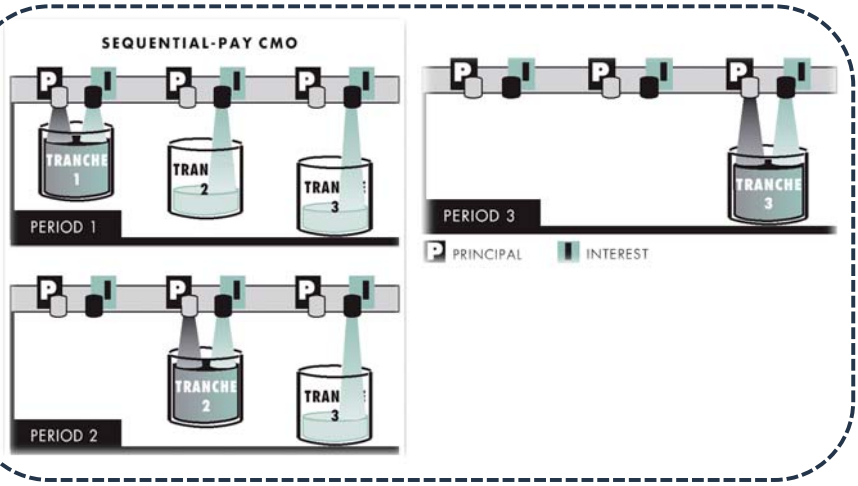
- **Different types of CMOs**
  - **1. Sequential Pay tranches**
    - ✓ Each class of bonds is retired sequentially in sequential pay **CMO.**

$$total\ CF \rightarrow \frac{total\ P}{total\ I} \begin{cases} \overset{2}{3} \dfrac{P}{I}(A) \\ \overset{1}{1} \dfrac{P}{I}(B) \end{cases}$$

    - ✓ The CMO structure with sequential-pay tranches allows investors concerned about extension risk to invest in shorter-term tranches and those concerned about contraction risk to invest in the longer-term tranches.

Collateralized Mortgage Obligations(CMO)

- **Sequential-pay CMO illustration**



Collateralized Mortgage Obligations(CMO)

- **2.Planned amortization class (PAC) and Support tranche**
  - ✓ A PAC is a tranche that is amortized based on a sinking fund schedule that is established within a range of prepayment speeds called the **initial PAC collar**.
  - ✓ This is a principal repayment schedule that must be satisfied
  - ✓ **PAC bondholders have priority over all other classes** in the CMO structure in receiving principal repayments from the collateral.
  - ✓ The greater certainty of the cash flow for the PAC bonds comes at the expense of the non-PAC tranches (**support tranches**). It is these tranches that **absorb the prepayment risk**.
  - ✓ PAC tranches have **protection against both extension risk and contraction risk**, providing two-sided prepayment protection.

Collateralized Mortgage Obligations(CMO)

Tranche	Contraction risk	Extension risk
A	HIGH	LOW
B		
C Sequential pay CMO		
D	LOW	HIGH

Tranche	Prepayment risk
A	LOW
B	
C	
D PAC tranches	
E	
F	
Support (broken or busted PAC)	HIGH

Collateralized Mortgage Obligations(CMO)

➢ The average life for the PAC tranche and the support tranche in assuming various actual prepayment rate

Prepayment Rate(PSA)	Average Life(years)	
	PAC Tranche(P)	Support Tranche(S)
50	10.2	24.9
100	8.6	22.7
150	↑	20.0
200	7.7 Initial Collar	10.7
250	↓	3.3
300	5.5	1.9
350	4.0	1.4

Collateralized Mortgage Obligations(CMO)

- **Support tranche**
  - Support tranches are included in a structure with PAC tranches specifically to provide prepayment protection for the PAC tranches.
  - The extent of prepayment risk protection provided by a support tranche increases as its par value increases relative to its associated PAC tranche.
  - The certainty of PAC bond cash flow comes at the expense of increased risk to the support tranches.
  - When the support tranches will eventually be paid off, and the principal will then go to the PAC holders, and the PAC is referred to as ***a broken or busted PAC***. Essentially, the PAC tranche becomes an ordinary sequential pay structure.

Tranche	Notional	Prepayment risk
PAC I	20 m	Lowest
PAC II	40 m	
Support tranche	30 m	Highest

Collateralized Mortgage Obligations(CMO)

- **3. Floating-rate tranche**
  - **Floater and inverse floater**

Tranche	Notional	Coupon
A	52 m	9%
B	9 m	9%
C	39 m	9%
Total	**100 m**	**9%**

Tranche	Notional	Coupon
A	52 m	9%
B	9 m	9%
Floater	26 m	LIBOR + 50 bp
Inverse floater	13 m	**26%** - 2LIBOR

- Constructing a floater and an inverse floater combination from any of the fixed-rate tranches in a CMO structure.
  - ✓ Floating rate tranche pays a higher rate when interest rates go up
  - ✓ The inverse floater pays a lower rate when interest rate go up

Collateralized Mortgage Obligations(CMO)

Tranche	Contraction risk	Extension risk
A (sequential pay)	HIGH	LOW
B (sequential pay)	↑	↓
C (sequential pay)	↑	↓
D (sequential pay)	↑	↓
Z (accrual)	LOW	HIGH

- The early tranches have lower prepayment risk than the later tranches. The unscheduled support tranche absorbs most of the prepayment risk

Tranche	Contraction risk	Extension risk
A (PAC I)	LOW	LOW
B (PAC I)	↓	↓
B (PAC II)	↓	↓
B (PAC II)	↓	↓
Support tranche	HIGH	HIGH

Non-agency RMBS

- Non-agency RMBS not guaranteed by Ginnie Mae, Fannie Mae, or Freddie Mae
- **Differences between Agency and Non-agency securities**
  - ***Agency securities:*** CMOs are created from pools of passthrough securities.
  - ***Non-agency securities:*** CMOs are created from unsecuritized mortgage loans.
  - Non-agency securities have no explicit or implicit government guarantee of payment of interest and principal as agency securities have.
  - All non-agency securities are **credit enhanced**: external and internal.

Credit enhancement

- Non-agency RMBS require one or more credit enhancement
  - **Internal credit enhancements**
    - ✓ **Senior/subordinated structure**: the subordinated bond classes(junior bond classes or non-senior bond classes) provide credit support for the senior bond classes
      - ◆The subordination levels are set at the time of issuance and change over time as voluntary prepayments and defaults occur;
      - ◆A deal designed to keep the amount of credit enhancement from deteriorating over time;
        - ☐ **Shifting interest mechanism**: locks out subordinated bond classes from receiving payments for a period of time if the credit enhancement for senior tranches deteriorates because of poor performance of the collateral.

Credit enhancement

- ✓ **Reserve funds**: provide credit support by paying for possible future losses.
  - ◆**Cash reserve fund**: deposit of cash provided to the SPV from the proceeds of the sale of the loan pool by the entity seeking to raise funds.
  - ◆**Excess spread amount**
    - ☐ allocation into an account of any amount resulting from monthly funds remaining after paying out the interest to the bond classes;
    - ☐ From servicing and other fees.
- ✓ **Overcollateralization**: the value of the collateral exceeds the amount of the par value of the outstanding bond classes issued by SPV.

Credit enhancement

- **External credit enhancements**: Credit support in the case of defaults resulting in losses in the pool of loans is provided in the form of a financial guarantee by a third party to the transaction.
  - *The most common third party financial guarantors are insurance companies, referred to as a monoline insurer.*
    - ✓ Private insurance company whose business is restricted to providing guarantees for financial products, such as municipal securities and ABS.

Mortgage-backed sector of the bond market

- **Warm-up——CMBS (Commercial mortgage-backed securities)** are backed by a pool of commercial mortgages on income-producing property, such as:
  - Multifamily properties (e.g„ apartment buildings)
  - Office buildings, industrial properties (including warehouses)
  - Shopping centers; Hotels
  - Health care facilities (e.g., senior housing care facilities).
- **Commercial mortgages** are ***non-recourse loans***, the lender can look only to the income-producing property backing the loan for interest payments and principal repayments;
- **The residential mortgage lender** can use only the proceeds from the sale of the property for repayment and has no recourse to the borrower for any unpaid balance;
- Analysis of CMBS securities focuses on the property and not the borrower.
  - Debt-to-service coverage ratio= $\frac{net\ operating\ income}{debt\ service}$
  - Loan-to-value ratio = $\frac{current\ mortgage\ amount}{current\ appraised\ value}$

Mortgage-backed sector of the bond market

- **Basic CMBS Structure – Call Protection**
  - A critical investment feature that distinguishes CMBS from RMBS is the protection against early prepayments available to investors' known as a **call protection**.
    - ✓ A borrower in the United States usually does not pay any penalty for prepayment. The discussion of CMOs highlighted how investors can purchase certain types of tranches to modify or reduces prepayment risk.
    - ✓ With CMBS, investors have considerable call protection. In fact, it is this protection that results in CMBS trading in the market more like corporate bonds than like RMBS.
    - ✓ The call protection comes either at the **structure level** or at the **loan level**.

Commercial mortgage-backed securities

- **Call protection at the structure level**
  - Structural call protection is achieved when CMBS are structured to have sequential-pay tranches, by credit rating.
  - A lower-rated tranche cannot be paid down until the higher-rated tranche is completely retired, so the AAA rated bonds must be paid off before the AA rated bonds are, and so on.
  - Principal losses resulting from defaults, however, are affected from the bottom of the structure upward.

Mortgage-backed sector of the bond market

- **Call protection at the loan level**
  - **Prepayment lockout** is a contractual agreement that prohibits any prepayments during a specified period of time;
  - **Defeasance**: The borrower provides sufficient funds for the servicer to invest in a portfolio of government securities that replicates the cash flows that would exist in the absence of prepayments;
    - ✓ The cost of assembling such a portfolio is the cost of defeasing the loan that must be repaid by the issuer.
  - **Prepayment penalty points**: Predetermined penalties that a borrower who want to refinance must pay;
  - **Yield maintenance charges(make-whole charge)** is a penalty paid by the borrower that makes refinancing solely to get a lower mortgage rate uneconomical for the borrower;
    - ✓ Designed to make the lender indifferent as to the timing of prepayments.

Mortgage-backed sector of the bond market

- **Basic CMBS Structure - Balloon Maturity Provision**
  - Many commercial loans backing CMBS are balloon loans that require substantial principal payment at maturity of the loan.
  - If the borrower fails to make the balloon payment, the borrower is in default.
    - ✓ The risk that a borrower will not be able to make the balloon payment because either the borrower cannot arrange for refinancing or cannot sell the property to generate sufficient funds to pay off the balloon balance is called **balloon risk**.
    - ✓ Balloon risk is a type of extension risk.
  - The lender may modify the original loan terms and charge a higher interest rate, called "workout period".
    - ✓ Lender may modify the original loan terms and charge a higher interest rate, called "default interest rate" during the workout period.

Non-Mortgage Asset-backed Securities

Non-Mortgage Asset-backed Securities(ABS)

- **1. Auto Loan ABS**
  - The cash flows for auto loan-backed securities consist of scheduled monthly payments (that is, interest payments and scheduled principal repayments) and any prepayments.
  - All auto loan-backed securities have some form of credit enhancement.
    - ✓ Senior/subordinated structure
    - ✓ Overcollateralization
    - ✓ Reserve account
      - ◆Excess spread account / excess interest cash flow, is an amount that can be retained and deposited into a reserve account and that can serve as a first line of protection against losses.

Non-Mortgage Asset-backed Securities

- **2. Credit Card Receivable ABS:** credit card receivables are used as collateral for the issuance, **non-amortizing loans**
  - For a pool of credit receivables, the cash flows consist of
    - ✓ **Finance charges collected:** represent the periodic interest the credit card borrower is charged on the unpaid balance after the grace period
    - ✓ **Fees:** include late payment fees and any annual membership fees
    - ✓ **Principal repayments:** "early amortization" or "rapid amortization" provisions included to safeguard the credit quality of the issue
  - **lockout periods:** cash flow paid out based on finance charges collected and fees
    - ✓ **After lockout periods:** principal no longer reinvested but paid to investors

Collateralized debt obligation (CDO)

- **Collateralized debt obligation (CDO)** is a generic term used to describe a security backed by a diversified pool of one or more debt obligations:
  - CDOs backed by corporate and emerging market bonds are **collateralized bond obligations (CBOs);**
  - CDOs backed by leveraged bank loans are **collateralized loan obligations (CLOs);**
  - CDOs backed by ABS, RMBS, CMBS, and other CDOs **are structured finance CDOs;**
  - CDOs backed by a portfolio of credit default swaps for other structured securities are **synthetic CDOs.**

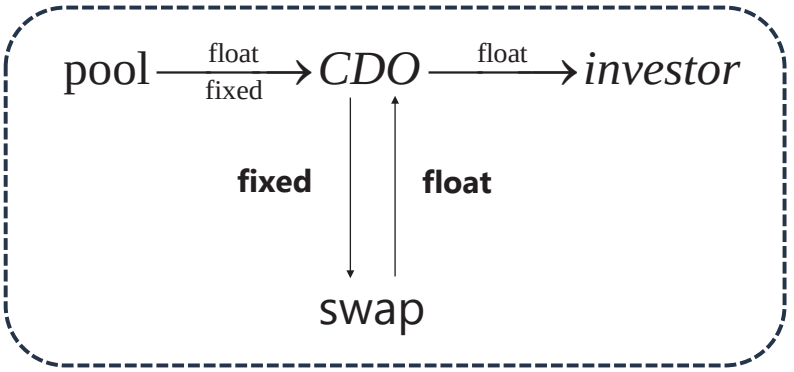
Collateralized debt obligation (CDO)

- **CDO Structure**
  - A CDO involves the creation of an SPE.
  - In a CDO, there is a need for a CDO manager, also called "collateral manager", to buy and sell debt obligations for and from the CDO's collateral (that is, the portfolio of assets) to generate sufficient cash flows to meet obligations to the CDO bondholders.
  - These debt obligations are bond classes or tranches and include senior bond classes, mezzanine bond classes, and subordinated bond classes, often referred to as the residual or equity tranches.

Senior tranche	At least A
Mezzanine tranche	BBB but no less than B
Subordinate/equity tranche	Receive the residual cash flow

Collateralized Debt Obligations (CDO)

- **CDO Transaction:**
  - In typical structure, one or more of the tranches is a **floating-rate security**.
  - Asset manager uses **interest rate swap** to deal with the mismatch.



Reading 55

Understanding Fixed-Income Risk and Return

Framework

1. Annualized holding period return
2. Interest rate risk
   - Duration
   - Convexity
   - Duration gap

Source of Return

- **Three sources of return:**
  - Receipt of the promised coupon and principal payments on the scheduled dates;
  - Reinvestment of coupon payments;
  - Potential capital gains or losses on the sale of the bond prior to maturity.
- **Total return:** future value of reinvested coupon interest payments and the sale price (par value if the bond is held to maturity);
- **Annualized holding period return:** A horizon yield is the internal rate of return between the total return (the sum of reinvested coupon payments and the sale price or redemption amount) and the purchase price of the bond. The horizon yield on a bond investment is the annualized holding-period rate of return.

$$annualzed\ holding\ period\ return = \left(\frac{total\ return}{bond\ price}\right)^{1/n} - 1$$

Illustration on sources of return

- **Results to gain from the analysis presented here.**
  - Hold a fixed-rate bond to maturity, reinvestment at YTM → Annualized rate of return=YTM
  - Sell prior to maturity, selling price priced at YTM → Annualized rate of return=YTM
  - Hold a bond to maturity, reinvestment rate (YTM) ↗ → realized return > YTM, vice versa
  - Hold for a short period, reinvestment rate (YTM) ↗ → realized return < YTM
  - Hold for a long period, reinvestment rate (YTM) ↘ → realized return < YTM

Illustration on sources of return

➢ **Results to gain from the analysis presented here.**

Investment horizon	Disposal price	Reinvestment rate of return	Holding period return
Hold to maturity	/	YTM	YTM
Disposal before maturity	Priced at YTM	YTM	YTM
Hold to maturity	/	Increased after purchase before first coupon date	> YTM
Hold to maturity	/	Decreased after purchase before first coupon date	< YTM

Illustration on sources of return

➢ **Situation 1: a fixed-rate bond, hold to maturity, earn an annualized rate of return equal to the YTM of the bond when purchased.**

- Assuming a 10% annual-pay 3-year bond purchased at a YTM of 12% and held to maturity.
  - ✓ N=3; I/Y=12; PMT=100; FV=1,000; CPT: PV=**-951.96**
- At maturity, coupon income and reinvestment income amount is
  - ✓ $100(1.12)^2+100(1.12)+100=$**$337.44** or
  - ✓ N=3; I/Y=12; PV=0; PMT=100; CPT: FV=**337.44**
- the investor's rate of return over the three-year holding period is:

$$Annualized\ holding\ period\ return = ((1,000+337.44)/951.96)^{1/3} - 1 = 12\%$$

Illustration on sources of return

➢ **Situation 2: sells a bond prior to maturity, earn a rate of return equal to the YTM at purchase if the YTM at sale has not changed since purchase.**

- Using the bond from "situation 1", assuming the investor with a two-year holding period.
- Price at sale at end of year 2, YTM = 12%:
  - ✓ 1,100/1.12=**982.14** or
  - ✓ N=1; I/Y=12; FV=1,000; PMT=100; CPT: PV=**-982.14**
- Coupon income and reinvestment income for two years:
  - ✓ 100(1.12)+100 =$**212** or
  - ✓ N=2; I/Y=12; PV=0; PMT=100; CPT FV=**212**
- Investor's annual compound rate of return over the two-year holding period is:

$$\left(\frac{212+982.14}{951.96}\right)^{1/2} - 1 = 12\%$$

Illustration on sources of return

- **Situation 3: market YTM for the bond, reinvestment rate increases (decreases) after the bond is purchased but before the first coupon date, a investor's realized return will be higher (lower) than the YTM of the bond when purchased when hold to maturity.**
  - A 3-year 10% bond purchased at par, assuming the YTM & reinvestment rate increases to 12% after purchase but before the first coupon payment date.
  - Coupon income and reinvestment income:
    - ✓ $100(1.12)^2+100(1.12)+100=$**$337.44** or
    - ✓ N=3; I/Y=12; PV=0; PMT=100; CPT: FV=**337.44**
  - Investor's annual compound holding period return:

$$\left(\frac{1337.44}{1000}\right)^{1/3}-1=10.177\%$$

which is greater than the 10% YTM at purchase.

Illustration on sources of return

- **Situation 4: market YTM for the bond, reinvestment rate, increases after the bond is purchased but before the first coupon date, a bond investor will earn a rate of return that is lower than the YTM at bond purchase if the bond is held for a short period.**
  - A 3-year 10% bond purchased at par, assuming the investor with a 1-year investment horizon. If the YTM increases from 10% to 12% after purchase.
  - Bond price just after first coupon has been paid with YTM=12%:
    - ✓ N=2; I/Y=12; FV=1,000; PMT=100; CPT: PV=**-966.20**
  - There is **no reinvestment income** and only one coupon of $100 received so the holding period rate of return is:

$$\left(\frac{966.20+100}{1000}\right)\text{-}1=6.62\%$$

which is less than the YTM at purchase.

Illustration on sources of return

- **Situation 5: market YTM for the bond, reinvestment rate *decreases* after the bond is purchased but before the first coupon date, a bond investor will earn a rate of return that is *higher* than the YTM at bond purchase if the bond is held for a *long* period.**
  - As previous bond in "situation 4", if YTM *decreases to 8%* after purchase and the bond is sold at the end of year 2.
  - Bond price just after first coupon has been paid with YTM=8%:
    - ✓ N=1; I/Y=8; FV=1,000; PMT=100; CPT: PV = -1,018.52
  - Coupon income and reinvestment income:
    - ✓ $100(1.08)+100=$**$208** or
    - ✓ N=2; I/Y=8; PV=0; PMT=100; CPT: FV=**208**
  - The holding period rate of return is simply:

$$\left(\frac{1018.52+208}{1000}\right)^{0.5}\text{-}1=10.75\%$$

which is greater than the YTM at purchase.

Illustration on sources of return

- **Assumption:**
  - A bond makes all of its promised coupon and principal payments on time (i.e., we are not addressing credit risk).
  - The interest rate earned on reinvested coupon payments is the same as the YTM on the bond.

Interest Rate Risk

- **Two types of interest rate risk**
  - **Coupon reinvestment risk**: uncertainty about income from reinvesting coupon payments.
    - ✓ Increases with a higher coupon rate and a longer investment horizon.
  - **Market price risk**: uncertainty about a bond price
- These risks offset each other: an increase (decrease) in YTM decreases (increases) a bond's price but increases (decreases) its reinvestment income.
  - Short investment horizon: longer duration
    - ✓ market price risk > reinvestment risk
    - ✓ annualized holding period return is negatively related with YTM
  - long investment horizon:
    - ✓ market price risk < reinvestment risk
    - ✓ annualized holding period return is positively related with YTM

Interest Rate Risk

- **Interest risk**
  - Interest rate risk: the price sensitivity to interest rate changes. More sensitive, more possible price volatility.
  - Use duration to measure interest rate risk. The higher duration, more interest rate risk.

$$duration = -\frac{percentage\ change\ in\ bond\ \ price}{yield\ \ change\ in\ \ percent}$$

Percentage price change= - duration × yield change in %

  - Exercise: A bond has a duration of 7.2, if the yield decreases from 8.3% to 7.9%, calculate the approximate percentage change in the bond price

Duration

- **Duration** measures the sensitivity of the bond's full price to changes in benchmark interest rates.
  - **Yield duration:**
    - ✓ **Macaulay duration**

$$Macaulay\ duration = \frac{\sum_{t=1}^{n} t \times PVCF_t}{\sum PVCF_t (= P_0)} = \sum_{t=1}^{n} [t \times (PVCF_t / P_0)]$$

    - ✓ **Modified duration**

$$Modified\ duration = \frac{Macaulay\ duration}{1 + periodic\ market\ yield}$$

    - ✓ **Approximate modified duration**

$$Approximate\ \mathrm{mod}ified\ duration = \frac{V_- - V_+}{2 \times V_0 \times \Delta YTM}$$

  - **Curve duration:**
    - ✓ **Effective duration**

$$Effective\ duration = \frac{V_- - V_+}{2 \times V_0 \times \Delta curve}$$

Money Duration and PVBP

- Money duration/dollar duration

  Money duration=annual modified duration * full price of bond

- Money duration expressed as money duration per 100 of bond par value

  Money duration per 100 units of par value
  = annual modified duration * full price of bond per 100 of par

- **Price value of a basis point (PVBP):** is the money change in full price of a bond when its YTM changes by one basis point(0.01%)

$$PVBP = P \times D \times 1bp$$

$$\mathrm{PVBP} = \frac{V_- - V_+}{2}$$

Example

- A life insurance company holds a USD10 million (par value) position in a 4.50% ArcelorMittal bond that matures on 25 February 2017. The bond is priced (flat) at 98.125 per 100 of par value to yield 5.2617% on a street-convention semiannual bond basis for settlement on 27 June 2014. The total market value of the position, including accrued interest, is USD9,965,000, or 99.650 per 100 of par value. The bond's (annual) Macaulay duration is 2.4988.
- **Calculate the money duration per 100 in par value for the ArcelorMittal bond.**
- **Correct answer:**
- The money duration: 2.4988 / (1+0.052617/2) × USD99.650 = USD242.62

Duration

- **Interpreting duration:**
  - Duration is the **slope** of the price-yield curve at the bond's current YTM. (the first derivative of the price-yield curve with respect to yield);
  - Duration is a **weighted average of time (in years)** until cash flow will be received. The weights are the proportions of the total bond value that each cash flow represents.
  - Duration is the **approximate percentage change** in price of 1% change in yield. (price sensitivity)

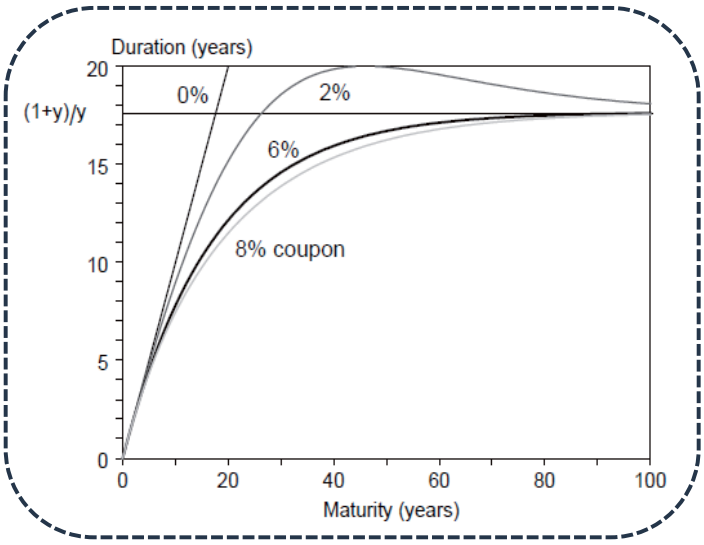
Effective duration and modified duration

- The modified duration: conventional yield duration statistic, measures sensitivity of the bond price with respect to the bond's own yield-to-maturity.
- Effective duration: curve duration, measures the price sensitivity with respect to changes in the U.S. Treasury par curve.
  - For a traditional option-free bond:
    - ✓ The modified duration and effective duration on a traditional option-free bond are not identical.
    - ✓ The difference narrows when the yield curve is flatter, the time-to-maturity is shorter, and the bond is priced closer to par value (so that the difference between the coupon rate and the yield-to-maturity is smaller).
    - ✓ The modified duration and effective duration on an option-free bond are identical only in the rare circumstance of an absolutely flat yield curve.

Duration

- A **perpetuity or perpetual bond** (consol): a bond that does not mature. There is no principal to redeem. The investor receives a fixed coupon payment forever, unless the bond is callable. Non-callable perpetuities are rare.
  - ✓ Macaulay duration= (1 + r)/r, as N approaches infinity
- **Zero coupon bond**: $Macaulay\ Duration(of\ \ a\ zero-coupon\ bond)=t$
- The Macaulay and modified duration statistics for a fixed-rate bond depend primarily on the coupon rate, yield-to-maturity, and time-to-maturity.
  - ✓ A higher coupon rate or a higher yield-to-maturity reduces the duration measures.
  - ✓ A longer time-to-maturity usually leads to a higher duration.
    - ◆It always does so for a bond priced at a premium or at par value.
    - ◆But if the bond is priced at a discount, a longer time-to-maturity might lead to a lower duration.
      - ◻ This situation only occurs if the coupon rate is low (but not zero) relative to the yield and the time-to-maturity is long
  - ✓ Bond with embedded options (callable bond & putable bond) has lower duration.

Duration and Maturity



Duration

- **Effects of bond characteristics on duration：**
  - Longer maturity, higher duration.
  - Lower coupon, higher duration.
  - Lower market yield, higher duration
  - Bond with embedded options (callable bond & putable bond) has lower duration.
- **注：**
  - $D_{perpetuity}$ = (1+YTM)/YTM
  - $D_{zero\text{-}coupon\ bond}$ = M zero-coupon bond
  - $D_{discount} > D_{premium}$
  - $D_{discount}$ 随着时间的变化先增加后减小，并不是时间越长，duration越大。

Relationships Between Price and Yield

- **Inverse effect:** The bond price is inversely related to the market discount rate. When the market discount rate increases, the bond price decreases.
- **Coupon effect:** For the same time-to-maturity, a lower-coupon bond has a greater percentage price change than a higher-coupon bond when their market discount rates change by the same amount.
- **Maturity effect:** Generally, for the same coupon rate, a longer-term bond has a greater percentage price change than a shorter-term bond when their market discount rates change by the same amount.
- **Convexity effect:** For the same coupon rate and time-to-maturity, the percentage price change is greater (in absolute value, meaning without regard to the sign of the change) when the market discount rate goes down than when it goes up.

Portfolio duration

- **Portfolio duration:**
  - **Method 1**: the weighted average of time to receipt of the aggregate cash flows.
    - ✓ The yield measure for calculating portfolio duration with this approach is the **cash flow yield**, the IRR of the bond portfolio.
    - ✓ This method is better theoretically but difficult to use in practice.
      - ◆the cash flow yield is not commonly calculated for bond portfolios
      - ◆the amount and timing of future coupon and principal payments are uncertain if the portfolio contains callable or putable bonds or floating-rate notes
      - ◆interest rate risk is usually expressed as a change in benchmark interest rates, not as a change in the cash flow yield
      - ◆the change in the cash flow yield is not necessarily the same amount as the change in the yields-to-maturity on the individual bonds
        - □ For instance, if the yields-to-maturity on the two zero-coupon bonds in this portfolio both increase or decrease by 10 bps, the cash flow yield increases or decreases by only 9.52 bps.

Portfolio duration

- **Method 2**: The Macaulay and modified durations for the portfolio are calculated as the weighted average of the statistics for the individual bonds. The shares of overall portfolio market value are the weights.

$$\textbf{Portfolio duration} = w_1D_1 + w_2D_2 + \ldots\ldots + w_nD_n$$

  - ✓ The **main advantage to the second approach** is that it is easily used as a measure of interest rate risk.
  - ✓ **Limitations**: the measure of portfolio duration implicitly assumes a **parallel shift in the yield curve.**
    - ◆A parallel yield curve shift implies that all rates change by the same amount in the same direction.
    - ◆In reality, interest rate changes frequently result in a steeper or flatter yield curve. **(non-parallel shifts → key rate duration)**

Key Rate Duration

- **key rate duration:** is a measure of a bond's sensitivity to a change in the benchmark yield curve at a specific maturity segment.
  - In contrast to effective duration, key rate durations help identify "shaping risk" for a bond-that is, a bond's sensitivity to changes in the shape of the benchmark yield curve. (such as: yield curve becoming steeper or flatter);
  - For parallel shifts in the benchmark yield curve, key rate durations will indicate the same interest rate sensitivity as effective duration.

Example

- A bond portfolio consists of the following three fixed-rate bonds. Assume annual coupon payments and no accrued interest on the bonds. Prices are per 100 of par value.

Bond	Maturity	Market Value	Price	Coupon	Yield-to-Maturity	Modified Duration
A	6 years	170,000	85,000	2.00%	4.95%	5.42
B	10 years	120,000	80,000	2.40%	4.99%	8.44
C	15 years	100,000	100,000	5.00%	5.00%	10.38

- The bond portfolio's modified duration is closest to:
  A. 7.62
  B. 8.08
  C. 8.20
- **Correct Answer: A**

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Convexity

- **Convexity** is a measure of the curvature of the price-yield curve.

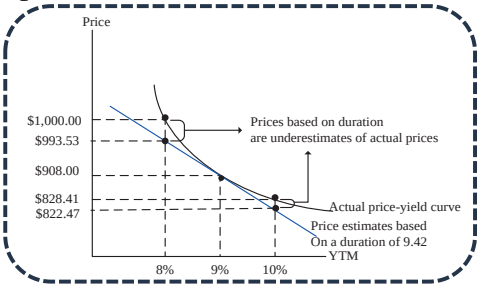
$$\text{approximate convexity}=\frac{V_{-}+V_{+}-2V_0}{(\Delta YTM)^2 V_0}$$

  - Effective Convexity

$$\text{effective convexity}=\frac{V_{-}+V_{+}-2V_0}{(\Delta \text{curve})^2 V_0}$$

  - The convexity adjustment is always positive when convexity is positive

$$\frac{\Delta P}{P}=\left[-MD\times(\Delta y)\right]+\left[0.5\times Conv\times(\Delta y)^2\right]$$



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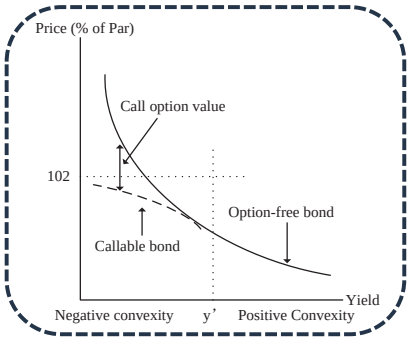
Effective Convexity

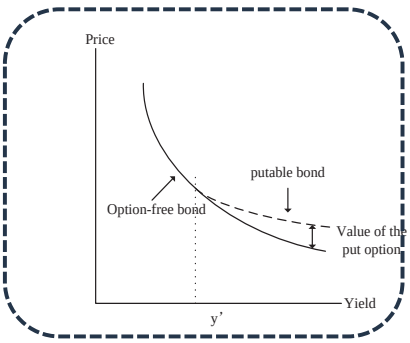
Callable

- High yield →unlikely call, → positive convexity
- Yield decline → may call the bond →**negative convexity**

Putable

- price/yield relationship will be **more convex** when yield increase





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Example

- An analyst accurately calculates that the price of an option-free bond with percent coupon would experience a **12 percent change** if market **yields increase 100 basis points**. If market yields **decrease** 100 basis points, the bond's price would likely:
  A. Increase by 12%
  B. Increase by less than 12%
  C. Increase by more than 12%

- **Correct answer: C**

Term structure of yield volatility

- **Term structure of yield volatility:** the relationship between maturity and yield volatility.
  - In calculation of duration and convexity, the yield curve is assumed to be **parallel shift**;
  - A central bank engaging in expansionary monetary policy might cause the yield curve to steepen by reducing short-term interest rates. But this policy might **cause greater volatility in short-term bond yields-to-maturity than in longer-term bonds,** resulting in a downward-sloping term structure of yield volatility.
- The importance of yield volatility in measuring interest rate risk is that bond price changes are products of two factors:
  - (1) the impact per basis-point change in the yield-to-maturity;
  - (2) the number of basis points in the yield-to-maturity change.

Duration Gap

- Macaulay duration may be interpreted as the investment horizon for which a coupon reinvestment risk and market price risk just offset each other, assuming there's a one-time parallel shift in the yield curve that occurs before the next coupon payment date.
- Relationships among interest rate risk, Macaulay duration, and investment horizon:
  1. if investment horizon > Macaulay duration, then reinvestment risk dominates price risk, investor's risk is to lower interest rates.
  2. if investment horizon = Macaulay duration, then reinvestment risk offsets price risk
  3. if investment horizon < Macaulay duration, then price risk dominates reinvestment risk, investor's risk is to higher interest rates.

Duration Gap

- **Duration gap:**

  Duration gap = Macaulay duration – investment horizon

  - **Positive gap** exposes the investor to market price risk from increasing interest rates
  - **Negative gap** exposes the investor to reinvestment risk from decreasing interest rates

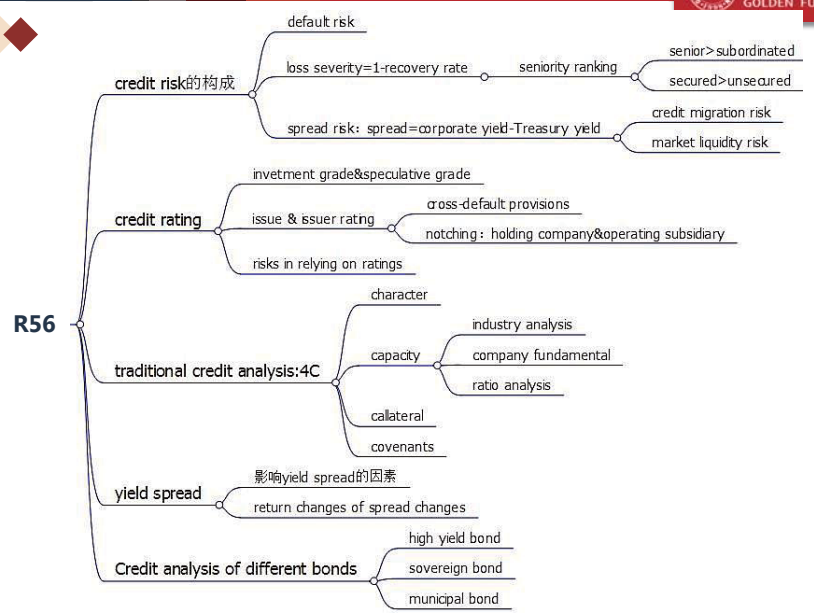
Credit and liquidity Spread

- YTM on a corporate bond includes a government benchmark yield and a spread.
- For an option-free bond, the same duration and convexity measures apply for both a change in benchmark yield and a change in spread. (source of change includes change in inflation, real int. rate, credit risk, liquidity)
- Bond's spread has two components:
  - Premium for credit risk
  - Premium for lack of liquidity
- The impact on a bond's value of a change in spread:

$$\%\Delta bond\ value = -duration\ (\Delta spread) + \frac{1}{2} convexity\ (\Delta spread)^2$$

Reading 56

Fundamentals of Credit Analysis



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Fundamentals of Credit Analysis

- **Credit risk** is the risk of loss resulting from the borrower (issuer of debt) failing to make full and timely payments of interest and/or principal. It has two components.
  - **Default risk**, or default probability, is the probability that a borrower defaults – that is, fails to meet its obligation to make full and timely payments of principal and interest, according to the terms of the debt security;
  - **Loss severity**, or loss given default, in the event of default, is the portion of a bond's value (including unpaid interest) an investor loses.
- **Expected loss = Default probability × Loss severity given default**
  - Loss severity given default = 1 – Recovery rate;
  - **Recovery rate** is the percentage of the principal amount recovered in the event of default.

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Fundamentals of Credit Analysis

- **Spread risk:** Corporate bonds and other "credit-risky" debt instruments typically trade at a yield premium, or spread, to bonds that have been considered "default-risk free".
  - Yield spreads, expressed in basis points, widen based on two primary factors:
    - ✓ A decline in an issuer's creditworthiness, sometimes referred to as credit migration or downgrade risk;
    - ✓ An increase in market liquidity risk.

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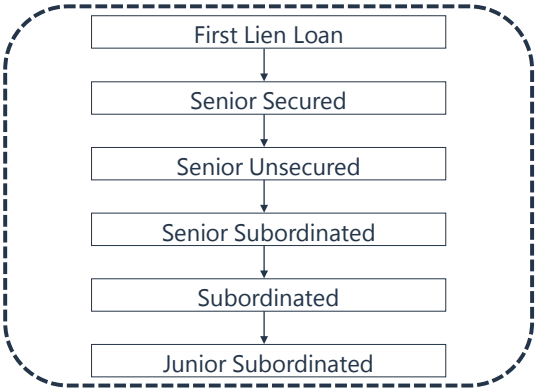
Fundamentals of Credit Analysis

- Spread risk is the bond price risk arising from changes in the yield spread on credit-risky bonds; reflects changes in the market's assessment and/or pricing of credit migration (or downgrade) risk and market liquidity risk.
  - **Credit migration (or downgrade) risk**: this is the risk that a bond issuer's creditworthiness deteriorates, or migrates lower, leading investors to believe the risk of default is higher and thus causing the yield spreads on the issuer's bonds to widen and the price of its bonds to fall.
  - **Market liquidity risk**: this is the risk that the price at which investors can actually transact may differ from the price indicated in the market.
    - ✓ Two main issuer-specific factors that affect market liquidity risk:
      - ◆The size of the issuer;
      - ◆The credit quality of the issuer.

Fundamentals of Credit Analysis

- **Capital Structure:** the composition and distribution across operating units of a company's debt and equity, including bank debt, bonds of all seniority rankings, preferred stock, and common equity.
- **Seniority Ranking**



Fundamentals of Credit Analysis

- **Secured debt:** the debtholder has a direct claim – a pledge from the issuer – on certain assets and their associated cash flows.
  - **First mortgage debt** refers to the pledge of a specific property (e.g., a power plant for a utility or a specific casino for a gaming company).
  - **First lien debt** refers to a pledge of certain assets that could include buildings but might also include property and equipment, licenses, patents, brands, and so on.
- **Unsecured debt** is often referred to as debentures. Unsecured bondholders have only a general claim on an issuer's assets and cash flow.
- **Priority of claims:** in the event of default, unsecured debtholders claim rank below (i.e., get paid after) those of secured creditors.

Fundamentals of Credit Analysis

- **Pari Passu**: All creditors at the same level of the capital structure are treated as one class; thus, a senior unsecured bondholder whose debt is due in 30 years has the same pro rata claim in bankruptcy as one whose debt matures in six months. This provision is referred to as bonds ranking pari passu ("on an equal footing") in right of payment.
- To avoid unnecessary delays, **bankruptcy** negotiation and compromise among various claimholders may result in a reorganization plan that does not strictly conform to the original priority of claims.

Example:

1. Under which circumstance is a subordinated bondholder most likely to recover some value in a bankruptcy without a senior creditor getting paid in full? When:
   A. absolute priority rules are enforced.
   B. the various classes of claimants agree to it
   C. the company is liquidated rather than reorganized
   - **Correct Answer: B**
2. In the event of bankruptcy, claims at the same level of the capital structure are:
   A. on an equal footing, regardless of size, maturity, or time outstanding
   B. paid in the order of maturity from shortest to longest, regardless of size or time outstanding.
   C. paid on a first-in, first-out (FIFO) basis so that the longest-standing claims are satisfied first, regardless of size or maturity
   - **Correct Answer: A**

Fundamentals of Credit Analysis

- For recovery rates, there are a few things worth noting:
  - Recovery rates can vary widely by industry.
  - Recovery rates can also vary depending on when they occur in a credit cycle.
  - These recovery rates are averages.
  - Priority of claims is not always absolute.
    - ✓ The priority of claims in bankruptcy:
      - ◆ secured creditors > unsecured creditors
      - ◆ senior creditors > junior creditors
    - ✓ In practice, however, more junior creditors and even shareholders may receive some consideration without more senior creditors being paid in full.
    - ✓ In the U.S., the bias is toward reorganization and recovery of companies in bankruptcy. In the UK, the bias is toward liquidation of companies in bankruptcy and maximizing value to the banks and other senior creditors.
    - ✓ Bankruptcy and bankruptcy laws are vary complex and can vary greatly by country.

Fundamentals of Credit Analysis

- **Credit ratings**

Moody's	S&P	Fitch	Summary Definition
Investment Grade—High Credit-Worthiness			
Aaa	AAA	AAA	Gilt edge, prime, maximum safety
Aa1 Aa2 Aa3	AA+ AA AA-	AA+ AA AA-	High grade, high-credit quality Upper medium grade Lower medium grade
A1 A2 A3	A+ A A-	A+ A A-	
Baa1 Baa2 Baa3	BBB+ BBB BBB-	BBB+ BBB BBB-	

Fundamentals of Credit Analysis

- **Credit ratings**

Moody's	S&P	Fitch	Summary Definition
Speculative-Lower Credit-Worthiness			
Ba1	BB+	BB+	Low grade speculative
Ba2	BB	BB	
Ba3	BB-	BB-	
B1	B	B+	Highly speculative
B2	B	B	
B3	B	B-	

Fundamentals of Credit Analysis

- **Credit ratings**

Moody's	S&P	Fitch	Summary Definition
Predominantly Speculative, Substantial Risk, or in Default			
Caa	CCC+ CCC	CCC+ CCC	Substantial risk, in poor standing
Ca	CC	CC	May be in default, very speculative
C	C	C	Extremely speculative
	CI		Income bonds-no interest being paid
		DDD	
	D	DD	Default

Fundamentals of Credit Analysis

- **Triple-A (Aaa or AAA):** highest quality, minimal credit risk, extremely low probabilities of default.
- **Double-A (Aa or AA):** high-quality grade, very low default risk.
- **Single-A:** supper-medium grade.
- Bonds rated Baa3/BBB- or higher are called "**investment grade**".
- Bonds rated ba1 or lower by Moody's and BB- or lower by S&P and Fitch have **speculative credit** characteristics and increasingly higher default risk.
- Bonds **rated D** by S&P and Fitch are already in default.
- For Moody's, bonds **rated C** are likely, but not necessarily, in default.

Fundamentals of Credit Analysis

- **Issuer credit rating**: address an obligor's overall creditworthiness – its ability and willingness to make timely payments of interest and principal on its debt.
  - Issuer credit rating usually applies to its senior unsecured debt.
- **Issue ratings** refer to specific financial obligations of an issuer and take into consideration such factors as ranking in the capital structure (e.g., secured or subordinated).
- **Notching** is a ratings adjustment methodology where specific issues from the same borrower may be assigned different credit ratings.
  - As a general rule, the higher the senior unsecured rating, the smaller the notching adjustment will be. For lower-rated credits, the risk of default is greater and thus the potential difference in loss from a lower (or higher) priority ranking is a bigger consideration in assessing an issue's credit riskiness. Thus, the rating agencies will typically apply larger rating adjustments.

Fundamentals of Credit Analysis

- The D rating is reserved for securities that are already in default in S&P's and Fitch's scales. For Moody's, bonds rated C are likely, but not necessarily, in default. **Cross default provisions** are provisions whereby events of default such as non-payment of interest on one bond trigger default on all outstanding debt; implies the same default probability for all issues.
- **Structural subordination**
  - When a corporation with a holding company structure has debt at both its parent holding company and operating subsidiaries, debt at the operating subsidiaries will get serviced by the cash flow and assets of the subsidiaries before funds can be passed ("upstreamed") to the holding company to service debt at that level.

Fundamentals of Credit Analysis

- **Risks in relying on agency ratings:**
  - **Credit ratings can be very dynamic.**
    - ✓ Creditworthiness can and does change – up or down – and that bond investors should not assume an issuer's credit rating will remain the same from time of purchase through the entire holding period.
  - **Rating agencies are not infallible.**
  - **Other types of so-called idiosyncratic or event risk are difficult to capture in ratings.**
  - **Ratings tend to lag market pricing of credit.**
    - ✓ Bond prices and credit spreads frequently move more quickly because of changes in perceived creditworthiness than rating agencies change their ratings (or even outlooks) up or down.
    - ✓ For certain speculative-grade credits, two bonds with similar ratings may trade at very different valuations.

Fundamentals of Credit Analysis

- **The four Cs of credit analysis**
  - ***Capacity*** refers to the ability of the borrower to make its debt payments on time.
  - ***Collateral*** refers to the quality and value of the assets supporting the issuer's indebtedness.
  - ***Covenants*** are the terms and conditions of lending agreements that the issuer must comply with.
  - ***Character*** refers to the quality of management.

Fundamentals of Credit Analysis

(1) Capacity:

- **Industry analysis**
  - Industry structure - Porter's five forces model
    - ✓ **Power of suppliers**: fewer supplier, greater credit risk
    - ✓ **Power of buyers/customers**: fewer buyers, greater credit risk
    - ✓ **Barriers to entry**: higher entry barriers, lower credit risk
    - ✓ **Substitution risk**: fewer substitutions, lower credit risk
    - ✓ **Level of competition**: heavier competition, greater credit risk

Fundamentals of Credit Analysis

(1) Capacity:

- Industry fundamentals
  - ✓ **Industry cyclicality**
    - ◆Industries that are cyclical—that is, have greater sensitivity to broader economic performance- have more volatile revenues, margins, and cash flows and thus are inherently riskier than non-cyclical industries.
  - ✓ **Industry growth prospects**
    - ◆Weaker competitors in slow- growth industries may begin to struggle financially, adversely affecting their creditworthiness.
  - ✓ **Published industry statistics**
    - ◆Published industry statistics can be a source for industry fundamentals and outlook.

Fundamentals of Credit Analysis

(1) Capacity:

➢ **Company fundamentals**

- **Competitive position**
  - ✓ Based on their knowledge of the industry structure and fundamentals, analysts assess a company's competitive position within the industry.
- **Track record/operating history**
  - ✓ It's useful to go back several years and analyze the company's financial performance, perhaps during times of both economic growth and contraction.
- **Management's strategy and execution**
  - ✓ Analysts can learn about management's strategy from reading comments, discussion, and analysis.)
- **Ratios and ratio analysis**

Fundamentals of Credit Analysis

- **Ratios and ratio analysis**
  - ✓ ***Profitability and cash flow measures***
    - ◆**EBITDA:** (= operating income + dep. & amor.)
      - ☐ Drawbacks: This is a somewhat crude measure of cash flow because it excludes certain cash-related expenses of running a business, such as capital expenditures and changes in (non-cash) working capital.
    - ◆**Funds from operations:** (= NI from continuing operations + dep. & amor. + deferred income taxes + other non-cash items)
      - ☐ The funds from operations differs only slightly from the better known cash flow from operations in that it excludes working capital changes.)

Fundamentals of Credit Analysis

✓ ***Profitability and cash flow measures***

◆**Free cash flow before dividends:** (= NI + dep. & amor. – capital expenditure – increase (plus decrease) in non-cash working capital – non-recurring items)

- This measures excess cash flow generated by the company (excluding non-recurring items) before payments to shareholders or that could be used to pay down debt or pay dividends.

◆**Free cash flow after dividend** (= FCF before div. – div.)

- If this number is positive, it represents cash that could be used to pay down debt or build up cash on the balance sheet. Either action may be viewed as deleveraging, which is favorable from a credit risk standpoint.

Fundamentals of Credit Analysis

- Ratios and ratio analysis

✓ ***Leverage ratios***

◆**Debt/capital**

- Capital = total debt + shareholders equity;
- A lower ratio indicates less credit risk;
- Where goodwill or other intangible assets are significant, it is often informative to also compute the debt to capital ratio after assuming a write-down of the after-tax value of such assets.

◆**Debt/EBITDA**

- A higher ratio indicates more leverage and thus higher credit risk;
- this ratio can be very volatile for companies with high cash flow variability, such as those in cyclical industries and with high operating leverage (fixed costs).

◆**FFO/debt**

- A higher ratio indicates greater ability to pay debt by funds from operations.

Fundamentals of Credit Analysis

- Ratios and ratio analysis

✓ ***Coverage ratios***

◆**EBITDA/interest expense**

- A higher ratio indicates higher credit quality;
- This measurement of interest coverage is a bit more liberal than the one that uses EBIT because it does not subtract out the impact of (non-cash) depreciation and amortization expense.

◆**EBIT/interest expense**

- A higher ratio indicates higher credit quality;
- Because EBIT does not include depreciation and amortization, it is considered a more conservative measure of interest coverage.

Fundamentals of Credit Analysis

(1) Capacity:

- **Comments on issuer's liquidity**
  - **Cash on the balance sheet**
    - ✓ Cash holdings provide the greatest assurance of having sufficient liquidity to make promised payments.
  - **Net working capital**
    - ✓ Working capital consumed billions of dollars in cash as accounts payable came due, when the companies most needed liquidity.
  - **Operating cash flow**
    - ✓ Analysts will project this figure out a few years and consider the risk that it may be lower than expected.

Fundamentals of Credit Analysis

(1) Capacity:

- **Comments on issuer's liquidity**
  - **Committed bank lines**
    - ✓ Committed but untapped lines of credit provide contingent liquidity in the event that the company is unable to tap other, potentially cheaper, financing in the public debt markets.
  - **Debt coming due and committed capital expenditures in the next one to two years**
    - ✓ Analysts will compare the sources of liquidity with the amount of debt coming due as well as with committed capital expenditures to ensure that companies can repay their debt and still invest in the business if the capital markets are somehow not available.

Fundamentals of Credit Analysis

(2) Collateral:

- **Intangible assets**
  - Patents are considered high-quality intangible assets because they can be more easily sold to generate cash flows as compared to other intangibles.
  - Goodwill is not considered a high-quality intangible asset and is usually written down when the company performance is poor.
- **Depreciation**
  - High depreciation expense relative to capital expenditures may signal that management is not investing sufficiently in the company.
  - The quality of the company's assets may be poor, which may lead to reduced operating cash flow and potentially high loss severity.
- **Equity market capitalization**
  - A stock that trades below book value may indicate that company assets are of low quality.
- **Human and intellectual capital**
  - These are difficult to value, but a company may have intellectual property that can serve as collateral.

Fundamentals of Credit Analysis

(3) Covenants:

- **Affirmative:** obligated to do
  - Include such duties as making interest and principal payments and filing audited financial statements on a timely basis.
  - Require a company to redeem debt in the event of the company being acquired or to keep the ratio of debt to EBITDA below some prescribed amount.
- **Negative:** limited in doing
  - Include a cap on the amount of cash that can be paid out to shareholders relative to earnings
  - or perhaps a cap on the amount of additional secured debt that can be issued.

Fundamentals of Credit Analysis

(4) *character:*

- **Soundness of strategy**
  - Make judgments about the soundness of management's strategy.)
- **Track record**
  - Management's past performance in executing its strategy and operating the company without bankruptcies, restructurings, or other distress situations that led to additional borrowing.
- **Accounting policies and tax strategies**
  - Using of aggressive accounting policies and/or tax strategies include using a significant amount of off-balance-sheet financing, capitalizing versus immediately expensing items, recognizing revenue prematurely, and/or frequently changing auditors.
- **Fraud and malfeasance record**
  - Any history of fraud or malfeasance—a major warning flag to credit analysts.
- **Prior treatment of bondholders**
  - Management actions that resulted in major credit rating downgrades. These actions might include a debt-financed acquisition, a large special dividend to shareholders, or a major debt-financed stock buyback program.

Fundamentals of Credit Analysis

- **Credit risk VS. return: yields and spreads**
  - The higher the credit risk, the greater the return potential and the higher the volatility of that return.
  - Yield on corporate bond

    = real risk-free interest rate

    + expected inflation rate

    + maturity premium

    + liquidity premium

    + credit spread

      ✓ Yield spread = liquidity premium + credit spread

Fundamentals of Credit Analysis

- **Factors affect the spreads on corporate bonds:**
  - **Credit cycle**
    - ✓ The bond market perceives low aggregate credit risk and is generally bullish. Spreads narrow as the credit cycle improves.
  - **Economic conditions**
    - ✓ A strengthening economy will cause credit spreads to narrow.
  - **Financial market performance**
    - ✓ Including equities, in weak financial markets, credit spreads will widen, whereas in strong markets, credit spreads will narrow.
  - **Broker-dealer capital**
    - ✓ If there is sufficient capital available for making markets, yield spreads will be narrow.
  - **General market demand and supply**
    - ✓ In periods of heavy new issue supply, credit spreads will widen if there is insufficient demand.

Fundamentals of Credit Analysis

- **Credit risk VS. return: yields and spreads**
  - The return impact from spread changes is driven by two main factors:
    - ✓ The modified duration of the bond
    - ✓ The magnitude of the spread change
      - ◆For **small spread changes**, the return impact (percent change in bond price) can be approximated by:
        Return impact ≈ - modified duration × Δ spread
      - ◆For **larger spread changes**, incorporating convexity improves the accuracy of return impact measurement:
        Return impact ≈ - modified duration × Δ spread + 0.5×convexity ×(Δ spread)^2

Fundamentals of Credit Analysis

- **Credit curves:** the plot of yield spreads for a given bond issuer across the yield curve.
  - typically upward sloping, with the exception of high premium-priced bonds and distressed bonds, where credit curves can be inverted because of the fear of default, when all creditors at a given ranking in the capital structure will receive the same recovery rate without regard to debt maturity.

Fundamentals of Credit Analysis

- **High-yield corporate bonds:** rated below Baa3/BBB-
- Reasons for companies rated below investment grade:
  - Highly leveraged capital structure
  - Weak of limited operating history
  - Limited or negative free cash flow
  - Highly cyclical business
  - Poor management
  - Risky financial policies
  - Lack of scale and/or competitive advantages
  - Large off-balance-sheet liabilities
  - Declining industry

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Fundamentals of Credit Analysis

- **Special considerations of high-yield credit analysis:**
  - ***Greater focus on issuer liquidity and cash flow***
    - ✓ Sources of liquidity, from strongest to weakest, are the following:
      - ◆Cash on the balance sheet
      - ◆Working capital
      - ◆Operating cash flow
      - ◆Bank credit facilities
      - ◆Equity issuance
      - ◆Asset sales
  - ***Detailed financial projections***
    - ✓ It's important to forecast, or project, future earnings and cash flow out several years to assess whether the issuer's credit profile is stable, improving, or declining.

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Fundamentals of Credit Analysis

- Special considerations of high-yield credit analysis:
  - **Detailed understanding and analysis of the debt structure**
    - ✓ A high-yield issuer will often have at least some of the following types of obligations in its debt structure:
      - ◆(Secured) bank debt
      - ◆Second lien debt
      - ◆Senior unsecured debt
      - ◆Subordinated debt, which may include convertible bonds
      - ◆Preferred stock

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Fundamentals of Credit Analysis

- Special considerations of high-yield credit analysis:
  - **Understanding of an issuer's corporate structure**
    - ✓ Subsidiaries' dividends are paid out of earnings after they satisfy of all their other obligations.
    - ✓ The parent's reliance on cash flow from its subsidiaries means that parent's debt is structurally subordinated to the subsidiaries' debt and have a lower recovery rating in default.
      - ◆Although the debt of an operating subsidiary may be "closer to" and better secured by particular assets of the subsidiary, the credit quality of a parent company might still be higher. The parent company could, while being less directly secured by any particular assets, still benefit from the diversity and availability of all the cash flows in the consolidated system.
    - ✓ Leverage ratios should be calculated at each of the debt-issuing entities, as well as a consolidated basis

Fundamentals of Credit Analysis

- Special considerations of high-yield credit analysis:
  - **Covenant analysis**
    - ✓ **Change of control put**
      - ◆In the event of an acquisition, bondholders have the right to require the issuer to buy back their debt, often at par or at some small premium to par value;
      - ◆For investment-grade issuers, this covenant typically has a two-pronged test: acquisition of the borrower and a consequent downgrade to a high-yield rating.
    - ✓ **Restricted payments**
      - ◆The restricted payments covenant is meant to protect creditors by limiting how much cash can be paid out to shareholders over time.
    - ✓ **Limitations on liens**
      - ◆Put limits on how much secured debt an issuer can have;
      - ◆This covenant is important to unsecured creditors who are structurally subordinated to secured creditors; the higher the amount of debt that is layered ahead of them, the less they stand to recover in the event of default.
    - ✓ **Restricted versus unrestricted subsidiaries**
      - ◆Restricted subsidiaries should be thought of as those that are designated to help service parent-level debt, typically through guarantees.

Fundamentals of Credit Analysis

- **Sovereign debt** is issued by national governments.
- **Sovereign credit analysis** is based on a combination of qualitative and quantitative factors:
  - A government's ability to pay;
  - Its willingness to pay.
    - ✓ Willingness to pay is important because, due to the principle of sovereign immunity, investors are generally unable to force a sovereign to pay its debts. Sovereign immunity prevents governments from being sued.

Fundamentals of Credit Analysis

- **Non-sovereign Government Debt:** bonds issued by local governments and quasi-government entities.
  - **GO bonds**
    - ✓ backed by the taxing authority of the issuing municipality;
    - ✓ The credit analysis has some similarities to sovereign analysis.
  - **Revenue-backed bonds**
    - ✓ Support specific projects, such as toll roads, bridges, airports, and other infrastructure;
    - ✓ The creditworthiness comes from the revenues generated by usage fees and tolls levied;
    - ✓ Often have higher credit risk than GO bonds;
    - ✓ The financial analysis has some similarities to the analysis of a corporate bond in that it is focused on operating results, cash flow, liquidity, capital structure, and the ability to service and repay the debt;
    - ✓ **Debt service coverage ratio (DSCR):** the ratio of the project's net revenue to the required interest and principal payments on the bonds.
      - ◆ Many revenue bonds include a covenant requiring a minimum DSCR to protect the lenders' interests.

It's not the end but just beginning.

This moment will nap, you will have a dream; But this moment study, you will interpret a dream.

现在睡觉的话会做梦，而现在学习的话会让梦实现。