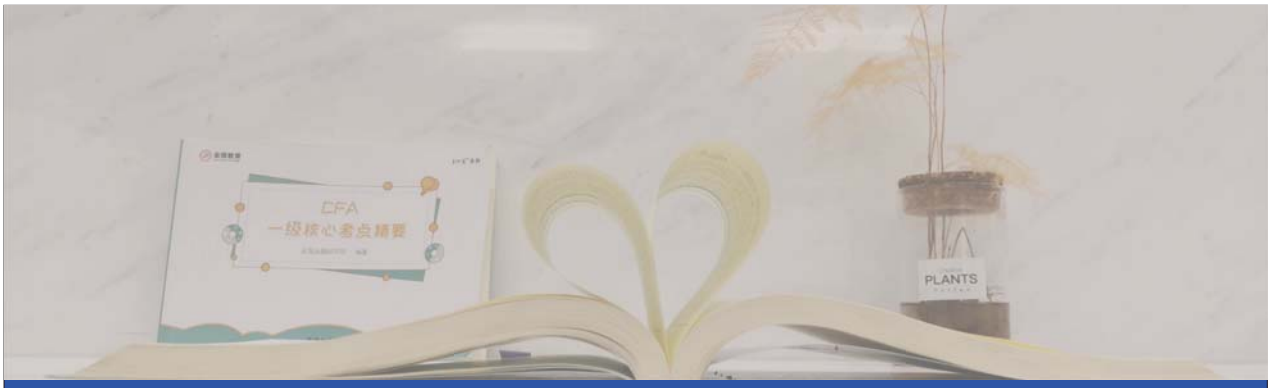


Fixed Income

CFA一级培训项目

讲师：林正

林正

6年授课，4000+授课课时

学位证书

- 金程教育资深培训师
- 英国Essex大学硕士
- CFA持证人
- PMP（Project Management Professional）持证人

服务客户

- 中国银行、中国建设银行、民生银行、平安证券、杭州联合银行、杭州银行、国泰君安证券、苏州元禾控股等。

工作背景

- 曾历任某外资银行支行行长，总行战略项目经理，十二年的外企银行工作资历，积累了丰富的金融实战经验。
- 现为金程教育资深培训师，熟悉CFA考试重点，CFA全级别授课。

Topic Weightings in CFA Level I

Topics	Weights (%)
Quantitative Methods	8-12
Economics	8-12
Financial Statement Analysis	13-17
Corporate Issuers	8-12
Equity	10-12
Fixed Income	10-12
Derivatives	5-8
Alternative Investments	5-8
Portfolio Management	5-8
Ethical and Professional Standards	15-20

Fixed Income

1. Fixed-Income Instrument Features
2. Fixed-Income Cash Flows and Types
3. Fixed-Income Issuance and Trading
4. Fixed-Income Markets for Corporate Issuers
5. Fixed-Income Markets for Government Issuers
6. Fixed-Income Bond Valuation: Prices and Yields

中文精读

1. 固定收益债券概述
2. 固定收益现金流和种类
3. 固定收益发行和交易
4. 公司发行人的固定收益市场
5. 政府发行人的固定收益市场
6. 债券估值：价格和收益率

Framework

Fixed Income

7. Yield and Yield Spread Measures for Fixed-Rate Bonds
8. Yield and Yield Spread Measures for Floating-Rate Instruments
9. The Term Structure of Interest Rates: Spot, Par, and Forward Curves
10. Interest Rate Risk and Return
11. Yield-Based Bond Duration Measures and Properties
12. Yield-Based Bond Convexity and Portfolio Properties
13. Curve-Based and Empirical Fixed-Income Risk Measures

中文精读

7. 固定利率债券的收益率和利差
8. 浮动利率工具的收益率和利差
9. 利率的期限结构：即期、平价和远期利率
10. 利率风险与收益
11. 收益率久期的衡量与性质
12. 收益率凸性和投资组合性质
13. 基于曲线和经验的风险度量

Framework

Fixed Income

14. Credit Risk
15. Credit Analysis for Government Issuers
16. Credit Analysis for Corporate Issuers
17. Fixed-Income Securitization
18. Asset-Backed Security (ABS) Instrument and Market Features
19. Mortgage-Backed Security (MBS) Instrument and Market Features

中文精读

14. 信用风险
15. 信用分析（政府发行人）
16. 信用分析（公司发行人）
17. 资产证券化介绍
18. 资产支持证券（ABS）工具和市场特征
19. 抵押贷款支持证券（MBS）工具和市场特征

Framework

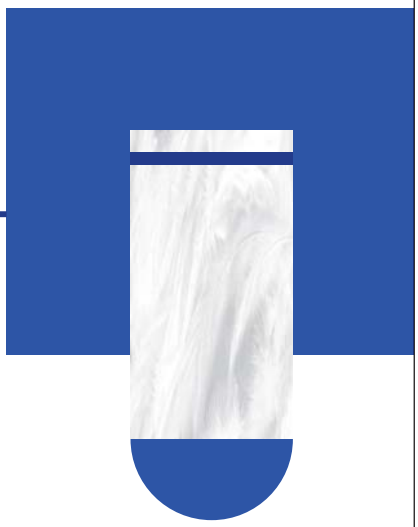
Module

Fixed-Income Instrument Features

1. Features of Fixed-Income Securities
2. Bond Indentures and Covenants

Features of Fixed-Income Securities

- Overview of a Fixed-Income Security

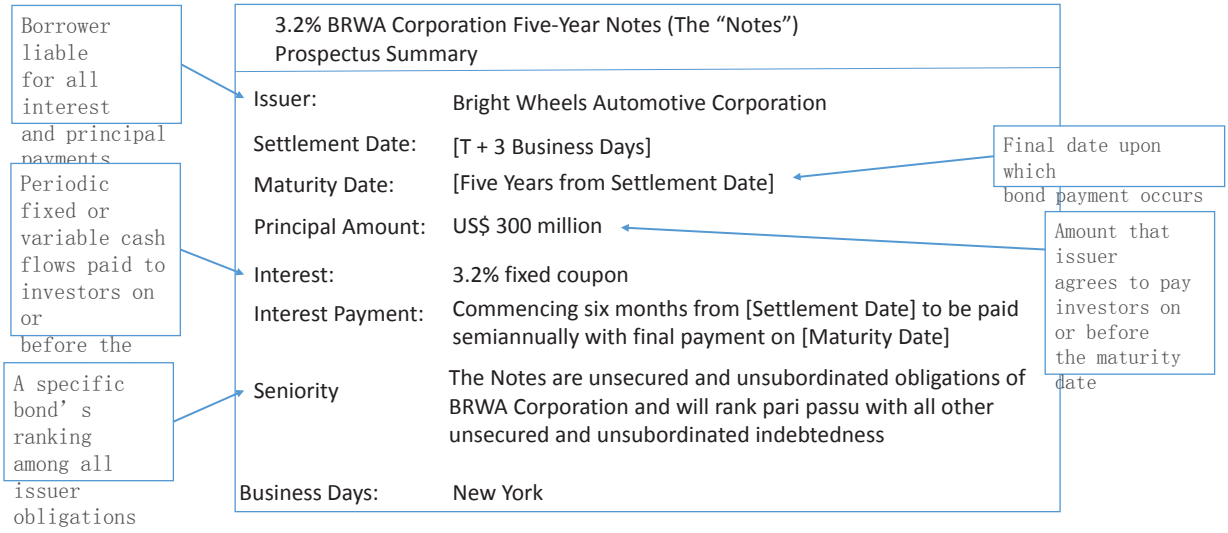


Features of Fixed-Income Securities

- The features of a fixed-income security include specification of:
  1. The **issuer** of the bond
  2. The **maturity** date of the bond
  3. The **par value** (principal value)
  4. **Coupon rate** and frequency
  5. **Currency** denomination
  6. **Seniority**

Features of Fixed-Income Securities

- Example: BRWA Corporation Bond: Brief Summary of Terms



Features of Fixed-Income Securities

- **Issuer**
  - **Supranational organizations**
    - ✓ Issued by organizations that **operate globally** such as the World Bank, the European Investment Bank, and the International Monetary Fund (IMF).
  - **Sovereign (national) governments**
    - ✓ A prime example is U.S. Treasury bonds.
  - **Non-sovereign (local) governments**
    - ✓ Issued by government entities that are not national governments, such as the state of California or the city of Toronto.
  - **Quasi-government entities**
    - ✓ Not a direct obligation of a country's government or central bank. An example is the Federal National Mortgage Association (Fannie Mae).
  - **Companies (i.e., corporate issuers)**
    - ✓ Divided into those issued by financial companies and those issued by nonfinancial companies.
  - **SPE/SPV (special purpose entities/special purpose vehicles)**

Features of Fixed-Income Securities

- **Maturity date:** the date on which the principal is to be repaid.
  - 1996, China issues US dollar bonds with a maturity of 100 years
  - 1997, Lehman Brothers helps Safra Republic Holdings issue bonds with maturity of 1000 years.
- **Tenor:** remaining **time to maturity**.
  - **Money market securities**: securities with **a tenor at issuance** (maturity) of **one year or less**.
  - **Capital market securities**: securities with **tenor longer than one year at issuance**.
  - **Perpetual bonds**: have no stated maturity date. They make periodic interest payment but no promise to repay the principal, such as consols issued by the sovereign government in the United Kingdom.
    - ✓ In late 2020, following a sharp decline in passenger volume during the COVID-19 pandemic, AAHK announced a USD1.5 billion perpetual bond issue to fund construction of a third runway and for general corporate purposes. Asian and European investors demonstrated confidence in the airport's recovery of passenger volume, placing orders totaling more than 10× the offer amount.

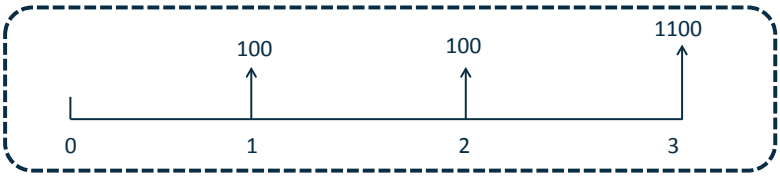
Features of Fixed-Income Securities

- **Par value/face value/ maturity value/principal/redemption value**
  - Mostly are 1000.
- **Coupon rate and frequency**
  - **Plain vanilla bond/conventional bond**: a bond with fixed coupon rate
  - **Zero-coupon bond/pure discount bond**: a bond pays no interest prior to maturity
    - ✓ The difference between the issuance price and par value represents a cumulative interest payment at maturity.
  - **Floating-rate notes**: a bond with variable interest payments
    - ✓ **Market reference rate (MRR)**: a standard borrowing or lending rate for issuers with the highest creditworthiness or lowest default risk for different currencies and maturities.
    - ✓ **Credit spread**: issuer-specific, is set at the time of FRN issuance, is usually **constant** over the bond's life.

Features of Fixed-Income Securities

- **Coupon rate and frequency – fixed rate bond**

10% coupon rate, 3 years matures from today, 1000 face value, annual payments (how about semi-annual payments?)



Example

Features of Fixed-Income Securities

- A European corporation issues a EUR10 million **FRN** that pays **quarterly** interest equal to the three-month MRR plus 125 bps. If three-month MRR is –0.50%, what is the corporation's FRN coupon interest payable on the FRN for the period?

- Correct Answer:
  - The answer is EUR18,750.
  - An FRN coupon comprises MRR plus the issuer-specific spread.
  - FRN coupon = MRR + Spread = –0.50% + 1.25% = 0.75%.
  - Annual interest = Principal × FRN coupon.
  - Annual interest = €10,000,000 × 0.75%.
  - Annual interest = €75,000, or €18,750 on a quarterly basis.

Features of Fixed-Income Securities

- **Seniority**
  - A debt issue's **seniority** or priority of repayment among all issuer obligations is an important determinant of risk.
  - **Senior debt** has priority over other debt claims in the case of bankruptcy or liquidation. **Junior debt**, or **subordinated debt**, claims have a lower priority than senior debt and are paid only once senior claims are satisfied. The BRWA Corporation bonds are senior debt and would be repaid before any BRWA subordinated debt in the event of bankruptcy.
- **Contingency Provisions**
  - A clause in a legal agreement that allows for an action if an event or circumstance occurs.
  - The most common contingency provision for bonds involves **embedded options**—specifically, call, put, and conversion to equity options, and cannot be traded separately from the bond itself.

Features of Fixed-Income Securities

- **Yield Measures**
  - **Current yield**: Equal to the bond's annual coupon divided by the bond's price and expressed as a percentage.
    - ✓ analogous to the dividend yield for an equity security
  - **Yield-to-maturity**: The internal rate of return (IRR) calculated using the bond's price and its expected cash flows to maturity (usually quoted as an **annual rate**).
    - ✓ 1. receives all promised interest and principal payments as scheduled (i.e., no default),
    - ✓ 2. holds the bond until maturity, and
    - ✓ 3. reinvests all periodic cash flows at the YTM.
    - ✓ If any of these assumptions do not hold, the investor's **realized rate of return** on the bond investment will **differ from** the **YTM.**

Features of Fixed-Income Securities

- **Example**

  If the five-year BRWA bond were trading at a price of USD101 per USD100 in face value, 3.2% coupon is paid semiannually. Calculate corresponding YTM.

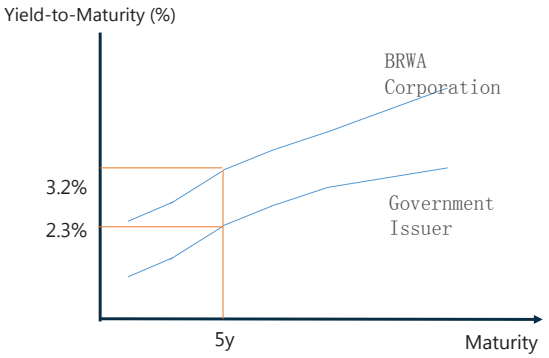
- **Solution**

  $1.6/(1 + r)^1 + 1.6/(1 + r)^2 + \ldots + 101.6/(1 + r)^{10}=101$

  r = 1.49% on a semiannual basis, or 1.49% × 2 = 2.98% annualized.

Features of Fixed-Income Securities

- **Yield Curves**
  - A useful way of evaluating the YTM on one issue is to graph all an issuer's debt instruments with identical features by their YTM and times to maturity. This graphical depiction results in a yield curve. BRWA has six bond issues outstanding, shown in below.
  - A way to measure the credit risk for a bond is to compare an issuer's yield curve to that of comparable sovereign bonds, which have little or no credit risk.



Example

Features of Fixed-Income Securities

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

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

Summary

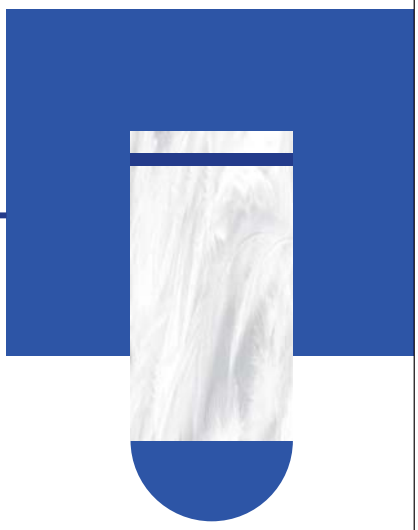
Fixed-Income Instrument Features

Features of Fixed-Income Securities

The issuer of the bond, the maturity date of the bond, the par value , coupon rate and frequency, Yield Measures, Yield Curves

Bond Indentures and Covenants

- Bond indenture
- Affirmative and negative covenants



Bond Indentures and Covenants

- **Bond indenture**
  - **Legal contract** that describes the form of the bond, the **obligations** of the issuer, and the **rights** of the bondholders.
  - 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 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.

Bond Indentures and Covenants

- **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.

Bond Indentures and Covenants

- **Collateral backing: a way to reduce credit risk**
  - **Unsecured bonds (No collateral):**
    - ✓ **Solo source**: a claim to **operating cash flows** of issuer.
    - ✓ Corporate bonds for issuers of higher credit quality are usually unsecured.
  - **Secured bonds:**
    - ✓ **Primary source：** operating cash flow
    - ✓ **Secondary source:** backed by **a claim to a specific assets** of a corporation.
    - ✓ Corporate issuers with less stable operating cash flows usually face more credit provisions and restrictions and may offer investors a legal claim (or lien or pledge) on specific assets.
  - 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.

Bond Indentures and Covenants

- **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 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;
    - ✓ Other affirmative covenant examples include a ***pari passu clause*** and ***cross-default clause***.
    - ✓ 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.

Bond Indentures and Covenants

- **Covenants (cont.)**
  - **Negative covenants**: frequently ***costly*** and ***do materially constrain*** the issuer's potential business decisions.
  - The purpose of negative covenants is to protect bondholders. Examples of negative covenants include the following:
    - ✓ **Restrictions on debt** regulate the issue of additional debt (maximum acceptable debt usage ratios).
    - ✓ **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).

Bond Indentures and Covenants

- **Covenants (cont.)**
  - The purpose of negative covenants is to protect bondholders. Examples of negative covenants include the following:
    - ✓ **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.

Bond Indentures and Covenants

- **Covenants (cont.)**
  - **Incurrence test**
    - ✓ Bondholders are protected by a set of covenants which closely monitor certain financial ratios and restrict its ability to pay dividends to shareholders, repurchase shares, and / or take on additional debt unless tighter financial restrictions are met.
    - ✓ For example
      - Incurrence Test: Test is met if issuer has Interest Coverage Ratio greater than 3.0× for each financial reporting period.

Example

Bond Indentures and Covenants

- A clause in a bond indenture that requires the borrower to perform a certain action is most accurately described as:

  A. an affirmative covenant.

  B. a trust deed.

  C. a negative covenant.

- Correct Answer: A.

Summary

Fixed-Income Instrument Features

Bond Indentures and Covenants

Bond Indenture, Source of repayment proceeds, Covenants

Summary

Module: Fixed-Income Instrument Features

Features of Fixed-Income Securities

Bond Indentures and Covenants

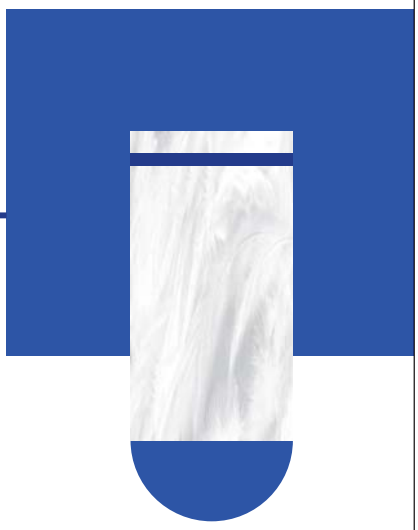
Module

Fixed-Income Cash Flows and Types

1. Fixed-Income Cash Flow Structures
2. Fixed-Income Contingency Provisions
3. Legal, Regulatory, and Tax Considerations

Fixed-Income Cash Flow Structures

- Common cash flow structures



Fixed-Income Cash Flow Structures

- **Cash flow structures**
  - **Plain vanilla bond/bullet bond**: periodic interest payments and principal is paid at maturity.
    - ✓ Balloon payment: the final payment includes a lump sum in addition to the final period's interest.

Example

principal=$1,000, maturity=3 years, coupon rate=10%, discount rate=10%, annual payment.

Correct Answer:

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	100.00	$100.00	$0.00	1000.00
2	100.00	100.00	0.00	1000.00
3	1100.00	100.00	1000.00	0.00

Fixed-Income Cash Flow Structures

- **Cash flow structures**
  - **Amortizing loan:** periodic payments include both interest and some repayment of principal.
    - ✓ Face **lower credit risk**
    - ✓ **Fully amortizing:** principal is fully paid off when the last periodic payment is made.
    - ✓ **Partially amortizing:** the final payment includes just the remaining unamortized principal amount at bond maturity.

Fully Amortized Bond

Year	Investor Cash Flows	Interest Payment	Principal Repayment	Outstanding Principal at the End of the Year
0	–$1,000.00			
1	402.12	$100.00	$302.12	$697.89
2	402.12	69.79	332.33	365.56
3	402.12	36.56	365.56	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	341.69	$100.00	$241.69	$758.31
2	341.69	75.83	265.86	492.45
3	541.69	49.24	492.45	0.00

Fixed-Income Cash Flow Structures

- **Cash flow structures**
  - Calculate the periodic payment (A):

$$A = \frac{r \times Principal}{1-(1+r)^{-N}}$$

Example

The fully amortized BRWA bond is a five-year, 3.2% YTM, 3.2% semiannual coupon bond with a par value of USD300 million. The periodic payment is calculated as follows, in millions:.

Correct Answer:

r = 3.2%/2 = 1.6% on a semiannual basis, Principal = USD300 million, N = 5×2 = 10 semiannual periods.

$$A = \frac{0.016 \times \text{USD}300}{1-(1+1.6\%)^{-10}}, A = \text{USD}32.70.$$

Fixed-Income Cash Flow Structures

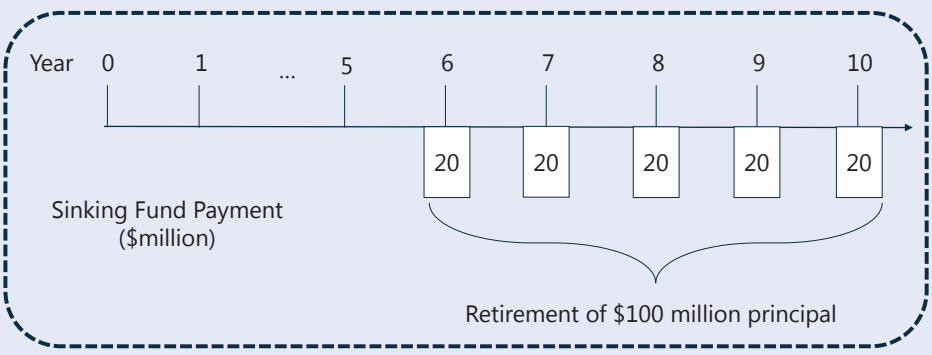
- **Cash flow structures**
  - Two **additional** bond amortization arrangements
  - **Waterfall structures**, which are commonly used in asset-backed securities (ABS) and mortgage-backed securities (MBS).
  - **Sinking fund provisions**: provide for the repayment of principal through a series of payments over the life of the issue.
    - ✓ 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.

Fixed-Income Cash Flow Structures

Example

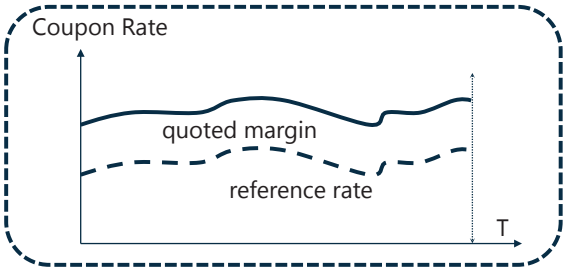
ABC Inc. issue a 10-year bond with a par value of $100 million.

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.



Fixed-Income Cash Flow Structures

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



Coupon rate = reference rate ± quoted margin

- ➢ Such as:
  - MRR
- ➢ It is a constant value.
- ➢ Mainly credit spread.

Fixed-Income Cash Flow Structures

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

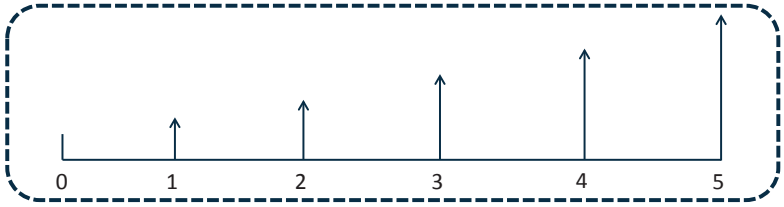
Assume that the coupon rate of a FRN that makes semi-annual interest payments in June and December is expressed as the six-month MRR + 150 bps. Suppose that in December 20X0, the six-month MRR is 3.25%.

Correct Answer:

The interest rate that will apply to the payment due in June 20X1 will be 4.75% (=3.25% + 1.50%).

Fixed-Income Cash Flow Structures

- **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.
  - 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.

Fixed-Income Cash Flow Structures

- **Credit-Linked Notes**
  - Coupon rate will go up (down) by a certain amount if the credit rating of the issuer falls (improves).
- **Leveraged Loan**
  - credit spread that adjusts based on change of credit quality, such as leverage and interest coverage ratios.
  - For example: credit spread based on Total leverage ratio at the end of each quarter
    - ✓ 325 bps p.a. if TLR ≥ 3.5X
    - ✓ 300 bps p.a. if 3.5X > TLR ≥ 2.5X
    - ✓ 275 bps p.a. if TLR < 2.5X

Fixed-Income Cash Flow Structures

- **Pay-in-Kind (PIK) Bonds**
  - Allow the issuer to make the coupon payment by increasing the principal amount of the outstanding bonds, essentially paying bond interest with more bonds.
- **Deferred coupon bonds: interest payments are deferred for a specified number of years.**
  - Financing for a firm financing a large project that will not be completed and generating revenue for some period of time after bond issuance.
  - Zero-coupon bonds: one type of deferred coupon bond.

Fixed-Income Cash Flow Structures

- **Index-Linked Bonds (Linkers)**
  - Has its coupon payments and/or principal repayment linked to a specified index.
  - **Inflation-linked bonds**: are an example of index-linked bonds.
  - **Nominal rate bond:** The fixed interest and principal payments of a standard bond are nominal cash flows whose purchasing power declines with inflation.
  - **Real rate bond:** The interest rate a bondholder receives net of inflation is the real interest rate, which is approximately equal to the nominal interest rate minus the rate of inflation.

Fixed-Income Cash Flow Structures

- **Different structure of inflation-index bonds**
  - **Interest-indexed bonds**: fixed nominal principal amount at maturity, and index-linked coupon rate during the bond's life.
  - **Capital-indexed bonds**: pay a fixed coupon rate, principal amount that increases in line with increases in the index during the bond's life.
    - ✓ **Treasury Inflation-Protected Securities (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.

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

Fixed-Income Cash Flow Structures

- **Example 1**
  - 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).

- **Correct Answer:**
  - Coupon1=$1000 ×(1+1.5%) × (10%÷2)=$50.75
  - Coupon2=$1000 ×(1+1.5%) × (1+2%) ×(10%÷2)=$51.77

Fixed-Income Cash Flow Structures

- **Example 2**
  - An investor purchases TIPS with the following terms:
    - ✓ Principal amount: 5,000
    - ✓ Semiannual coupon: 1.00% p.a.
  - If the CPI rises from 265.00 to 270.3 over the next semiannual interest period, calculate the next coupon payment.

- **Correct Answer:**
  - Inflation adjustment: (270.3 − 265) / 265 = 2%
  - Inflation-adjusted principal = Principal amount × (1 + Inflation adjustment) = USD 5100 (5,000 × 1.02)
  - Annual interest expense = Coupon rate × Inflation-adjusted principal = 1.00% × 5100 = USD 51
  - Semiannual interest paid = USD51/2 = USD 25.5

Example

Fixed-Income Cash Flow Structures

- Assume a hypothetical country, Namoria, where the national government has issued 30-year capital-indexed bonds linked to CPI. Namoria 's economy has been free of inflation until the most recent year, when the CPI increased. Following the increase in inflation:
  A. the coupon rate remains unchanged but the principal amount increases.
  B. the principal amount remains unchanged but the coupon rate increases.
  C. the coupon payment remains unchanged but the principal amount increases.

- Correct Answer：A.

Example

Fixed-Income Cash Flow Structures

- Calculate the periodic payment and the interest and principal components of the first payment for a **fully amortizing bond** based on the following:
  - Loan amount: USD10,000,000
  - Annual interest rate: 2.75%
  - Loan term: 10 semiannual periods (5 years)

- Correct Answer：
  - Using Equation: A = $\frac{r \times Principal}{1-(1+r)^{-N}}$
    - ✓ r = 1.375% (= 2.75%/2)，Principal = USD10,000,000，N = 10
    - ✓ USD1, 077, 174 = $\frac{(0.01375) \times (10,000,000)}{1-(1.01375)^{-10}}$.
  - The initial USD1,077,174 periodic payment comprises the following:
    - ✓ Initial interest payment: USD10,000,000 × 1.375% = USD137,500.
    - ✓ Initial principal repayment: USD1,077,174 − USD137,500 = USD939,674.

Example

Fixed-Income Cash Flow Structures

- Match the term in the left column with its description in the right column.

A. Payment-in-kind	I. Coupon is based on a market reference rate plus a spread.
B. Floating-rate note	II. Interest coupon may be paid by increasing the principal.
C. Step-up coupon	III. Coupon increases by specified margins at specified dates.

- Correct Answer：
  - A. II is correct. A payment-in-kind feature allows an issuer to pay a bond or loan interest coupon by increasing principal.
  - B. I is correct. A floating-rate note coupon is based on a market reference rate plus a spread.
  - C. III is correct. A step-up coupon feature involves a coupon that increases by specified margins at specified dates.

Summary

Fixed-Income Cash Flows and Types

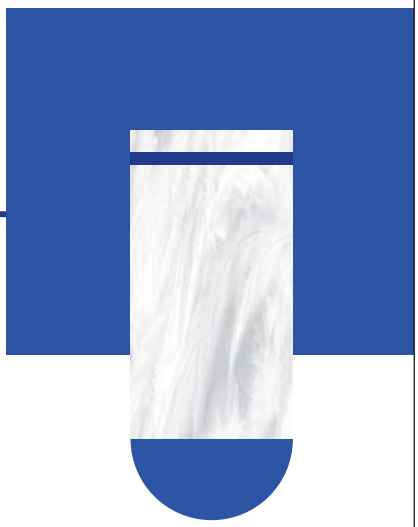
Fixed-Income Cash Flow Structures

Plain vanilla bond/bullet bond, Amortizing loan

Sinking fund provisions, Floating-Rate Notes

Fixed-Income Contingency Provisions

- Callable Bonds
- Putable Bonds
- Convertible Bonds



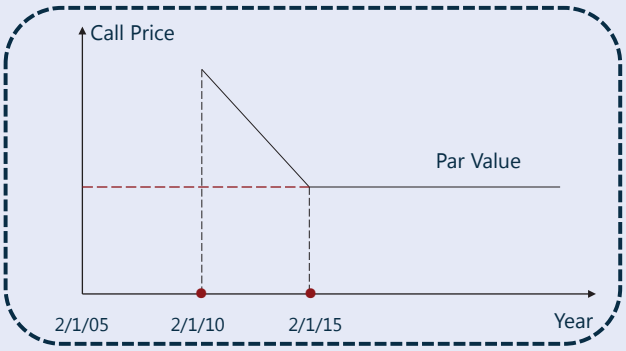
Fixed-Income Contingency Provisions

- **Callable Bonds**
  - **Call provisions** are beneficial to the issuer.
  - Callable bond offers a higher yield (lower price) than identical non-callable bond.
    - ✓ **Value of callable bonds = value of identical pure (non-callable) bonds - call option value**
  - **Call protection period**: 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 in **call period**.

Fixed-Income Contingency Provisions

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).



Fixed-Income Contingency Provisions

- **Callable Bonds**
  - 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 **(reinvestment risk).**
    - ✓ Callable bond offers a higher yield (lower price) than identical non-callable bond
  - Three styles of exercise for callable bonds:
    - ✓ **American style**: can be called anytime after the first call date.
    - ✓ **European style**: can only be called on the call date specified.
    - ✓ **Bermuda style:** can be called on specified dates after the first call date, often on coupon payment dates.

Fixed-Income Contingency Provisions

- **Callable Bonds**
  - **Make-whole call provision**: the call price is not fixed but includes a lump-sum payment based on the present value of the future coupons the bondholder will not receive if the bond is called early, which is unlikely to be lower than the market value of the bond
    - ✓ To avoid the higher interest rates required on a callable bonds but still preserve the option to redeem bond early.
    - ✓ Make-whole provision does not put an upper limit on the bond value when interest rates fall.

Fixed-Income Contingency Provisions

- **Callable Bond Example**
  - **Issuer:** Vivivyu Incorporated
  - **Maturity Date:** [Seven Years from Settlement Date]
  - **Principal Amount:** USD400 million
  - **Interest:** 6.5% fixed coupon
  - **Seniority:** The Notes are secured and unsubordinated obligations of VIVU and rank pari passu with all other secured and unsubordinated debt.
  - **Call Provision:** The Issuer may redeem some or all of the Notes on any Business Day before [Maturity] starting three years after [Settlement] based on the Call Price Schedule as a percentage of the Principal Amount plus accrued interest.
  - **Call Price Schedule:**
    - ✓ 103.25% [Three to Four Years after Settlement]
    - ✓ 102.50% [Four to Five Years after Settlement]
    - ✓ 101.75% [Five to Six Years after Settlement]
    - ✓ 101.00% [Six to Seven Years after Settlement]

Fixed-Income Contingency Provisions

- **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 identical pure(non-putable) 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.

Fixed-Income Contingency Provisions

- **Convertible Bonds**
  - are beneficial to the bondholders, bondholders can accept very low yield-to-maturity.
  - **Key terms of conversion provision**:
    - ✓ **Conversion price**: the price per share at which the bond (at its par value) may be converted to common stock..
    - ✓ **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, also known as conversion parity
      - ☐ Conversion value = market price of stock × conversion ratio

Fixed-Income Contingency Provisions

- **Convertible Bonds Example**
  - **Issuer:** ZTG Biotech
  - **Maturity Date:** Five Years from Settlement Date unless the Notes are redeemed earlier in a Conversion
  - **Principal Amount:** EUR300 million
  - **Interest:** 1.25% fixed coupon to be paid annually
  - **Seniority:** The Notes are an unsecured obligation of and rank pari passu with other unsecured debt
  - **Conversion Provision:** An Investor has, at its sole option, the right to convert a portion or the full sum of the Principal Amount, or any part outstanding at any time at the Conversion Price during the Conversion Period
  - **Current Share Price:** EUR28.00 per ZTGB common equity share
  - **Conversion Price:** EUR42.00 per ZTGB common equity share
  - **Conversion Period:** Any Business Day starting One Year from the Settlement Date through the Maturity Date

Fixed-Income Contingency Provisions

- **Convertible Bonds Example**
  - Conversion ratio = Convertible bond par value/Conversion price = 1000/42 = 23.81
  - Assume that one year from ZTGB's issuance date, the issuer's shares are trading at EUR35.00
  - Conversion value = Conversion ratio × Current share price = 23.81 × 35 = 833.35

Fixed-Income Contingency Provisions

- **Convertible Bonds**
  - 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 above conversion price**
      - Bondholders can exchange the bond for a specific number of shares of issue company.
      - The bond price will more closely track its conversion value.
    - ✓ If share prices **decrease below conversion price**
      - 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

Fixed-Income Contingency Provisions

- **Convertible Bonds**
  - 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, allowing issuers to limit bond investor gains from share price appreciation by redeeming bonds early.
  - 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.

Fixed-Income Contingency Provisions

- **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.

Fixed-Income Contingency Provisions

- **Contingent Convertible Bonds ("CoCos")**
  - Can convert from debt to common equity automatically if a specific event occurs.
  - This type of bond has been issued by some European banks.
  - **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.

Example

Fixed-Income Contingency Provisions

- All else equal, the bond with the greatest benefit to the issuer is a bond with:

  A. no contingency provisions.

  B. a fixed-price call provision.

  C. a make-whole call provision.

- Correct Answer: B.
  - Fixed-price calls grant the issuer the right to buy back the bond at a predetermined price in the future, which is a benefit to the issuer if interest rates fall.

Example

Fixed-Income Contingency Provisions

- Match each description in the right column with the correct bond in the left column.

A. Convertible bond	I. Conversion occurs automatically
B. Contingent convertible (CoCo) bond	II. Conversion occurs at the discretion of the investor
	III. More likely to convert if share price increases
	IV. More likely to convert if share price decreases

- Correct Answer:
  - A. II and III are correct. A standard convertible bond grants the right to redeem a bond for an issuer's equity, occurs at the discretion of the investor, and is more likely if the issuer's share price increases.
  - B. I and IV are correct. Contingent convertible (CoCo) bonds are convertible on the downside and occur automatically if a specified event occurs, such as a decline in bank capital below a regulatory minimum level.

Example

Fixed-Income Contingency Provisions

- An issuer that would like to conserve near-term cash outflows would most likely issue a:

  A. putable bond.

  B. callable bond.

  C. convertible bond.

- Correct Answer: C.
  - All else equal, an issuer would have the lowest interest payments on a convertible bond. Bondholders are often willing to accept a yield-to-maturity that is very low (or even zero) in exchange for conversion rights. Putable bonds offer lower yields than callable bonds because the put option is a benefit to the bondholder while the call option is a benefit to the issuer. However, the yields on callable and putable bonds are high compared to yields on convertibles.

Summary

Fixed-Income Cash Flows and Types

Fixed-Income Contingency Provisions

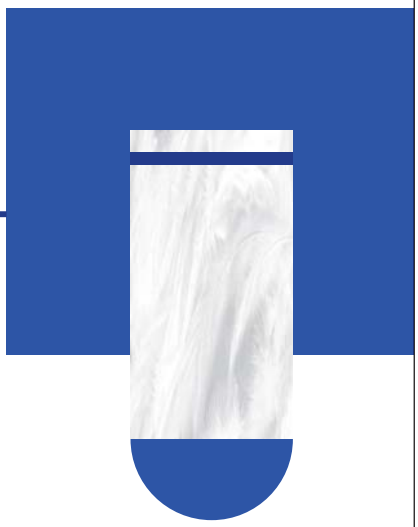
Callable Bonds

Putable Bonds

Convertible Bonds

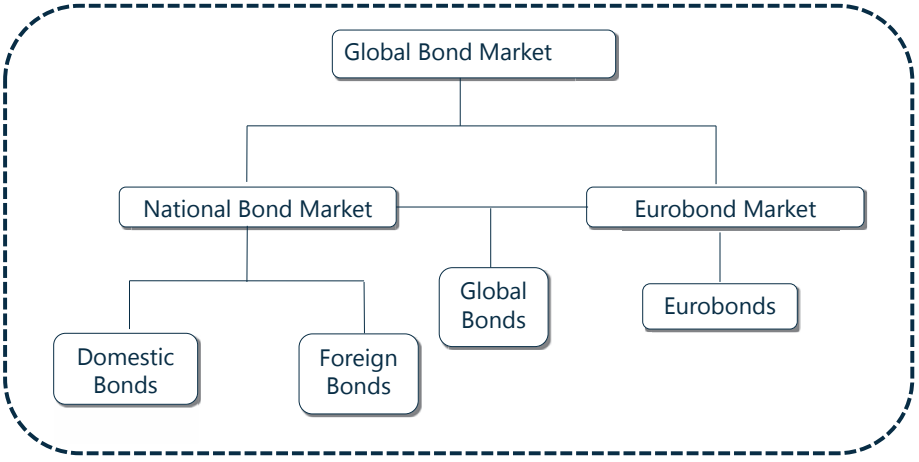
Legal, Regulatory, and Tax Considerations

- Global bond market
- Tax considerations



Legal, Regulatory, and Tax Considerations

- **Sectors of the global bond market**



Legal, Regulatory, and Tax Considerations

- **Domestic bonds:** Bonds issued by a firm domiciled in a country and also traded in that country's currency.
- **Foreign bonds:** Bonds sold in a country and denominated in that country's currency by an entity from another country (foreign country).
  - For example, "Panda bonds" in China, "Yankee bonds" in the United States.
- **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.
  - In the past, Eurobonds typically were **bearer bonds**. Trustee does not keep records of the ownership of the bonds, only the clearing system knew who is the bond holder.
  - Eurobonds, domestic bonds, and foreign bonds are now **registered bonds** for which ownership is recorded by either name or serial number.
- **Global bonds:** Issued simultaneously in the Eurobond market and in at least one domestic bond market.

Legal, Regulatory, and Tax Considerations

- **Tax considerations**
  - Interest income paid to bondholders is taxed as **ordinary income** at the same rate as wage and 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.
    - ✓ Long-term CG: capital gains on the sale of an asset that has been owned for more than the minimum amount of time, which is taxed at an even lower rate.
    - ✓ Short-term CG: is equal to the ordinary income tax rate very often.
    - ✓ However, not all countries implement a capital gains tax.

Legal, Regulatory, and Tax Considerations

- **Tax considerations**
  - **Original issue discount (OID) bonds**: a portion of the discount from par at issuance is treated as taxable interest income each year.
    - ✓ This tax treatment also allows that the tax basis of the OID bond is increased each year by the amount of interest income recognized, so there is no additional capital gains tax liability at maturity.
    - ✓ Pure-discount bonds: a portion of the discount from par at issuance is treated as **taxable interest income**.
    - ✓ Premium bond: allow investors to deduct a prorated portion of the premium value from their taxable income every tax year until maturity.

Legal, Regulatory, and Tax Considerations

- **Example**
  - Assume both a US-based investor and an investor based in a tax jurisdiction without an original discount tax provision purchase an identical zero-coupon US Treasury security based on the following terms:
    - ✓ Principal amount: USD25,000,000
    - ✓ Time to maturity: 5 years
    - ✓ Issuance price: USD92 (per USD100 par value)
  - The original issue discount may be calculated as follows:
    - ✓ Original issue discount = Bond par value − Issuance price.
    - ✓ USD 2mio = USD25mio − (0.92 × USD25mio).
      - US investor will recognize a prorated portion of the USD 2mio as taxable income each year and pay no capital tax on maturity.

Example

Legal, Regulatory and Tax Considerations

- Compared to a discount bond with an original issue discount (OID) tax provision, an otherwise identical bond without this provision would most likely have:

  A. lower taxes due at maturity.
  B. the same taxes due at maturity.
  C. higher taxes due at maturity.

- Correct Answer: C
- Under the OID tax provision, the investor will recognize a prorated portion of the OID as taxable income each year and pay no capital gains tax upon maturity.
- Investors without an OID tax provision will recognize no taxable income until maturity, upon which they will face capital gains tax on the maturity (provided there is capital gains tax in their jurisdiction).

Summary

Fixed-Income Cash Flows and Types

Legal, Regulatory, and Tax Considerations

Global bond market

Tax Considerations

Summary

Module: Fixed-Income Cash Flows and Types

Fixed-Income Cash Flow Structures

Fixed-Income Contingency Provisions

Legal, Regulatory, and Tax Considerations

Module

Fixed-Income Issuance and Trading

1. Fixed-income instruments and markets
2. Primary and Secondary Fixed-Income Markets

Fixed-income instruments and markets

- Classification of Fixed-Income Markets
- Fixed-Income Indices
- Investors in Fixed-income Securities

Fixed-income instruments and markets

- **Fixed-income instruments and markets are typically categorized along three dimensions:**
  - Issuer type (often known as sector)
  - Credit quality
  - Time to maturity
- **By type of issuer:**
  - Government and government-related sector
  - Corporate sector
  - Securitized sector

Fixed-income instruments and markets

- **By credit quality:**
  - Investment grade
    - ✓ Baa3 or above by Moody's
    - ✓ BBB- or above by Standard & Poor's (S&P) and Fitch
  - Non-investment grade/**high yield**
    - ✓ Below investment grade (fallen angel)

Moody's	S&P	Fitch	Summary Definition
Aaa	AAA	AAA	Highest credit quality, lowest level of credit risk
Aa1	AA+	AA+	Very high credit quality with very low level of credit risk
Aa2	AA	AA	
Aa3	AA-	AA-	
A1	A+	A+	High credit quality with low level of credit risk
A2	A	A	
A3	A-	A-	
Baa1	BBB+	BBB+	Good credit quality with moderate level of credit risk
Baa2	BBB	BBB	
Baa3	BBB-	BBB-	
Ba1	BB+	BB+	Speculative with substantial credit risk
Ba2	BB	BB	
Ba3	BB-	BB-	
B1	B+	B+	Highly speculative with high credit risk
B2	B	B	
B3	B-	B-	

Fixed-income instruments and markets

- **Investment-grade corporate issuer**
  - Use commercial paper to meet its short term or seasonal working capital needs
  - Use intermediate-term debt to cover more permanent working capital or medium-term investments
  - Use long-term debt to match the longer useful life of capital investments
- **High-yield corporate issuer**
  - Limited access to unsecured commercial paper market.
  - Relies on **secured** working capital and credit facilities from banks to meet its short-term needs

Fixed-income instruments and markets

- **Fixed-income indexes**
  - describe a given bond market or sector, as well as to evaluate the performance of investments and investment managers.
  - **Differ in three ways from equity index**
    - ✓ 1. A single issuer may issue many individual fixed-income securities. All bonds that meet index eligibility requirements are included in indexes, causing fixed-income indexes to have many more constituent securities than equity indexes have. Some indexes have over 10,000 constituents.
    - ✓ 2. Finite maturity and higher frequency of new issuance lead to far more changes in constituents (turnover) in fixed-income indexes than in equity indexes. Bond indexes are usually rebalanced each month to both add new issues and remove those that fall below a minimum maturity.
    - ✓ 3. Equity indexes weighted by market capitalization, bond index constituents are usually weighted by market value of debt outstanding.

Fixed-income instruments and markets

- **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.
    - ✓ Includes securities from 28 developed and emerging markets. However, the index excludes high-yield and unrated debt instruments and those that do not meet minimum issuance size.
  - **J.P Morgan Emerging Market Bond Index**: used to describe the emerging market.
  - **Bloomberg Barclays MSCI Euro Corporate Sustainable SRI Index**: bond indexes that regularly screen for and exclude issuers that fail to meet certain minimum ESG criteria.
    - ✓ Must have an MSCI ESG rating of BBB or higher
    - ✓ Excludes issuers involved in certain business lines such as alcohol, tobacco and gambling, etc

Fixed-income instruments and markets

- **Major categories of bond 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.
    - ✓ **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.

Example

Fixed-income instruments and markets

- The Bloomberg Barclays Global Aggregate Index includes:

  A. all issuer sizes.

  B. issuers in multiple currencies.

  C. high-yield and unrated issuers.

- Correct Answer: B.
  - The Bloomberg Barclays Global Aggregate Index includes fixed-coupon capital market securities from all major issuer types in 28 developed and emerging markets that meet the inclusion criteria. However, the index excludes high-yield and unrated debt instruments and those that do not meet minimum issuance size.

Example

Fixed-income instruments and markets

- Match the characteristics on the right with the indexes on the left.

A. Broad equity index	I. Includes sovereign issuers
B. Broad bond index	II. Less frequent rebalancing
	III. Easier to fully replicate
	IV. Larger number of constituents

- Correct Answer:
  - A. II and III
  - B. I and IV

Summary

Fixed-Income Issuance and Trading

Fixed-income instruments and markets

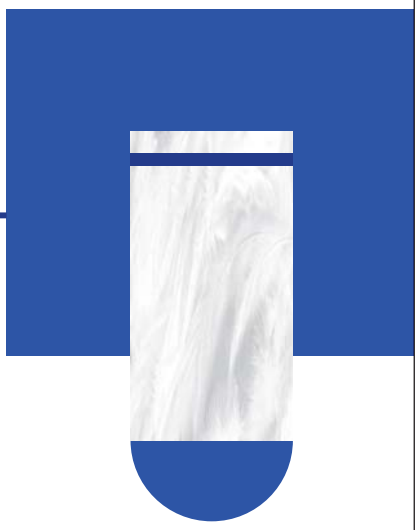
Classification of Fixed-Income Markets

Fixed-Income Indices

Investors in Fixed-income Securities

Primary and Secondary Fixed-Income Markets

- Primary Market
- Secondary Markets



Primary and Secondary Fixed-Income Markets

- **Primary market: sales of newly issued bonds**
  - **Public offering**: bonds can be registered with securities regulators for sale to the public and is typically done with the help of an investment bank.
    - ✓ **Underwritten offering**: with the investment bank or syndicate purchasing the entire issue and selling the bonds to dealers.
    - ✓ **Best efforts offering**: investment bank sells the bonds on a commission basis and do not commit to purchase the whole issue.
    - ✓ **Auction**: commonly used by issuing government debts.
    - ✓ **Shelf registration**: a bond issue is registered with securities regulators in its aggregate value with a master prospectus and can be issued over time when issuer needs to raise funds
  - **Private placement**: sale of an entire issue to a qualified investor or a group of investors, which are typically large institutions.

Primary and Secondary Fixed-Income Markets

- **Primary market: sales of newly issued bonds**
  - **New issuer (debut issuers):** takes several weeks prior to issuance to familiarize potential investors with the new entity and its uses of and sources for repayment for the new bond.
  - **Repeat issuer:** process is far more abbreviated
  - **Issue price**: more usually issue a new bond priced at par.
    - ✓ **Reopening** of an existing bond: increase the size of an existing bond with a price significantly different from par.

Primary and Secondary Fixed-Income 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.
    - ✓ **Bid-offer spread** are narrower (wider) for liquid (less liquid) issues
  - **Electronic Trading Network** (growth)
- **Distressed debt: Bonds of issuers believed to be very close to or in bankruptcy**
  - Typically trades in the secondary market at a price well below par, because bondholders are unlikely to receive all promised future interest and principal payments.
  - Distressed debt is traded until either the issuer has liquidated its assets or restructure its outstanding bonds.
    - ✓ In contrast, an equity security may be delisted if it fails to meet the listing requirements, such as minimum share prices. By the time an issuer's debt has become distressed, its equity securities will likely have already been delisted.

Example
Primary and Secondary Fixed-Income Markets

- Relative to unsecured issuers, secured issuers most likely experience an issuance timeline that is:

A. shorter.
B. the same.
C. longer.

- Correct Answer: C.
  - Secured bond issuance among corporate high-yield, some special purpose entities, and other issuers (e.g., VIVU) is usually a longer and more involved process than for unsecured investment-grade bonds. Investors must familiarize themselves with unique and more complex covenants, as well as the use of both operating cash flows and collateral as sources of bond repayment.

Example
Primary and Secondary Fixed-Income Markets

- For a firm in distress, its bonds will most likely stop trading:

A. before the firm's equity.
B. at the same time as the firm's equity.
C. after the firm's equity.

- Correct Answer: C.
  - Distressed debt is traded until either the corporate issuer has liquidated its assets or its outstanding bonds have been restructured. In contrast, an equity security may be removed or delisted from secondary trading on an exchange if it fails to meet the listing requirements of the exchange, which often include minimum share prices, net worth, and free float. By the time an issuer's debt has become distressed, its equity securities will likely have already been delisted.

Summary

Fixed-Income Issuance and Trading

Primary and Secondary Fixed-Income Markets

Primary Market

Secondary Markets

Summary

Module: Fixed-Income Issuance and Trading

Fixed-income instruments and markets

Primary and Secondary Fixed-Income Markets

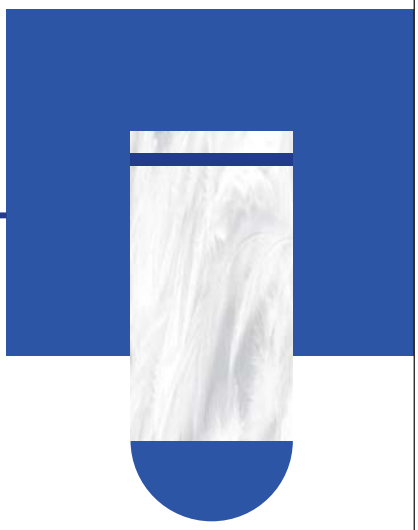
Module

Fixed-Income Markets for Corporate Issuers

1. Short-Term Funding Alternatives
2. Repurchase Agreements
3. Long-Term Corporate Debt

Short-Term Funding Alternatives

- External Loan Financing
- External, Security-Based Financing
- Short-Term Funding Alternatives for Financial Institutions



Short-Term Funding Alternatives

- **External Loan Financing**
  - **Non-financial corporations** often rely on financial intermediaries for short-term financing.
  - Common instruments include:
    - ✓ Uncommitted bank lines of credit,
    - ✓ Committed bank lines of credit, and
    - ✓ Revolving credit agreements, or revolvers.

Short-Term Funding Alternatives

- **External Loan Financing**
  - **1. Uncommitted bank lines of credit**
    - ✓ The least reliable form of bank borrowing for a company.
    - ✓ A bank offers a certain principal amount ("credit line") for a pre-determined maximum maturity, charging a base or market reference rate (MRR) plus an issuer-specific spread.
    - ✓ The most flexible and least costly means of external funding.
    - ✓ Require minimal capital reserves until they are drawn down and used, but banks reserve the right to refuse to honor any request for use of the line.
    - ✓ Do not require the company to pay any compensation other than interest on balances outstanding to the bank.

Short-Term Funding Alternatives

- **External Loan Financing**
  - **2. Committed bank lines of credit**
    - ✓ A more reliable source of financing than uncommitted lines because they involve a **formal written commitment**.
    - ✓ Require more bank capital than uncommitted lines, although commitments of less than a year (usually 364 days) minimize a bank's capital requirement.
    - ✓ Regular lines are unsecured and pre-payable without penalty.
    - ✓ Unlike uncommitted lines, regular lines usually involve upfront costs in the form of a commitment fee (such as 0.50%).
    - ✓ Can form a syndicate to reduce capital needed.

Short-Term Funding Alternatives

- **External Loan Financing**
  - **3. Revolving credit agreements (revolvers)**
    - ✓ The most reliable source of short-term bank funding.
    - ✓ Multiyear credit commitments and lenders typically seek protections.
    - ✓ have similar features to regular lines and may also include optional medium-term loan features.
  - **Secured Loans and Factoring**
    - ✓ **Secured loans** (asset-based loans): Loans in which the lender requires the company to provide collateral in the form of an asset.
      - Companies that **lack sufficient credit quality** to qualify for unsecured loans might arrange for secured loans.
    - ✓ **Factor**: Firms sell accounts receivable to a lender, typically at a substantial discount.

Short-Term Funding Alternatives

- **Commercial paper:** short term, unsecured, low rate (issued by corporations of high credit quality) debt.
  - It is a source of funding for working capital and seasonal demands for cash. It is also a source of **bridge financing**-that is, interim financing that provides funds until permanent financing can be arranged.
  - 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 sufficient liquidity to repay maturing commercial paper if rolled over is not available.

Short-Term Funding Alternatives

- **Commercial paper:**
  - Commercial paper issued in the international market is known as **Eurocommercial paper (ECP)**. Although similar to **United States commercial paper (USCP)**, typical ECP transaction sizes are much smaller and less liquid than the USCP market.
  - **Asset-backed commercial paper (ABCP)**: loans or receivables are sold to a special purpose entity (SPE) that issues debt and makes interest and principal payments from asset cash flows.
    - ✓ First, a bank agrees to transfer short-term loans to an SPE in exchange for cash.
      - The originator(bank) save capital cost by selling loan for cash.
    - ✓ Second, the SPE issues ABCP to investors with a backup credit liquidity line provided by the bank.

Short-Term Funding Alternatives

- **Financial institutions short-term funding**
  - **Deposits**
    - ✓ **Checking accounts**: have immediate access to the funds in their deposit accounts and use the funds as a form of payment for transactions;
    - ✓ **Operational deposits:** generated by clearing, custody, and cash management activities are also a relatively stable source of funding;
    - ✓ **Saving deposits**: Usually held for non-transactional purposes and often have a stated term.
      - **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.

Short-Term Funding Alternatives

- **Financial institutions short-term funding**
  - **Interbank Market**
    - ✓ Involves short-term borrowing and lending among financial institutions on a secured or unsecured basis.
    - ✓ **Interbank funds:** are unsecured loaned between banks for periods of one day to a year.
    - ✓ **Central bank funds market**: allowing banks with a surplus of funds to lend to others.
      - The interest rate at which central bank funds are bought (i.e., borrowed) and sold (i.e., lent) is known as the central bank funds rate.

Example

Short-Term Funding Alternatives

- Pennington Corporation is a large pharmaceutical company with an investment-grade credit rating and uses Cavalier Bank for some of its financing needs. Pennington maintains stable cash deposits at Cavalier Bank and is seeking a short-term financing option with no upfront commitment fee. Which of the following financing options would be most appropriate for Pennington?

  A. Secured loan
  B. Committed bank line of credit
  C. Uncommitted bank line of credit.

- Correct Answer: C.
  - Banks offer uncommitted lines of credit on an unsecured basis to clients who maintain stable cash deposits at the bank, allowing the banks to closely monitor and react to adverse borrower developments, such as declining account balances. Uncommitted lines of credit also have no upfront commitment fee and are obtained by stronger companies, such as Pennington. A is incorrect because secured loans are obtained by companies that lack sufficient credit quality to qualify for unsecured loans.

Summary

Fixed-Income Markets for Corporate Issuers

Short-Term Funding Alternatives

External Loan Financing, External, Security-Based Financing

Short-Term Funding Alternatives for Financial Institutions

Repurchase Agreements

- Repurchase agreements

Repurchase Agreements

- **Repurchase (repo) Agreement:** an institution sells a security with a commitment to buy it back at a later date at a specified price.
  - **Repurchase price**: is greater than the selling price and accounts for the interest charged by 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 Agreements

- **Repurchase (repo) Agreement:** an institution sells a security with a commitment to buy it back at a later date at a specified price.
  - **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 uniqueness: collateral security is in high demand or low supply.

Repurchase Agreements

- **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) Agreements**
  - 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.

Repurchase Agreements

- **Initial margin:** the provision of collateral in excess of the cash exchanged.
  - Initial Margin $= \frac{\text{Security Price}_0}{\text{Purchase Price}_0}$
  - Haircut$= \frac{\text{Security Price}_0 - \text{Purchase Price}_0}{\text{Security Price}_0}$
  - Variation margin=(Initial margin × Purchase Price$_t$) − Security Price$_t$
    - ✓ Security price decline required a cash borrower to provide additional collateral to the seller.
    - ✓ Security price increase leads to overcollateralized, resulting in releasing a of notes with value of variation margin.

Repurchase Agreements

- **Example:** Assume that today (t = 0) the current US 5-year Treasury note trades at par USD100,000,000. The security buyer takes delivery of the US Treasury note today and pays the security seller USD80,000,000. If we assume a repo term of 180 days (360 days/year) and an annual interest rate (or repo rate) of 2%,
  - **Calculate** purchase price, repurchase price, initial margin and associated haircut.
  - **Calculate** the variation margin five days after trade inception if the price of the five-year US Treasury note rises to 103% of the security's USD100 million face value.
  - According to calculation result, **specify** next action step.

Repurchase Agreements

- **Solution**
  - Purchase price = 80mio
  - Repurchase price= USD80mio × [1 + (2% × 180/360)] = USD808mio.
  - Initial Margin = Security price$_0$/purchase price$_0$=100mio / 80mio =1.25
  - Haircut=(Security price$_0$-purchase price$_0$)/security price$_0$=(100mio-80mio)/100mio = 20%
  - Variation margin = (Initial margin × Purchase price$_t$) − Security price$_t$ =(1.25 ×80.022) -103=-2.9725mio
    - ✓ Purchase price= Purchase price0×[1+（2%×5/360）] = 80mio ×1.000278 = 80.022mio
    - ✓ Overcollateralization of the loan by USD2.9725mio, allowing the cash borrower (security seller) to request the release of five-year US Treasury notes with a face value of USD2.886 million (USD2.9725mio/1.03).

Repurchase Agreements

- **Repurchase Agreement Applications and Benefits**
  - From a security buyer's perspective, a repo offers a **short-term** cash investment on a collateralized basis with minimal liquidity or default risk.
  - Central banks are also active participants in the repo market to conduct monetary policy.
  - Security buyer enters a repo not only to lend cash for interest but also to use the security for another use. For instance, a **hedge fund** may take a short position in a security, with a view that its price will decline.
    - ✓ **Reverse repo agreement**: cash lending counterparty.
- **Risks Associated with Repurchase Agreements**
  - Default risk: primarily exposure
  - **Bilateral repos**: Repos executed directly between two parties.
  - **Triparty repo**: use a third-party agent for the transaction.
    - ✓ providing access to a larger collateral pool and multiple counterparties
    - ✓ specializing in the valuation and safekeeping of assets

Example

Repurchase Agreements

- Assume that today (t = 0) the current US five-year Treasury note trades at a price equal to the bond's face value of USD100,000,000. The security buyer takes delivery of the US Treasury note today and pays the security seller a purchase price based on an initial margin of 103%. The repo haircut is closest to:

  A. 0.00%.

  B. 2.91%.

  C. 3.00%.

- Correct Answer: B.
  - Using an initial margin of 103%, the purchase price (loan amount) is calculated as USD100,000,000/1.03 = USD97,087,379.
  - The repo haircut is then calculated as:
  - (USD100,000,000 − USD97,087,379)/USD100,000,000 = 2.91%.

Summary

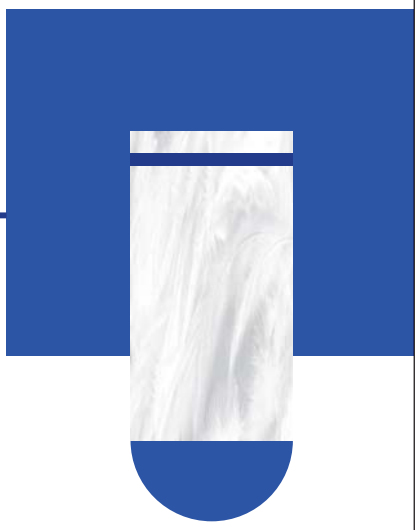
Fixed-Income Markets for Corporate Issuers

Repurchase Agreements

repurchase agreements

Long-Term Corporate Debt

- Long-term funding of investment-grade versus high-yield corporate issuers



Long-Term Corporate Debt

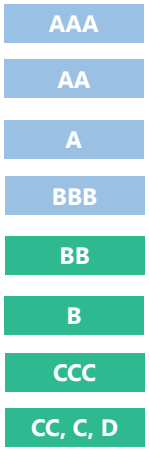
- **Similarities between** Long-Term Investment-Grade and High-Yield Issuance
  - Under normal market conditions, longer maturities are associated with both higher interest rates (yields-to-maturity on government bonds) and higher credit spreads for a given issuer.
  - Trade-offs for both investors and issuers exists.
    - ✓ **Investor:** may be attracted to the higher YTM of the longer bond. By investing in a bond whose maturity exceeds its planned investment horizon, the investor takes on the price risk of selling what will be a two-year bond in five years' time.
    - ✓ **Issuer:** may be attracted to the lower YTM of a potential three-year issuance to fund a five-year project. However, in doing so, issuer assumes rollover risk.

Long-Term Corporate Debt

- **Differences between** IG and HY Issuance
  - IG
    - ✓ lower risk premium, significant proportion of the YTM is attributed to the government benchmark yield.
    - ✓ relatively standardized debt instruments, few or no restrictive covenants
    - ✓ **high degree of flexibility in choosing debt maturities**
  - High-yield issuers are characterized by a higher expected likelihood of financial distress
    - ✓ higher proportion of a bond's YTM attributed to an issuer-specific spread.
    - ✓ Given the higher chance of default, these instruments are more equity-like in nature (i.e., uncertain cash flows)
    - ✓ Analysts place a greater emphasis on the potential loss given default and the protections and secondary repayment sources that are available.
    - ✓ As a result, investors generally impose more constraints on high-yield issuers.
      - Issuers in the high-yield market often seek to **retain financial flexibility** by borrowing under **leveraged loans with prepayment features** or **issuing bonds with contingency features**.
      - **Except: fallen Angels, outstanding debt has IG bond feature**

Long-Term Corporate Debt

- **Differences between** IG and HY Issuance



Bond Features

Lower YTM proportion due to credit spreads

Fewer issuer restrictions

Unlikely to default

Bond-like cash flows

Equity-like cash flows

Higher YTM proportion due to credit spreads

Issuer restrictions and/or bonds secured by assets

More likely to default

Analytical Approach

Use **financial ratios and credit ratings** to determine if/when IG issuer's likelihood of default will change

Consider **likelihood of default and potential loss given default** given covenants, restrictions and/or security

Summary

Fixed-Income Markets for Corporate Issuers

Long-Term Corporate Debt

Similarities between Long-Term Investment-Grade and High-Yield Issuance

Differences between IG and HY Issuance

Summary

Module: Fixed-Income Markets for Corporate Issuers

Short-Term Funding Alternatives

Repurchase Agreements

Long-Term Corporate Debt

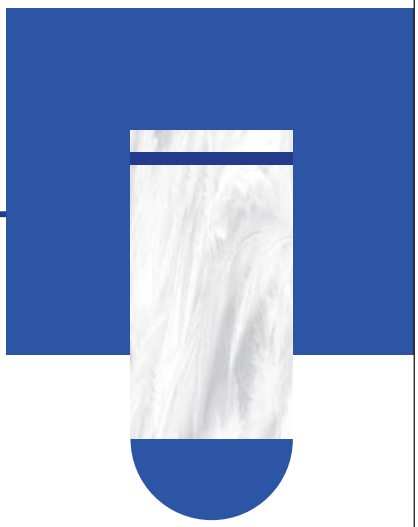
Module

Fixed-Income Markets for Government Issuers

1. Sovereign Debt
2. Non-Sovereign, Quasi-Government, and Supranational Agency Debt

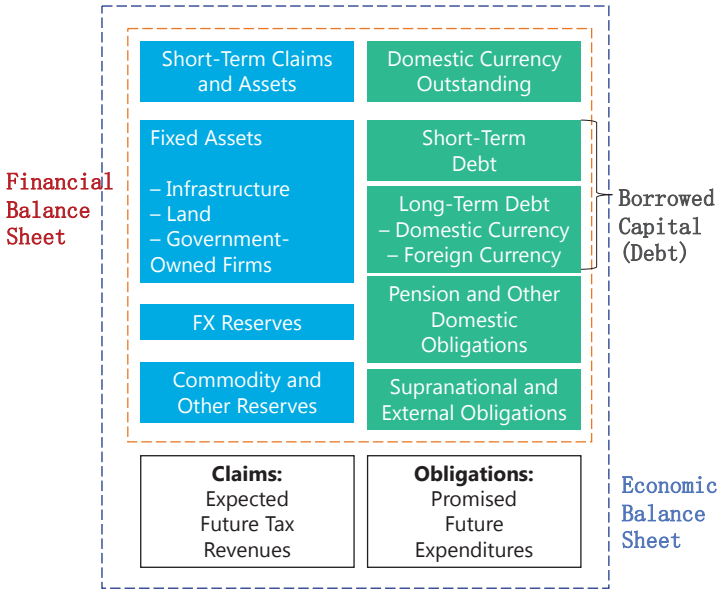
Sovereign Debt

- Sovereign Debt



Sovereign Debt

- **Government "Balance Sheet".**
  - Public sector financial accounting standards vary widely and are often prepared **using cash, rather than accrual-based, principles**, typically excluding such items as the depreciation of fixed public goods, such as federal highways, or the accrual of unfunded liabilities, such as government pension obligations.

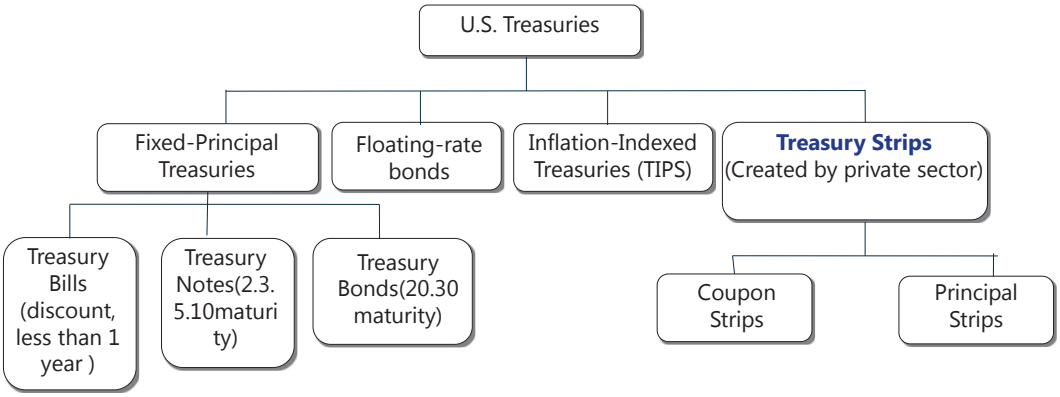


Sovereign Debt

- **Key distinction: difference between developed market and emerging market sovereign issuers.**
  - Developed market (DM) sovereign issuers
    - ✓ DMs are characterized by a strong, stable, well-diversified domestic economy.
    - ✓ Broad-based individual and business tax cash flows, resulting in stable and transparent fiscal policy.
    - ✓ DM fixed-income securities are denominated in a major currency commonly held in reserve by foreign governments.
  - Emerging market (EM) sovereign issuers
    - ✓ Higher growth but less stable and less well-diversified economies subject to greater fluctuations over the economic cycle.
    - ✓ EM sovereign debt securities are often denominated in a **restricted domestic currency**, or one with limited convertibility into other currencies due to illiquidity.

Sovereign Debt

- **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



Sovereign Debt

- **Treasury Strips:** zero coupon securities of various maturities.
  - **Coupon Strips**: created from coupon payments stripped from the original security.
  - **Principal Strips:** bond (maturities of 20-30 years) and note (maturities of 2.3.5 and 10 years) principal payment with the coupons stripped off.
- **On-the-Run Issues**
  - Most Recently Auctioned
  - More Actively Traded
  - More Liquid
  - Market prices of on-the-run issues provide better information about current market yields.
- **Off-the-Run Issues:** replaced by a more recently auctioned issue.

Sovereign Debt

- **The benefits of issuing sufficient longer-term sovereign government securities:**
  - Establishment of a risk-free benchmark for all debt of specific maturities.
  - Preferred use as collateral in repo and derivative transactions.
  - Use in managing and hedging market interest rate risk.
  - Government bond use in monetary policy and foreign exchange reserves.

Sovereign Debt

- Once a government debt **auction** is announced, prospective investors submit **competitive or non-competitive bids.**
  - A non-competitive bidder agrees to accept the price determined at auction and always receives securities.
  - A competitive bidder specifies an acceptable price and number of securities to be purchased.
    - ✓ A competitive bid process: either a **single**-price auction or **multiple-price** auction. Single-price auction results in **lower cost of funds** and **broad distribution among investors**.
- A **single-price auction process** has four phases:
  - The auction is announced by the government debt management office.
  - Dealers, institutional investors, and individuals make bids.
  - All non-competitive bids are accepted while competitive bids are **ranked starting at the lowest yield (highest bond price)**. Competitive bidders who bid higher than this yield **(stop yield)** do not purchase any securities.
  - Securities are delivered to the non-competitive and winning competitive bidders in exchange for proceeds.

Summary

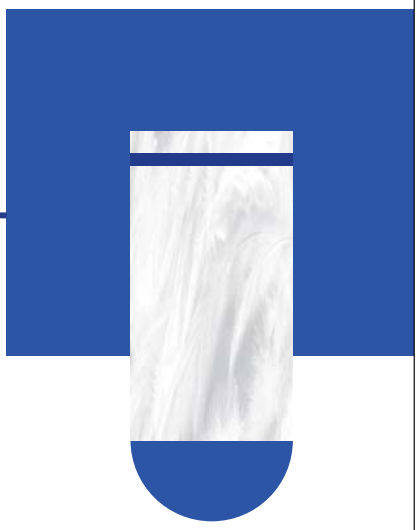
Fixed-Income Markets for Government Issuers

Sovereign Debt

Sovereign debt, Sovereign debt issuance and trading

Non-Sovereign, Quasi-Government, and Supranational Agency Debt

- Non-Sovereign Bonds
- Quasi-Government Bonds
- Supranational Bonds

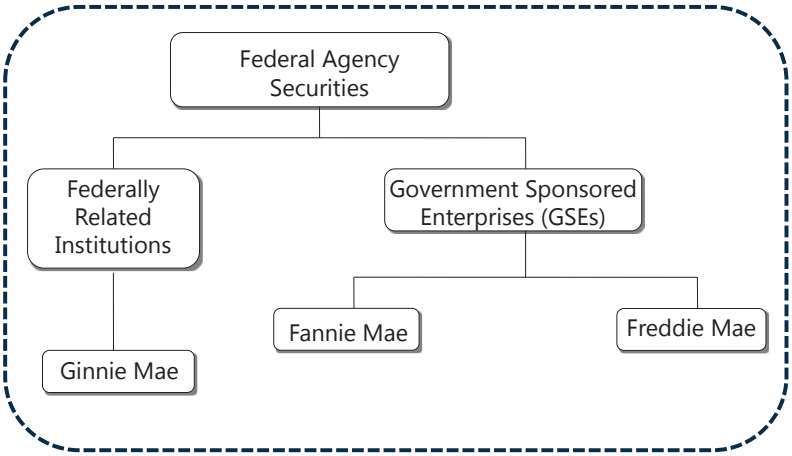


Non-Sovereign, Quasi-Government, and Supranational Agency Debt

- **Non-sovereign 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.
      - Longer maturity funding.
      - Involve more risk, provide higher yield.

Non-Sovereign, Quasi-Government, and Supranational Agency Debt

- **Agency/quasi-government bonds:** issued by entities created by national government and may be **explicitly or implicitly** backed by government.
  - Quasi-government bonds are guaranteed by the national government receive the highest ratings and trade at a lower yield and higher price.



Non-Sovereign, Quasi-Government, and Supranational Agency Debt

- **Supranational bonds:** issued by supranational agencies (multilateral agencies) that operate across national.
  - High credit quality and can be very liquid, especially large issues of well-known entities.
  - E.g. World bank, the IMF, the Asian Development Bank.

Summary

Fixed-Income Markets for Government Issuers

Non-Sovereign, Quasi-Government, and Supranational Agency Debt

Non-Sovereign Bonds

Quasi-Government Bonds

Supranational Bonds

Summary

Module: Fixed-Income Markets for Government Issuers

Sovereign Debt

Non-Sovereign, Quasi-Government, and Supranational Agency Debt

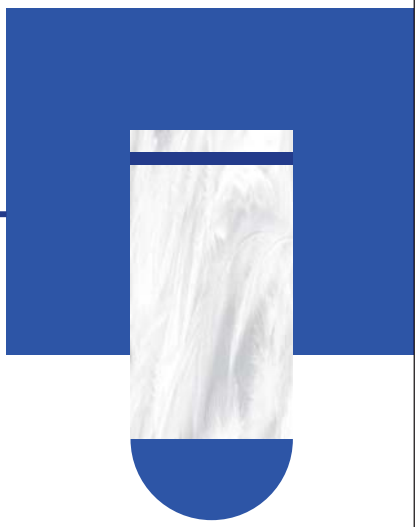
Module

Fixed-Income Bond Valuation: Prices and Yields

1. Bond Pricing
2. Relationships between Bond Prices and Bond Features

Bond Pricing

- Yield to Maturity (YTM)
- Flat price, Accrued interest, and Full price
- Matrix Pricing



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

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

Example

Bond Pricing

- 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.

Yield to Maturity (YTM)

- **YTM/yield to redemption/redemption yield**
  - Internal rate of return, market discount rate or required yield when pricing
- **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**

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

Yield to Maturity (YTM)

- **Valuation of a zero-coupon bond**

$$\text{Bond value} = \frac{\text{Par value}}{(1+\frac{\text{YTM}}{2})^{2\text{N}}}$$

Example

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

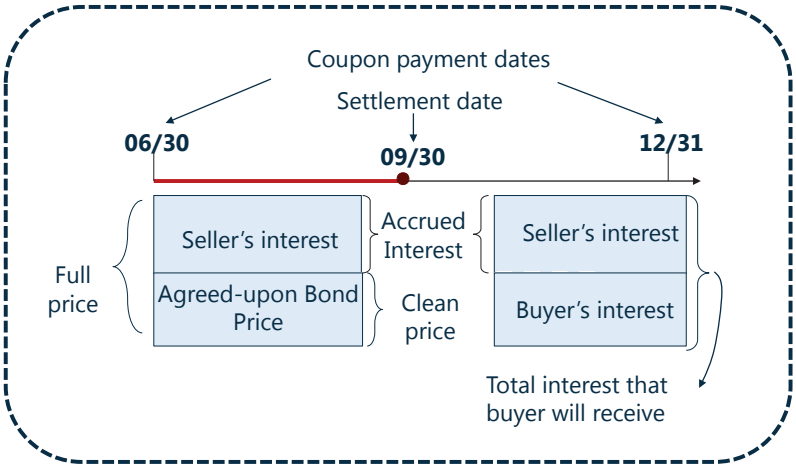
Correct Answer:

N=8×2=16; FV=1000; I/Y=8/2=4; PMT=0; CPT→PV=533.9038

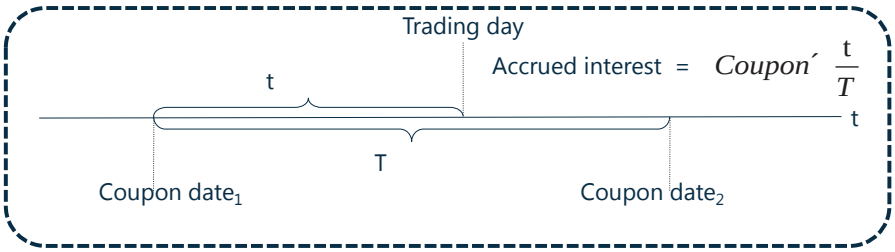
Flat price, Accrued interest, and Full price

- **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, also called **quoted price**.
- **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**

Flat price, Accrued interest, and Full price



Flat price, Accrued interest, and Full price



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 × 10%/2) × (1-58/183)=50 × (1-0.3169)=34.155

Flat price, Accrued interest, and Full price

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

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

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%.

Flat price, Accrued interest, and Full price

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.

$$PV = \frac{3}{(1.0300)^{1}} + \frac{3}{(1.0300)^{2}} + \ldots + \frac{103}{(1.0300)^{23}} = 100$$

$$PV^{Full} = 100 \times (1.0300)^{89/180} = 101.472251$$

- The full price on 18 June is EUR101.472251.
  - ✓ AI =89/180×3=1.4833333
  - ✓ $\mathrm{PV}^{\mathrm{flat}} = 101.472251 - 1.483333 = 99.9889$
- The accrued interest is EUR1.483333, and the flat price is EUR99.988918.

Matrix Pricing

- **Matrix pricing**
  - Some fixed-rated bonds are **not actively traded** bonds, based on more frequently traded comparable bonds.
    - ✓ These comparable bonds have similar times-to-maturity, coupon rates, and credit quality.
  - Matrix pricing is also used in **underwriting new bonds** to get an estimate of the required yield spread over the benchmark rate.
  - The benchmark rate typically is the yield-to-maturity on a government bond having the same, or close to the same, time-to-maturity.
  - The spread is the difference between the yield-to-maturity on the new bond and the benchmark rate, this spread is sometimes called the **spread over the benchmark.**

Matrix Pricing

- **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, find two bonds with similar credit quality

- 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) × (5.17-3.68)]=4.18%

Example

Bond Pricing

- A three-year sovereign bond issued on 1 January 2030 pays semiannual coupons of 1.5% per year on 30 June and 31 December each year and has a face value of 100. The market discount rate is 2.0%. For a trade settlement date of 29 August 2031, the flat price of the bond as a percentage of par value, assuming an actual/actual day count, is closest to:

A. 99.343.
B. 99.587.
C. 99.832.

- Correct Answer: A.
  - flat price = full price - accrued interest.
  - The full price is the present value as of the trade settlement date, which involves **partial** payment periods because we're **between coupon dates**.

Example

Bond Pricing

- **Method 1**
  - N=3, PMT=0.75, I/Y=1, FV=100
  - Solve: $PV_{2031.6.30}$=99.2648, then $PV_{2031.8.29}= 99.2648 \times (1 + 1\%)^{60/184} = 99.5873$
    - ✓ 60 days from 30 June 2031 to 29 August 2031), 184 days from 30 June 2031 to next coupon on 31 December 2031
  - Accrued interest is the proportional share of the next coupon payment owed the seller.
  - $AI = \frac{t}{T} \times PMT,\ AI = \frac{60}{184} \times 0.75,$ AI = 0.2446.
  - The flat price is 99.5873 – 0.2446 = 99.3427
- Recall that corporate bond yields typically use the 30/360 day count convention. Sometimes, these yields are restated using an **actual/actual** day count, known as a **government equivalent yield**.

Example

Bond Pricing

- **Method 2**
  - $PV^{full} = \frac{\text{PMT}}{(1+\text{r})^{1-\text{t/T}}} + \frac{\text{PMT}}{(1+\text{r})^{2-\text{t/T}}} + \ldots + \frac{\text{PMT}}{(1+\text{r})^{\text{N}-\text{t/T}}}$
  - PMT = 0.75, r = 0.01, t = 60 (days from 30 June 2031 to 29 August 2031), T = 184 (days from 30 June 2031 to next coupon on 31 December 2031), FV = 100, N = 3
  - $PV^{full} = \frac{0.75}{(1+0.01)^{1-60/184}} + \frac{0.75}{(1+0.01)^{2-60/184}} + \frac{100.75}{(1+0.01)^{3-60/184}}$, $PV^{full} = 99.587$.
  - Accrued interest is the proportional share of the next coupon payment owed the seller.
  - $AI = \frac{t}{T} \times PMT$, $AI = \frac{60}{184} \times 0.75$, AI = 0.245.
  - The flat price is 99.587 – 0.245 = 99.343.

Summary

Fixed-Income Bond Valuation: Prices and Yields

Bond Pricing

Yield to Maturity (YTM)

Flat price, Accrued interest, and Full price

Matrix Pricing

Relationships between Bond Prices and Bond Features

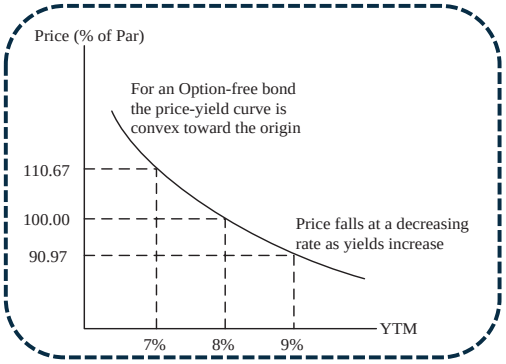
- The relationships among a bond's price, coupon rate, maturity, and yield-to-maturity

Relationships between Bond Prices and Bond Features

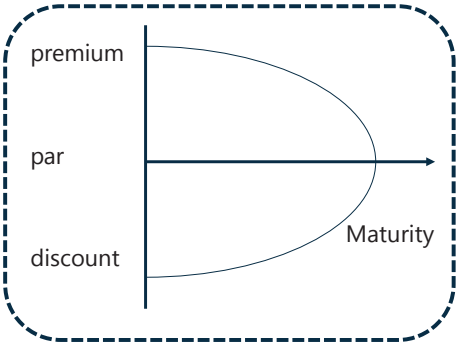
- **Inverse effect:** The bond price is inversely related to the market discount rate. When the market discount rate increases, the bond price decreases.
- **Coupon effect:** For two bonds with different coupons but are otherwise identical, a **lower-**coupon bond has a **greater** percentage price change than a higher-coupon bond when their market discount rates change by the same amount.
- **Maturity effect:** For two bonds with different time-to-maturity but are otherwise identical, 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.

Relationships between Bond Prices and Bond Features

- **Convexity effect**
  - 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 Bond Prices and Bond Features



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

Time of Maturity	YTM=2%	YTM=4%	YTM=6%
3.0 years	1,057.95	1,000.00	945.83
2.5	1,048.53	1,000.00	954.20
2	1,039.02	1,000.00	962.83
1.5	1,029.41	1,000.00	971.71
1.0	1,019.70	1,000.00	980.87
0.5	1,009.90	1,000.00	990.29
0	1,000.00	1,000.00	1,000.00

Summary

Fixed-Income Bond Valuation: Prices and Yields

Relationships between Bond Prices and Bond Features

Inverse Relationship, Coupon Effect

Maturity Effect , Constant-Yield Price Trajectory

Summary

Module: Fixed-Income Bond Valuation: Prices and Yields

Bond Pricing

Relationships between Bond Prices and Bond Features

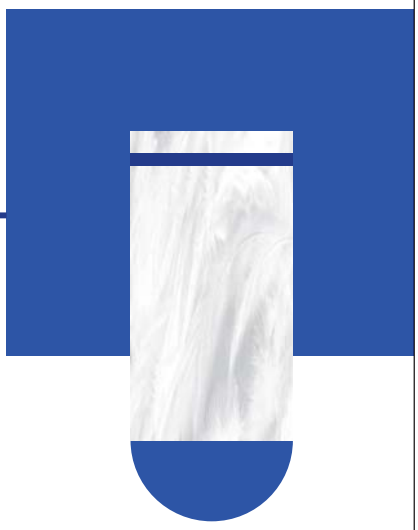
Module

Yield and Yield Spread Measures for Fixed-Rate Bonds

1. Yield Measures for Fixed-Rate Bonds
2. Yield spread

Yield Measures for Fixed-Rate Bonds

- Yield Measures for Fixed-Rate Bonds



Yield Measures for Fixed-Rate Bonds

- **Effective annual rate**: has a periodicity of one because there is just one compounding period in the year.

$$\text{effective annual rate}=(1+\frac{\text{YTM}}{\text{m}})^{\text{m}}-1$$

  - 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)

$$(1+\frac{\text{APR}_{\text{m}}}{\text{m}})^{\text{m}}=(1+\frac{\text{APR}_{\text{n}}}{\text{n}})^{\text{n}}$$

  - **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.
      - E.g., if a bond yield is 2% per semiannual period, its annual yield is 4% when stated on a semiannual bond basis.

Yield Measures for Fixed-Rate Bonds

Example

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:

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

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

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

Yield Measures for Fixed-Rate Bonds

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

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

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

- **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.

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.
    - ✓ This assumption simplifies bond price and yield calculations and commonly is used in practice.
- **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

- **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.
  - Provide the **most conservative** assumption for the rate of return to investor.
- **Other yield measure for embedded option bond**
  - **Option-adjusted price**: the investor bears the call risk (the bond issuer has the option to call), so the embedded call option **reduces** the value of the bond from the investor's perspective. The investor pays a **lower price** for the callable bond than if it were option-free.
    - ✓ The option-adjusted price is used to calculate the **option-adjusted yield**.

Example

Yield Measures for Fixed-Rate Bonds

- 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%	15.82%
B.	7.80%	15.72%
C.	7.78%	15.72%

- Correct Answer: A.

Example

Yield Measures for Fixed-Rate Bonds

- A 20-year government of Canada strip (zero-coupon) bond is priced at 69.4300 per 100. An analyst wants to **compare** the yield of the strip bond with that of a newly issued 20-year coupon bond. The 20-year coupon bond pays semiannual coupons of 2%, and its current price is 101.99 per 100, which corresponds to a semiannual bond equivalent yield of 1.880%.

- Approach 1:
  - Assume that compounding happens semiannually and calculate the semiannual effective rate, then annualize.
  - $69.43 = \frac{100}{(1+r)^{40}}$, $r = 0.009163 = 0.916\,\%$.
  - To annualize this, we multiply it by 2 and obtain the result: 1.833%.

Example

Yield Measures for Fixed-Rate Bonds

- Approach 2.
  - The 20-year strip bond does not pay any coupons, so as the first step, we assume annual compounding (periodicity of 1) to calculate an effective annual rate based on the current price and remaining years to maturity.
  - $69.43 = \frac{100}{(1+r)^{20}}$, $r = 0.01840997 = 1.841\,\%$.
  - The next step is to convert the effective annual rate to semiannual bond equivalent yield.
  - $\left(1+\frac{APR_m}{m}\right)^m = \left(1+\frac{APR_n}{n}\right)^n$, $\left(1+\frac{0.01841}{1}\right)^1 = \left(1+\frac{APR_2}{2}\right)^2$, $APR_2 = 0.01832604 = 1.833\,\%$

Example

Yield Measures for Fixed-Rate Bonds

- A bond has a yield-to-maturity of –0.50% using annual compounding. If the yield is converted to monthly compounding, it will most likely be:

  A. greater than –0.50%.

  B. equal to –0.50%.

  C. less than –0.50%.

- Correct Answer: C.
  - A general rule for periodicity conversions is compounding more frequently within the year corresponds to a lower (or more negative) yield-to-maturity.

Example

Yield Measures for Fixed-Rate Bonds

- An analyst observes the following reported statistics for two bonds.

	Antelas AG Bond	BRWA Bond
Annual Coupon Rate	3.20%	2.50%
Coupon Payment Frequency	Quarterly	Semiannually
Years to Maturity	5 Years	5 Years
Price (per 100 of par value)	94	98.70
Current Yield	3.40%	2.53%
Yield-to-Maturity	4.548%	2.780%

- The analyst believes that the BRWA bond has less risk than the Antelas AG bond. How much additional compensation, in terms of basis points of yield-to-maturity, does a buyer of the Antelas AG bond receive for bearing this risk compared with the BRWA bond?

Example

Yield Measures for Fixed-Rate Bonds

- Solution:
  - The yields-to-maturity on the two bonds have different periodicity assumptions. Therefore, the difference in the yields is not 177 bps (0.04548 – 0.02780). It is **essential to compare the yields for the same periodicity to make a statement about relative value**. The Antelas AG bond yield-to-maturity of 4.548% for a periodicity of 4 converts to 4.574% for a periodicity of 2:
  - $\left(1+\frac{APR_{\mathrm{m}}}{\mathrm{m}}\right)^{\mathrm{m}}=\left(1+\frac{APR_{\mathrm{n}}}{\mathrm{n}}\right)^{\mathrm{n}}$,
  - $\left(1+\frac{0.04548}{4}\right)^{4}=\left(1+\frac{APR_{2}}{2}\right)^{2}$,
  - $\mathrm{APR}_2 = 0.04574 = 4.574\ \%$
  - The additional yield that the buyer of the BRWA bond receives to compensate for its higher risk, compared to the Antelas AG bond, is (0.04574 – 0.02780) =179 bps.

Summary

Yield and Yield Spread Measures for Fixed-Rate Bonds

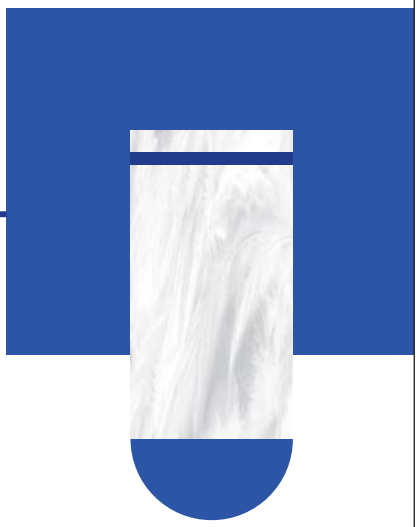
Yield Measures for Fixed-Rate Bonds

Periodicity and Annualized Yields

Yield Measures for Fixed-Rate Bonds

Yield spread

- G-spread
- I-spread
- Z-spread
- Option-adjusted spread



Yield spread

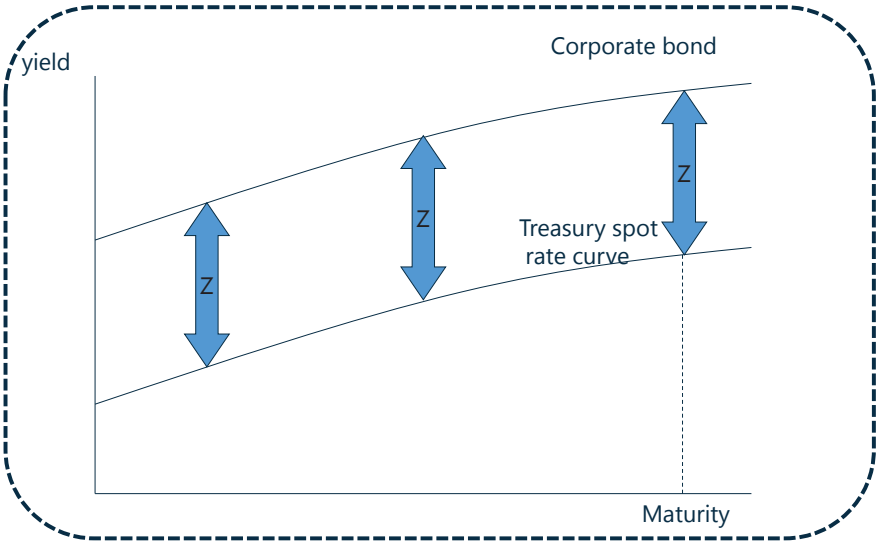
- **Yield spreads**
  - **Benchmark spread**: the yield spread over a specific benchmark
    - ✓ difference between the yield-to-maturity and the benchmark yield
  - **G-spread**: the benchmark is actual or interpolated government bond yield
    - ✓ Bearing risk relative to the sovereign bond
  - **Interpolated spread (I-spread)**: the benchmark is swap rate
  - **Zero-volatility spread (Z-spread)**: constant and zero volatility
    - ✓ Z-spread is what must be added to each benchmark spot rate to make the present value of a bond's cash flows equal its price
  - **Option-adjusted spread (OAS):** Z spread adjusted for embedded options.
    - ✓ Callable bond: OAS = Z spread – Option value in basis points
      - OAS_{call} < Z spread
    - ✓ Putable bond: OAS > Z spread

Yield Spread - Example

Data source: Bloomberg FIRV Page for the 3.75% Apple Bond

- **Benchmark spread/G-spread/I-spread**
  - The yield spread over a particular Treasury benchmark was 72 bps.
  - The G-spread over an interpolated government bond yield was 76 bps. The spread over the benchmark and the G-spread sometimes differ by a few basis points, especially if the benchmark maturity differs from that of the underlying bond.
  - The bond's I-spread was 106 bps. An I-spread larger than the G-spread indicates that Treasury yields were slightly higher than swap rates at that time.

Yield spread



Example

Yield spread

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

- Both bonds pay annual interest. The current 3-year EUR interest rate swap benchmark is 2.42%. The G-spread on the U.K. corporate bond is closest to:
  - A. 264 bps.
  - B. 285 bps.
  - C. 300 bps .
- Answer: B

Example

Yield spread

- Assume that the Russian Federation has issued a 30-year US dollar–denominated sovereign bond based on the following terms:

5.25% Russian Federation Bonds	
Brief Summary of Terms	
Issuer:	Russian Federation
Settlement Date:	[T + 5 Business Days]
Maturity Date:	[30 Years from Settlement Date]
Principal Amount:	USD 750 million
Interest:	5.25% fixed semiannual 30/360 basis
Issuance Price:	99.625
Issuance Spread:	200 bp versus current US 30y Treasury
Issuance and Trading:	US Private Placement under Rule 144A DTC / Euroclear / Clearstream
Seniority:	Senior Unsecured
Exchanges:	Luxembourg

Example

Yield spread

- Six years after the original issuance date, on 15 March 2026, the bond is trading at a price of 123.5 per 100 face value, and an analyst observes that 20-year and 30-year US Treasury yields are currently 2.00% and 2.25%, respectively. **Calculate** the current **G-spread** of the Russian Federation bond.

- Step 1 Calculate the current yield-to-maturity of the Russian Federation bond.
  - $PV = \frac{\text{PMT}}{(1+\text{r})^1} + \frac{\text{PMT}}{(1+\text{r})^2} + \ldots + \frac{\text{PMT+FN}}{(1+\text{r})^{\text{N}}}$
  - r= 3.756%.

Example

Yield spread

- Step 2 Linearly interpolate the current 20-year (r_{20y}) and 30-year (r_{30y}) US Treasury yields to solve for an approximate 24-year (r_{24y}) US Treasury benchmark:
  - 1. Solve for the weights of the 20-year and the 30-year bonds in the interpolation calculation:
    - ✓ 20-year bond weight = w_{20} = 60% [= (30 – 24)/(30 – 20)].
    - ✓ 30-year bond weight = w_{30} = 40%, or (1 – w_{20}).
    - ✓ Note that (w_{20} × 20) + (w_{30} × 30) = 24.
  - 2. The 24-year government rate is a weighted average of the 20-year bond rate and the 30-year US Treasury rate using the weights above.
    - ✓ $\text{r}_{24y} = w_{20} \times \text{r}_{20y} + w_{30} \times \text{r}_{30y} = 2.1\%$
  - G-spread = 3.756%-2.1%=1.66%

Example

Yield spread

- A fixed-income analyst has compiled the following statistics for three corporate bonds issued by companies domiciled in three different countries.

Bond	Yield-to-Maturity	Applicable Swap Rate
A	13.379%	12.419%
B	8.121%	6.527%
C	5.406%	4.184%

- Which bond most likely has the greatest credit risk?
  - A. Bond A
  - B. Bond B
  - C. Bond C
- Correct Answer: B.
  - To estimate which bond most likely has the greatest credit risk, we calculate the I-spread.
  - Bond A: 96bps, Bond B: 159bps, Bond C: 122 bps

Summary

Yield and Yield Spread Measures for Fixed-Rate Bonds

Yield spread

G-spread, I-spread

Z-spread, Option-adjusted spread

Summary

Module: Yield and Yield Spread Measures for Fixed-Rate Bonds

Yield Measures for Fixed-Rate Bonds

Yield spread

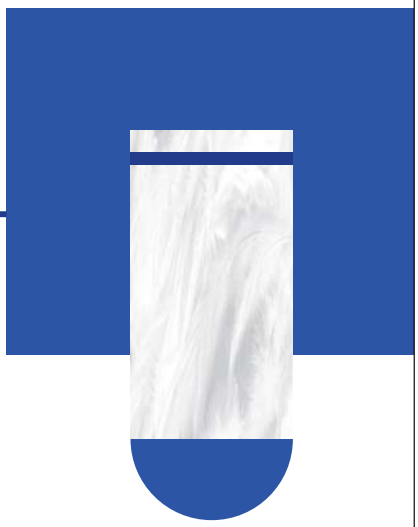
Module

Yield and Yield Spread Measures for Floating-Rate Instruments

1. Yield measures for floating-rate notes
2. Yield Measures for Money Market Instruments

Yield measures for floating-rate notes

- Yield and yield spread measures for floating-rate instruments



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.
- **FRN pricing model**

$$\text{PV} = \frac{\frac{(MRR + QM) \times FV}{m}}{\left(1 + \frac{MRR + DM}{m}\right)^1} + \frac{\frac{(MRR + QM) \times FV}{m}}{\left(1 + \frac{MRR + DM}{m}\right)^2} + \cdots + \frac{\frac{(MRR + QM) \times FV}{m} + FV}{\left(1 + \frac{MRR + DM}{m}\right)^N}$$

Example

Yield Measures for Floating-Rate Notes

- A floating-rate note's quoted margin is +50 basis points and its required margin is +75 basis points. On its next reset date, the price of the note will be:
  - A. less than par value.
  - B. greater than par value.
  - C. equal to par value.

- Correct answer: A

Example

Yield Measures for Floating-Rate Notes

- A two-year Italian floating-rate note pays three-month Euribor of –0.50% plus 250 bp. The floater is priced at 99 per 100 of par value. Assuming the 30/360 day-count convention and evenly spaced periods, the discount margin for the floater is closest to:
  - A. 201 bps.
  - B. 251 bps.
  - C. 300 bps.

- Correct Answer: C.
  - Using the information provided, the periodic PMT is equal to.
  - $\frac{(MRR+QM)\times FV}{m} = \frac{(-0.005 + 0.0025) \times 100}{4} = 0.5$
  - PV = –99, FV = 100, PMT = 0.5, and N = 8, we solve for the I/Y= 0.63%, i.e. YTM = 2.51%
  - DM = 2.51%-(-0.5%)=3.01 %

Summary

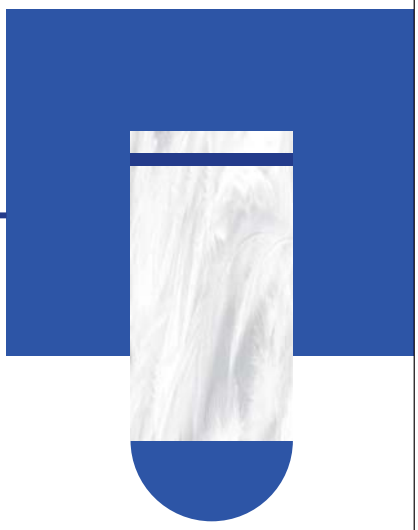
Yield and Yield Spread Measures for Floating-Rate Instruments

Yield measures for floating-rate notes

Yield and yield spread measures for floating-rate instruments

Yield Measures for Money Market Instruments

- Yield measures for money market instruments



Yields Measures for Money Market Instruments

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

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

  - **Add-on rate:** (e.g., MRR, bank CD rates)

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

    - ✓ Both discount basis and add-on rate 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.
    - ✓ DR **understates** the rate of return to an investor and **understates** the funding cost of issuer.

Example
Yields Measures for Money Market Instruments

- Which of the following yields is a bond-equivalent yield?
  - A. Discount yield based on a 360-day year.
  - B. Discount yield based on a 365-day year.
  - C. Add-on yield based on a 365-day year.

- Correct answer: C

Example

Yields Measures for Money Market Instruments

- A treasury bill has a maturity of 180 days, par value of $1,000, and a discount yield of 0.9%. Its market price and the add-on yield based on 365-day are:

- Correct answer:

  Its market price based on 365-day:

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

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

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

$$AOR = 0.9043\%$$

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

Summary

Yield and Yield Spread Measures for Floating-Rate Instruments

Yield Measures for Money Market Instruments

Discount yield, Add-on yield

Summary

Module: Yield and Yield Spread Measures for Floating-Rate Instruments

Yield measures for floating-rate notes

Yield Measures for Money Market Instruments

Module

The Term Structure of Interest Rates: Spot, Par, and Forward Curves

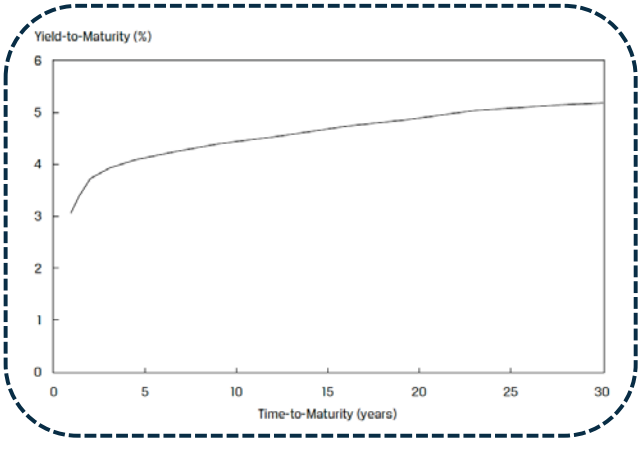
1. Maturity Structure of Interest Rates and Spot Rates
2. Par and Forward Rates

Maturity Structure of Interest Rates and Spot Rates

- Spot rates and the spot curve
- Calculate the price of a bond using spot rates

Maturity Structure of Interest Rates and Spot Rates

- **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.**



Maturity Structure of Interest Rates and Spot Rates

- **Spot rates**: Yields-to-maturity on a series of default-risk-free zero-coupon bonds..
- **The no-arbitrage price** of a bond is calculated using spot rates.

$$\text{no-arbitrage price} = \frac{\text{CPN}_1}{(1+Z_1)} + \frac{\text{CPN}_1}{(1+Z_2)^2} + \ \ldots\ldots + \frac{\text{CPN}_N + Par}{(1+Z_N)^N}$$

Example

Maturity Structure of Interest Rates and Spot Rates

- If spot rates are 3.2% for one year, 3.4% for two years, and 3.5% for three years, the price of a 3-year, $100,000 face value, annual-pay bond with a coupon rate of 4% is closest to:
  - A. $108,230.
  - B. $101,790.
  - C. $101,420.
- Correct answer: C
  - $V_0 = \frac{4000}{1.032} + \frac{4000}{1.034^2} + \frac{104000}{1.035^3}$ =101,419.28

Summary

The Term Structure of Interest Rates: Spot, Par, and Forward Curves

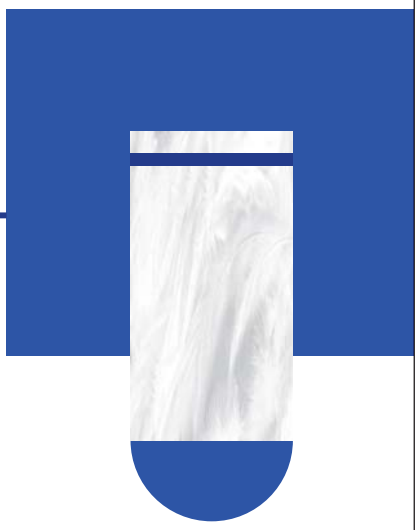
Maturity Structure of Interest Rates and Spot Rates

Spot rates and the spot curve

Calculate the price of a bond using spot rates

Par and Forward Rates

- Par Rates from Spot Rates
- Forward Rates from Spot Rates
- Bond Pricing with Forward Rates
- Compare the spot curve, par curve, and forward curve



Par and Forward Rates

- **Par curve**: shows the coupon rates for bonds of various maturities that would result in bond prices equal to their par values.
  - **Par rate**: a yield-to-maturity that makes the present value of a bond's cash flows equal to par (100% of face value).
  - **Calculate a par rate:**

$$100 = \frac{PMT}{(1+Z_1)} + \frac{PMT}{(1+Z_2)^2} + \frac{PMT+100}{(1+Z_N)^N}$$

Example

Assuming a 3-year annual-pay bond with spot rates of 2.6%, 3.2%, 3.9% , its 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 rate=3.86%

Par and Forward Rates

- **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:** 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**

$$(1+\mathrm{Z_N})^{\mathrm{N}} = (1+\mathrm{Z_1})(1+1\mathrm{y}1\mathrm{y})\ldots(1+(\mathrm{N}-1)\mathrm{y}1\mathrm{y})$$

- **Valuation Using Forward Rates**

$$\text{bond value} = \frac{CF_1}{(1+Z_1)} + \frac{CF_2}{(1+Z_1)(1+1\mathrm{y}1\mathrm{y})} + \ldots\ldots + \frac{CF_N}{(1+Z_1)(1+1\mathrm{y}1\mathrm{y})\ldots(1+(\mathrm{N}-1)\mathrm{y}1\mathrm{y})}$$

Par and Forward Rates

- **Spot, Par, and Forward Curve Relationship**

Spot Curve Shape	Par Curve	Forward Curve
Upward Sloping	Below spot curve	Above spot curve
Flat	Equal to spot curve	Equal to spot curve
Downward Sloping (Inverted)	Above spot curve	Below spot curve

Example

Par and Forward Rates

- The 4-year spot rate and 3-year spot rate are 9.45% and 9.85%, respectively. What is the 1-year forward rate three years from today?

  A. 11.059%.
  B. 9.850%.
  C. 8.258%.

- Correct answer: C
  - $(1.0945)^4 = (1.0985)^3 \times (1 + 3y1y)$
  - $3y1y = \frac{1.0945^4}{1.0985^3} - 1 = 8.258\%$
  - Approximate forward rate = 4(9.45%) – 3(9.85%) = 8.25%.

Example

Par and Forward Rates

- Assuming the following spot and forward rates:
  - Current 1-year spot rate is 5.5%.
  - One-year forward rate one year from today is 7.63%.
  - One-year forward rate two years from today is 12.18%.
  - One-year forward rate three years from today is 15.5%.

The value of a 4-year, 10% annual-pay, $1,000 par value bond is *closest* to:

A. $1,086.
B. $1,009.
C. $996.

- Correct answer: B
  - Bond value $= \frac{100}{1.055} + \frac{100}{1.055 \times 1.0763} + \frac{100}{1.055 \times 1.0763 \times 1.1218} + \frac{1100}{1.055 \times 1.0763 \times 1.1218 \times 1.155} = 1009.03$

Summary

The Term Structure of Interest Rates: Spot, Par, and Forward Curves

Par and Forward Rates

Par Rates from Spot Rates, Forward Rates from Spot Rates

Bond Pricing with Forward Rates, Compare the spot curve, par curve, and forward curve

Summary

Module: The Term Structure of Interest Rates: Spot, Par, and Forward Curves

Maturity Structure of Interest Rates and Spot Rates

Par and Forward Rates

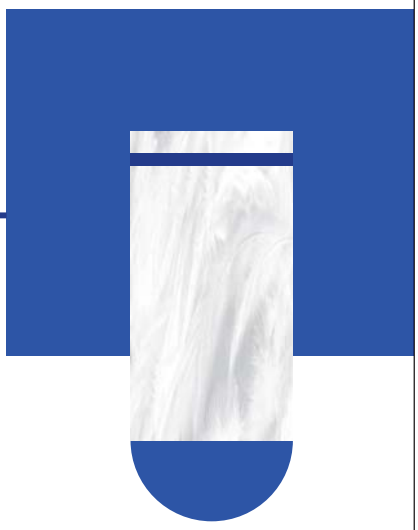
Module

Interest Rate Risk and Return

1. Sources of return
2. Investment Horizon and Interest Rate Risk
3. Macaulay Duration

Sources of return

- Sources of Return



Sources of return

- **Three sources of return:**
  - Coupon and principal payments
  - Reinvestment of coupon payments
  - Capital gain or loss if bond is sold before 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 (horizon yield):** calculated as the compound annual return earned from the holding period .
  - $\mathrm{FV}=\mathrm{PV}\times(1+R)^{n}$
  - $\text{annualized holding period return (R)} = \left(\frac{\text{Future value}}{\text{bond price}}\right)^{1/\mathrm{n}} - 1$

Sources of return

- **Violation of YTM assumption analysis: Annualized HPR vs YTM**
  1. Hold a fixed-rate bond to maturity, reinvestment at YTM → Annualized rate of return=YTM;
  2. Sell prior to maturity, selling price priced at YTM → Annualized rate of return=YTM;
  3. Hold a bond to maturity, reinvestment rate ↗ → realized return > YTM, vice versa;
  4. Hold for a short period, reinvestment rate ↗ → realized return < YTM, vice versa;
  5. Hold for a long period, reinvestment rate ↘ → realized return < YTM, vice versa.

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:

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

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

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

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.

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:

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

which is less than the YTM at purchase.

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 lower than the YTM at bond purchase if the bond is held for a long period.**
  - Consider a 10-year 10% bond purchased at par, if YTM decreases to 8% after purchase and the bond is sold at the end of year 8.
  - Bond price paid with YTM=8%
    - ✓ N=2; I/Y=8; FV=1,000; PMT=100; CPT: PV = -1,035.67
  - Coupon income and reinvestment income
    - ✓ $100(1.08)^7+100(1.08)^6+100(1.08)^5+\ldots\ldots 100(1.08)+100=$**$1063.66** or
    - ✓ N=8; I/Y=8; PV=0; PMT=100; CPT: FV=1063.66
  - The annualized holding period rate of return is simply

$$\left(\frac{1035.67+1063.66}{1000}\right)^{1/8}-1=9.71\%$$

which is less than the YTM at purchase.

Summary

Interest Rate Risk and Return

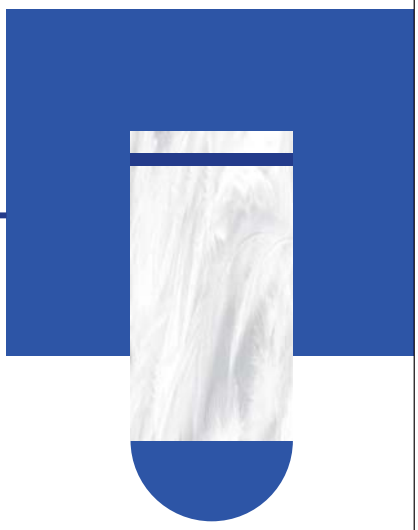
Sources of Return

Sources of return, Investment Horizon and Interest Rate Risk

Macaulay Duration

Investment Horizon and Interest Rate Risk

- Interest Rate Risk
- Duration Gap



Investment Horizon and Interest Rate Risk

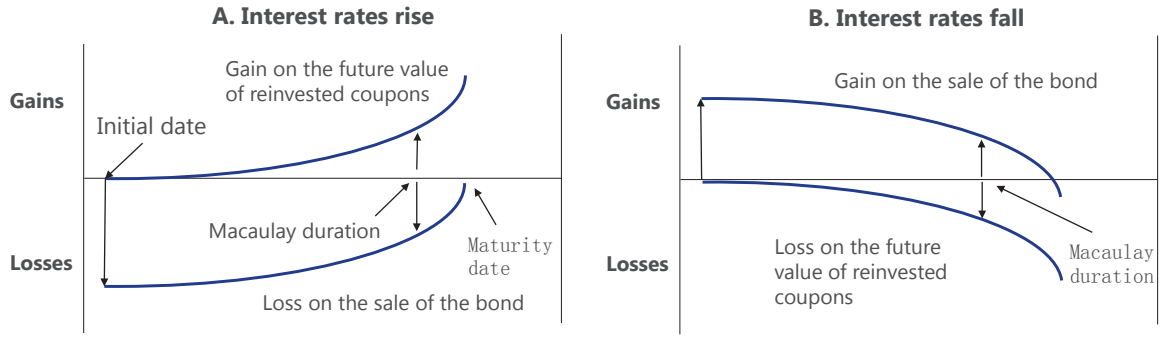
- **Two offsetting types of interest rate risk**
  - **Coupon reinvestment risk**: uncertainty about income from reinvesting coupon payments.
    - ✓ Increases with a higher coupon rate and a longer investment horizon.
  - **Price risk**: uncertainty about a bond price
- These risks offset each other: an **increase** in YTM **decreases** a bond's price but **increases** 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

Investment Horizon and Interest Rate Risk

- Mac. D (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, Mac. D , and investment horizon
  1. If investment horizon > Mac. D, then reinvestment risk dominates price risk, investor's risk is to lower interest rates.
  2. If investment horizon = Mac. D, then reinvestment risk offsets price risk.
  3. If investment horizon < Mac. D, then price risk dominates reinvestment risk, investor's risk is to higher interest rates.
     - ✓ Bond price will fall as interest increase, therefore negative price risk.
     - ✓ increase in interest rates is beneficial for coupon reinvestment, has positive reinvestment risk.

Investment Horizon and Interest Rate Risk

- Interest Rate Risk, Macaulay Duration, and Investment Horizon



Investment Horizon and Interest Rate Risk

- **Duration gap**

Duration gap = Mac. D – 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.

Example

Investment Horizon and Interest Rate Risk

- An investor buys a 5-year bond with a 6.5% annual coupon and the YTM is 6%. Before the first coupon payment, the YTM decreases to 5.5%. Assuming coupon payments are reinvested at the YTM and the bond is held to maturity, the investor's return is:

  A. greater than 6.0%.
  B. less than 6.0%.
  C. equal to 6.0%.

- Correct answer: B

Summary

Interest Rate Risk and Return

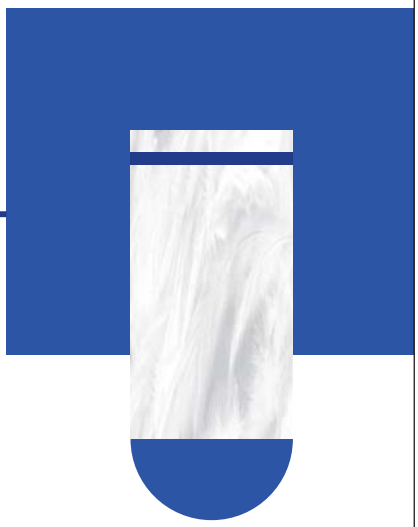
Investment Horizon and Interest Rate Risk

Interest Rate Risk

Duration Gap

Macaulay Duration

- Macaulay Duration



Macaulay Duration

- **Macaulay duration (Mac.D)** is the weighted average of the time to receipt of the bond's cash flows, where the weights of each cash flow in the calculation are each cash flow's share of the bond's full price.
  - **Mac.D**

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

Example

Macaulay Duration

- An investor buys a 6% annual payment bond with three years to maturity. The bond has a yield-to-maturity of 8% and is currently priced at 948.45806 per 1000 of par. The bond's Macaulay duration is closest to:
  - A. 2.66.
  - B. 2.83.
  - C. 3.00.

- Correct answer: B

period	Cash flow	Present value	weight	Period × weight
1	60	55.55556	0.058575	0.058575
2	60	51.44033	0.054236	0.108471
3	1060	841.46218	0.887190	2.661570
		948.45806	1.000000	2.828617

Example

Macaulay Duration

- Consider a bond that has two years remaining to maturity, a coupon of 4% paid **semiannually**, and a yield-to-maturity of 4.60%. Assuming it is 63 days into the first coupon period and a 30/360 basis, the bond's annualized Macaulay duration is closest to:
  - A. 0.9419 years.
  - B. 1.7666 years.
  - C. 1.9416 years.

Period	Time to Receipt	Cash Flow	*PV*	Weight	Time to Receipt × Weight
1.0000	0.6500	2.0000	1.9707	0.0198	0.0129
2.0000	1.6500	2.0000	1.9264	0.0193	0.0319
3.0000	2.6500	2.0000	1.8830	0.0189	0.0501
4.0000	3.6500	102.0000	93.8759	0.9420	3.4383
			99.6559	1.0000	3.5331
				Annualized MacDur	1.7666

- Correct Answer: B.
  - The first cash flow's time-to-receipt is (180-63)/180 = 0.65 periods from now as it is 63 days into the period. Each subsequent cash flow is received one period later after the first, so time-to-receipt = 0.65 + 1, 0.65 + 2, and so on.

Summary

Interest Rate Risk and Return

Macaulay Duration

Macaulay Duration

Summary

Module: Interest Rate Risk and Return

Sources of return

Investment Horizon and Interest Rate Risk

Macaulay Duration

Module

Yield-Based Bond Duration Measures and Properties

1. Different types of Yield Duration
2. Properties of Duration

Different types of Yield Duration

- Modified duration
- Money duration
- Price value of a basis point (PVBP)

Different types of Yield Duration

- **Duration** measures the sensitivity of the bond's **full price** to changes in interest rates.
  - **Yield duration (with respect to the bond's own YTM)：underlying CF are certain**

    ✓ **MD (Modified duration)**

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

    ✓ **Approximate modified duration**

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

Different types of Yield Duration

- **Money duration/dollar duration:** linear approximation of the bond price change. Usually used to measure a 1% change in yield.
  - Money duration=annual MD * full price of bond
  - $\%\Delta PV^{Full} \approx -MoneyDur \times \Delta yield$
- **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%).

$$PVBP = P \times D \times 1bp \qquad PVBP = \frac{V_- - V_+}{2}$$

Different types of Yield Duration

- **Duration of Perpetuity**
  - A **perpetuity or perpetual bond**: 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.
    - ✓ Mac. D= (1 + y)/y, as N approaches infinity.

$$P = \frac{C}{y}$$

$$\frac{\Delta P}{\Delta y} = -\frac{1}{y} \times \frac{C}{y} = -\frac{1}{y} \times P = -MD \times P$$

$$MD = \frac{1}{y}$$

$$Mac.D = \frac{1+y}{y}$$

Different types of Yield Duration

- **Duration of Floating-Rate Notes and Loans**
  - Interest rate risk arises only between reset dates, because at the next reset date, coupon payments will adjust to the new MRR. Therefore, the Macaulay duration for a floating-rate note or bond is simply the fraction of a period remaining until the next reset date:

$$MacDur_{Floating} = \frac{(T-t)}{T}$$

  - Floating-rate instruments typically have very low duration because coupon periods are typically less than six months in length. As a result, they are commonly used by investors to reduce duration in fixed-income portfolios.

Example

If there are 180 days in the coupon period and 57 days have passed since the last coupon, the Macaulay duration is:

Correct Answer:

$$MacDur_{Floating} = \frac{(180-57)}{180} = 0.683333$$

Example

Different types of Yield Duration

- An annual-pay coupon bond has a coupon rate of 14% and six years to maturity. The bond is currently trading at par. Assuming a 25bps change in yield, the bond's approximate modified duration is *closest* to:

A. 0.392.
B. 3.888.
C. 3.970.

- Correct answer: B
  - V_- = 100.979
    - ✓ N = 6; PMT = 14.00; FV = 100; I/Y = 13.75; CPT → PV = –100.979
  - V_+ = 99.035
    - ✓ I/Y = 14.25; CPT → PV = –99.035
  - V_0 = 100.000
  - Δy = 0.0025
  - Approximate modified duration = $\frac{V_- - V_+}{2V_0\Delta YTM} = \frac{100.979-99.035}{2\times100\times0.0025} = 3.888$

Example

Different types of Yield Duration

- Bond C has a coupon rate of 1%, paid semiannually, and matures in five years. If its yield-to-maturity is –0.5%, its Macaulay duration is most likely:

A. less than its modified duration.
B. the same as its modified duration.
C. greater than its modified duration.

- Correct Answer: A.
  - Recall that a bond's modified duration is equal to its Macaulay duration divided by 1 plus its yield-to-maturity:
  - $ModDur = \frac{MacDur}{(1+r)}$
  - If the yield, r, is negative, the denominator will be less than 1, which results in a MacDur less than the modified duration.

Example

Different types of Yield Duration

- Deepak Chowdhury, a bond analyst, is evaluating a USD30 million investment in par value terms in the BRWA bond. Assuming that the bond was issued on 15 October 2025 and it is currently 15 January 2026, 92 days into the first coupon period, Chowdhury has compiled the following data:
  - Coupon: 3.200%
  - Coupon frequency: 2
  - Yield-to-maturity: 3.200%
  - Maturity: 15 October 2030
- Complete the following table:

	BRWA
Full price (per 100 of par value)	
Macaulay duration	
Modified duration	
Full price, assuming 5 bp YTM increase	
Full price, assuming 5 bp YTM decrease	
Approx. modified duration	
Price value per basis point	
Market value of investment (USD)	
Money duration (percent of par)	
Expected loss from a 100 bp YTM increase (USD)	

Example

Different types of Yield Duration

- Correct Answer:

	BRWA
Full price (per 100 of par value)	100.815
Macaulay duration	4.405
Modified duration	4.335
Full price, assuming 5 bp YTM increase	100.596
Full price, assuming 5 bp YTM decrease	101.033
Approx. modified duration	4.335
Price value per basis point	0.044
Market value of investment (USD)	30,244,381
Money duration (percent of par)	437.054
Expected loss from a 100 bp YTM increase (USD)	–1,311,163

Example

Different types of Yield Duration

BRWA Bond: Full Price and Duration					
YTM (periodic): 0.01600					
Period	**Time to Receipt**	**Cash Flow**	**PV**	**Weight**	**Time ×Weight**
1	0.489	1.600	1.588	0.016	0.008
2	1.489	1.600	1.563	0.016	0.023
3	2.489	1.600	1.538	0.015	0.038
4	3.489	1.600	1.514	0.015	0.052
5	4.489	1.600	1.490	0.015	0.066
6	5.489	1.600	1.466	0.015	0.080
7	6.489	1.600	1.443	0.014	0.093
8	7.489	1.600	1.421	0.014	0.106
9	8.489	1.600	1.398	0.014	0.118
10	9.489	101.600	87.394	0.867	8.226
			100.815	1.0000	8.809
Annualized Macaulay Duration and Convexity					4.405
Modified Duration					8.670
Annualized Modified Duration					4.335

Example

Different types of Yield Duration

BRWA Bond: Full price, assuming 5 bp YTM increase				BRWA Bond: Full price, assuming 5 bp YTM decrease			
YTM (periodic): 0.01625				**YTM (periodic):** 0.01575			
Period	**Time to Receipt**	**Cash Flow**	**PV+**	**Period**	**Time to Receipt**	**Cash Flow**	**PV-**
1	0.489	1.600	1.587	1	0.489	1.600	1.588
2	1.489	1.600	1.562	2	1.489	1.600	1.563
3	2.489	1.600	1.537	3	2.489	1.600	1.539
4	3.489	1.600	1.513	4	3.489	1.600	1.515
5	4.489	1.600	1.488	5	4.489	1.600	1.492
6	5.489	1.600	1.465	6	5.489	1.600	1.468
7	6.489	1.600	1.441	7	6.489	1.600	1.446
8	7.489	1.600	1.418	8	7.489	1.600	1.423
9	8.489	1.600	1.395	9	8.489	1.600	1.401
10	9.489	101.600	87.190	10	9.489	101.600	87.598
			100.596				101.033

Example

Different types of Yield Duration

- Correct Answer:

BRWA Bond: Approx. Ann. Modified Duration	
PV0	100.815
PV+	100.596
PV-	101.033
Approximate Ann. ModDur	4.335

Example

Different types of Yield Duration

BRWA Bond: Full price, assuming 1 bp YTM increase				BRWA Bond: Full price, assuming 1 bp YTM decrease			
YTM (periodic): 0.01605				**YTM (periodic):** 0.01595			
Period	**Time to Receipt**	**Cash Flow**	**PV+**	**Period**	**Time to Receipt**	**Cash Flow**	**PV-**
1	0.489	1.600	1.588	1	0.489	1.600	1.588
2	1.489	1.600	1.563	2	1.489	1.600	1.563
3	2.489	1.600	1.538	3	2.489	1.600	1.538
4	3.489	1.600	1.514	4	3.489	1.600	1.514
5	4.489	1.600	1.490	5	4.489	1.600	1.490
6	5.489	1.600	1.466	6	5.489	1.600	1.467
7	6.489	1.600	1.443	7	6.489	1.600	1.444
8	7.489	1.600	1.420	8	7.489	1.600	1.421
9	8.489	1.600	1.398	9	8.489	1.600	1.399
10	9.489	101.600	87.353	10	9.489	101.600	87.435
			100.771				100.858

Example

Different types of Yield Duration

- Correct Answer:

BRWA Bond			
PV+	100.771	Full price	100.815
PV-	100.858	Par	30,000,000
PVBP	0.044	Market value	30,244,381
AnnModDur	4.335	MoneyDur	437.054
Full price	100.815	MV	30,244,381
MoneyDur	437.054	ChgYield	0.01
		Exp. Loss	(1,311,163)

Summary

Yield-Based Bond Duration Measures and Properties

Different types of Yield Duration

Modified duration

Money duration

Price value of a basis point (PVBP)

Properties of Duration

- How a bond's maturity, coupon, and yield level affect its interest rate risk

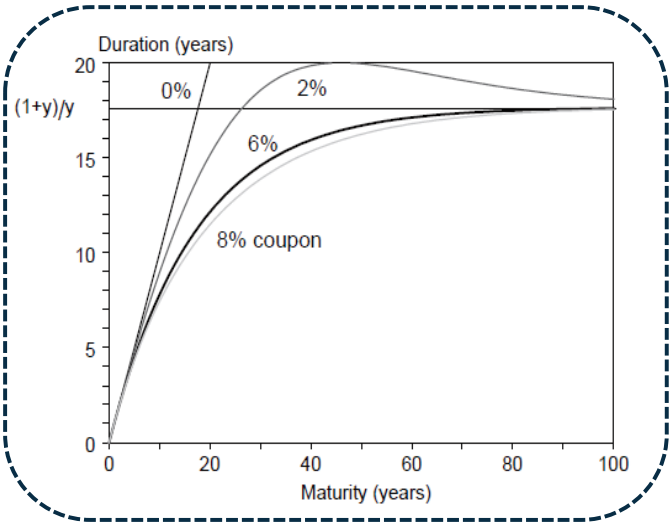
Properties of Duration

- **Coupon effect:** For two bonds with different coupons but are otherwise identical, 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:** For two bonds with different time-to-maturity but are otherwise identical, 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.

Properties of 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:**
  - $D_{perpetuity} = (1+y)/y$
  - $D_{zero\text{-}coupon\ bond} = M_{zero\text{-}coupon\ bond}$
  - $D_{discount} > D_{premium}$
  - $D_{discount}$ 随着时间的变化先增加后减小，并不是时间越长，duration越大。

Properties of Duration



Example

Properties of Duration

- Which of the following bonds (similar except for yield and maturity) has the *least* Mac.D? A bond with:
  - A. 6% yield and 10-year maturity.
  - B. 5% yield and 10-year maturity.
  - C. 5% yield and 20-year maturity.

- Correct Answer: A.
  - Other things equal, Mac.D is less when yield is higher and when maturity is shorter. The bond with the highest yield and shortest maturity must have the lowest Mac.D.

Example

Properties of Duration

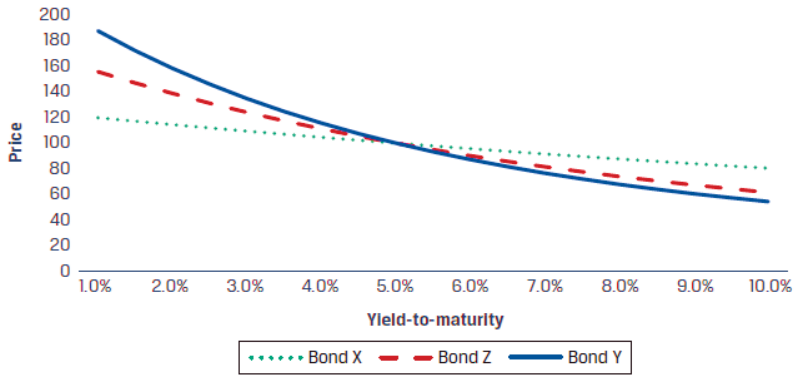
- A bond analyst is comparing Bond D, a perpetual bond with a coupon of 5%, with Bond E, a zero-coupon bond maturing in five years. If both bonds are priced to yield 6%, Bond D has:
  - A. lower interest rate risk.
  - B. the same interest rate risk.
  - C. higher interest rate risk.

- Correct Answer: C.
  - The Macaulay duration for Bond D is 1.06/0.06 = 17.667. The Macaulay duration for Bond E is five years. The perpetual bond, Bond D, has higher interest rate risk.

Example

Properties of Duration

- The graph depicts the price–yield relationships for three bonds, Bond X, Bond Y, and Bond Z. The three bonds have the same coupon rate, 5%.



  - A. Bond X
  - B. Bond Y
  - C. Bond Z

Example

Properties of Duration

- Correct Answer: B.
  - Bond Y has the steepest price-yield line, indicating that it has the greatest modified duration and, most likely, the longest time-to-maturity.

Summary

Yield-Based Bond Duration Measures and Properties

Properties of Duration

How a bond's maturity, coupon, and yield level affect its interest rate risk

Summary

Module: Yield-Based Bond Duration Measures and Properties

Different types of Yield Duration

Properties of Duration

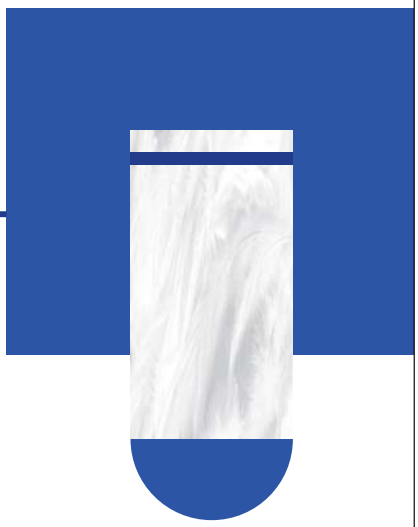
Module

Yield-Based Bond Convexity and Portfolio Properties

1. Convexity
2. Portfolio Duration and Convexity

Convexity

- Convexity
- Convexity adjustment



Convexity

- **Convexity** is a measure of the curvature of the price-yield curve.
  - Convexity is a complementary risk metric that measures the **second-order (non-linear) effect** of yield changes on option-free fixed-rate bond price. Modified duration measures the first-order (linear) effect.

$$Convexity = \frac{1}{(1+y)^2}\sum_{t=1}^{n} w_t \times t \times (t+1)$$

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

Convexity

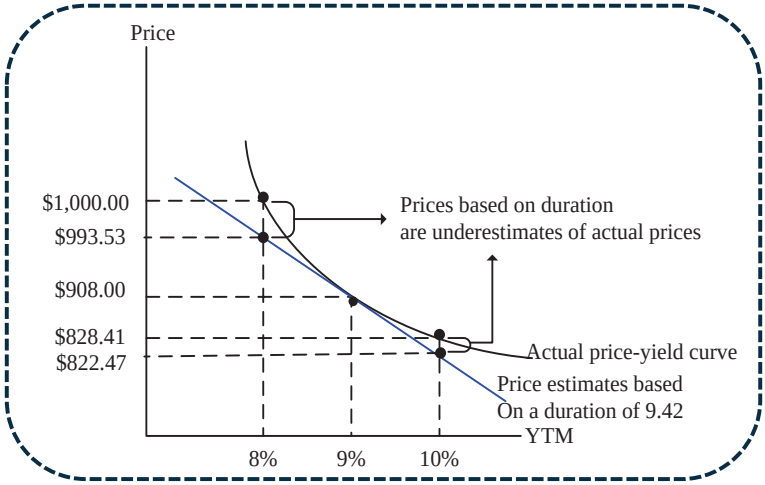
- **Convexity**
  - The **convexity adjustment** is always positive when convexity is positive.

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

$$\Delta P = \left[-MoneyDur \times (\Delta y)\right] + \left[0.5 \times MoneyConv \times (\Delta y)^2\right]$$

    - ✓ Money convexity of the bond is the annual convexity multiplied by the full price.
    - ✓ **Convexity adjustment is most useful** for large yield changes, because duration provides a good measure for small yield changes.

Convexity



Convexity

- **Convexity properties**
  - Bond features that lead to greater convexity are the same as for duration. A fixed-rate bond will have **greater** convexity:
    - ✓ the longer its time-to-maturity
    - ✓ the lower its coupon rate
    - ✓ the lower its yield-to-maturity
    - ✓ Another factor is the **dispersion of cash flows**, meaning the degree to which payments are spread out over time. For two bonds with the same duration, the one with the greater dispersion of cash flows has greater convexity.

Example

Convexity

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

- Correct answer: A

Example

Convexity

- A bond has an MD of 10.5 and a convexity of 97.3. Assuming a decline in yield of 200 basis points, the estimated percentage change in the bond's price is closest to:
  - A. 24.89%.
  - B. 22.95%.
  - C. 19.05%.

- Correct answer: B
  - Total estimated price change = (duration effect + convexity effect)
  - $\Delta P/P = -10.5 \times (-2\%) + 1/2 \times 97.3 \times (-2\%)^2 = 21.0\% + 1.95\% = 22.95\%$

Example

Convexity

- Calculate the convexity of an option-free fixed-rate bond (BRWA bond). The following information are:
  - BRAW Corporate, two year, 3.2% semiannual bond
  - Principal: 300,000,000
  - Fixed coupon: 3.2%
  - Periods per year: 2
  - Price (per 100 Par): 100
  - Yield-to-maturity: 3.2%

Example

Convexity

- Correct Answer:

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6 = Col. 2×Col. 5	Col. 7 = Col. 2 × (Col. 2 + 1)× Col. 5 × (1 + YTM/2)^(-2)
Period	**Time to Receipt**	**Cash Flow**	**Present Value**	**Weight**	**Time to Receipt×Weight**	**Convexity of Cash Flows**
1	1.0	1.6	1.5748	0.0157	0.0157	0.0305
2	2.0	1.6	1.5500	0.0155	0.0310	0.0901
3	3.0	1.6	1.5256	0.0153	0.0458	0.1774
4	4.0	101.6	95.3496	0.9535	3.814	18.474
			100.0000	1.0000	3.9065	18.772
Annualized Macaulay Duration and Convexity					1.953	4.693

Summary

Yield-Based Bond Convexity and Portfolio Properties

Convexity

Convexity, Convexity adjustment

Portfolio Duration and Convexity

- Portfolio Duration
- Portfolio Convexity

Portfolio Duration and Convexity

- **Portfolio duration:**
  - **Method 1**: the weighted average of time to receipt of the aggregate cash flows.
    - ✓ This method is better ***theoretically but difficult to use in practice*.**
  - **Method 2:** Using the weighted averages of the durations and convexities of the individual bonds that make up the portfolio

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

$$\text{Portfolio convexity} = w_1C_1 + w_2C_2 + \ldots\ldots + w_nC_n$$

    - ✓ ***Commonly used*** by fixed-income portfolio managers. The main advantage is easily used.
    - ✓ The shares of overall portfolio **market value** are the weights.
    - ✓ **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).**

Example

Portfolio Duration and Convexity

- 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	MD
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 MD is closest to:

A. 7.62.

B. 8.08.

C. 8.20.

- Correct Answer: A.

Example

Portfolio Duration and Convexity

- An investor purchases EUR10 million par value of a 5-year, zero-coupon bond and a 10-year, fixed-rate semiannual coupon bond. Details of the bonds are shown below.

Bond	Maturity (Years)	Coupon (%)	Price	YTM (%)	Duration	Convexity
Zero	5	0.00	83.18777	3.750	4.81928	27.87052
Semiannual	10	5.50	105.91556	4.750	7.71210	72.54897

- Based on rising inflation and tightening monetary policy, the investor expects interest rates to rise. Given that view, which bond should the investor consider replacing the 10-year bond with?

A. A 20-year bond

B. A 15-year floating-rate bond

C. A 10-year bond with a lower coupon

Example

Portfolio Duration and Convexity

- Correct Answer: B.
  - With interest rates expected to rise, the investor should choose a bond with lower interest rate risk. Both the 20-year bond and the 10-year bond with a lower coupon should have higher durations than the current 10-year bond, all else equal, and would be expected to experience a larger percentage price decrease if interest rates increase. Floating-rate bonds, however, have low interest rate risk because coupon payments adjust to changing interest rates.

Summary

Yield-Based Bond Convexity and Portfolio Properties

Portfolio Duration and Convexity

Portfolio Duration, Portfolio Convexity

Summary

Module: Yield-Based Bond Convexity and Portfolio Properties

Convexity

Portfolio Duration and Convexity

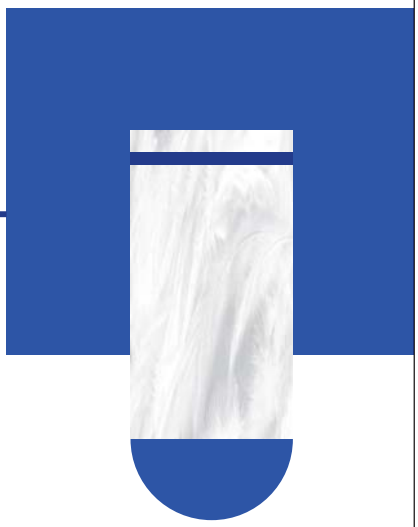
Module

Curve-Based and Empirical Fixed-Income Risk Measures

1. Curve Duration and Convexity
2. Key Rate Duration
3. Empirical Duration

Curve Duration and Convexity

- Effective duration
- Effective convexity



Curve Duration and Convexity

- **Curve Duration and Convexity**
  - Yield duration and convexity assume a bond's cash flows are **certain**.
  - However, if a bond has contingency features, such as embedded options, as with a callable bond, then future cash flows are **uncertain** since option exercise depends on the level of market interest rates relative to coupon interest being paid.
    - ✓ do not have well-defined yields-to-maturity, so Macaulay and modified durations are **not** appropriate interest rate risk measures for such bonds.
    - ✓ Effective duration: measure of interest rate risk is the sensitivity of the bond's price to a change in a **benchmark yield curve**, such as the government par curve.

Curve Duration and Convexity

- **Effective duration**

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

- **Effective Convexity**

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

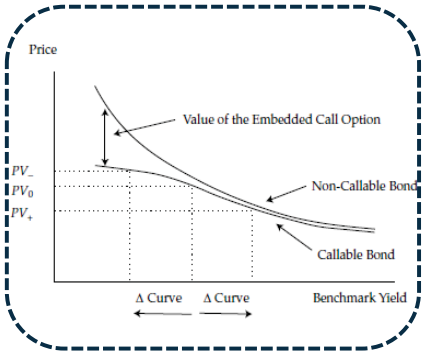
- Effective duration and effective convexity can be used to estimate the percentage change in a bond's full price for a given shift in the benchmark yield curve (Δcurve)

$$\%\Delta PV^{Full} \approx \left(-EffDur \times \Delta Curve \right) + \left[\frac{1}{2} \times EffCon \times (\Delta Curve)^2 \right]$$

Curve Duration and Convexity

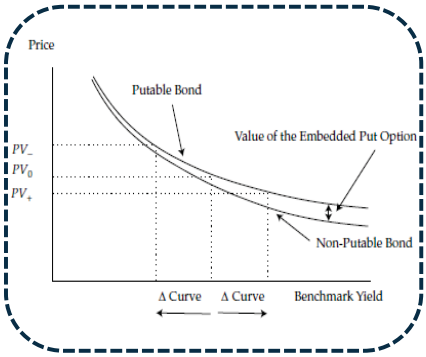
Callable

- 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.



Summary

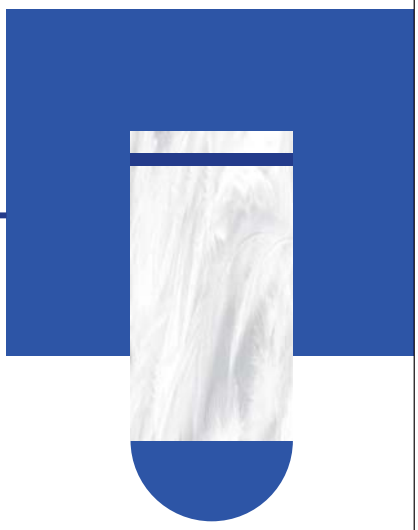
Curve-Based and Empirical Fixed-Income Risk Measures

Curve Duration and Convexity

Effective duration, Effective convexity

Key Rate Duration

- Key rate duration



Key Rate Duration

- **Key rate duration/partial duration:** is a measure of a bond's sensitivity to a change in the benchmark yield curve at a specific maturity segment.
  - Key rate durations define a security's price sensitivity over a set of maturities along the yield curve, with the sum of key rate durations being identical to the effective duration:

$$Key\ Rate\ Duration_k = -\frac{\Delta P/P}{\Delta y_k}$$

$$\sum_{k=1}^{n} Key\ Rate\ Duration^k = Effective\ Duration$$

  - For example, calculate the expected price change of the callable bond if y_2 increase by 25bps and other maturity benchmark rates remain unchanged, KRD_2 is 1.9
    - ✓ Price change = $-\ KRD_2 \times \Delta y_2 = -1.9 \times 0.0025 = -0.475\%$

Key Rate Duration

- 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.
  - Key rates include: 3m, 1yr, 2yr, 3yr, 5yr, 7yr, 10yr, 15yr, 20yr, 25yr, 30yr. (totally **11** maturity dates)

Key Rate Duration

- In portfolio, key rate duration values of the bonds in a portfolio sum to the portfolio duration.
  - By using key rate durations, a portfolio manager can **over-or underweight specific tenors** to maximize risk-adjusted return.
- **Example:** KRD for several maturities in three bond portfolios, as shown in Exhibit 1.
  - If the 5- and 10-year key rates increase by 20 basis points, but the 2- and 20-year key rates remain unchanged, choose which portfolio?
  - Portfolio 1 will experience the best price performance.

Exhibit 1: Key Rate Durations for Three Fixed-income Portfolios

Key Rate Maturity	Portfolio 1	Portfolio 2	Portfolio 3
2-year	2.45	0.35	1.26
5-year	0.20	0.40	1.27
10-year	0.15	4.00	1.23
20-year	2.20	0.25	1.24
Total	5.00	5.00	5.00

Summary

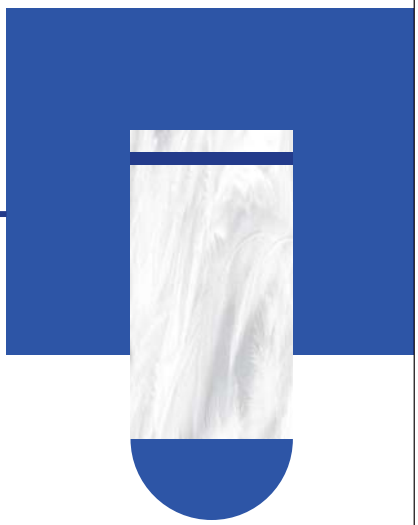
Curve-Based and Empirical Fixed-Income Risk Measures

Key Rate Duration

key rate duration

Empirical Duration

- Empirical Duration
- Analytical duration



Empirical Duration

- **Analytical duration:** To estimate duration and convexity statistics using **mathematical formulas**. (The approach taken in this reading)
  - Implicitly assume that government bond yields and spreads are independent variables that are **uncorrelated**.
- **Empirical duration:** Professionals often use historical data in statistical models that incorporate various factors affecting bond prices to calculate empirical duration estimates. (**consider correlation between benchmark yields and spreads**)
  - For example, during market turmoil, analytical and empirical duration estimates **differ** among bond types:
    - ✓ **For a government bond** (with little or no credit risk): we would expect analytical and empirical duration to be similar because benchmark yield changes largely drive bond prices.
    - ✓ **For high-yield bond**: Since credit spreads and benchmark yields are negatively correlated under a market stress scenario, **wider credit spreads will partially or fully offset the decline in government benchmark yields**, resulting in **lower empirical duration estimates** than analytical duration estimates.

Example

Empirical Duration

- DEF Investment Ltd. is a fixed-income investment firm that actively manages a government bond fund and a corporate bond fund. Holdings of the government bond fund are mainly medium-term US Treasury securities but also include debt of highly rated developed-market sovereign issuers. About half of the corporate bond fund is invested in investment-grade issues, and the other half consists of high-yield issues, all with a mix of maturities and from a mix of American, European, and Asian companies.
- Explain why empirical duration is likely to be a more accurate risk measure for DEF's corporate bond fund than for its government bond fund.

Example

Empirical Duration

- **Solution:**
  - For the government bond fund that includes debt securities of the US government and other highly rated developed-market sovereign issuers, **benchmark yields** are the **primary driver** of changes in overall bond yields, thus the results of **analytical duration** and **empirical duration** should be broadly **similar.**
  - The corporate bond fund includes various debt securities with varying levels of credit quality and liquidity and, therefore, different credit and liquidity spreads.
  - Interactions between benchmark yield changes and credit and liquidity spreads would tend to **offset** each other, particularly during stressed market conditions, making **empirical duration significantly lower than analytical duration.** As a result, empirical duration may be the more accurate risk measure for the corporate bond fund.

Summary

Curve-Based and Empirical Fixed-Income Risk Measures

Empirical Duration

Empirical Duration, Analytical duration

Summary

Module: Curve-Based and Empirical Fixed-Income Risk Measures

Curve Duration and Convexity

Key Rate Duration

Empirical Duration

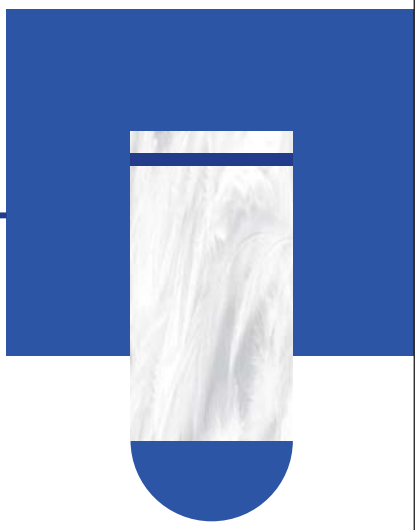
Module

Credit Risk

1. Sources of Credit Risk
2. Credit Rating Agencies and Credit Ratings
3. Factors Impacting Yield Spreads

Sources of Credit Risk

- The Cs of Credit Analysis
- Measure Credit risk



Sources of Credit Risk

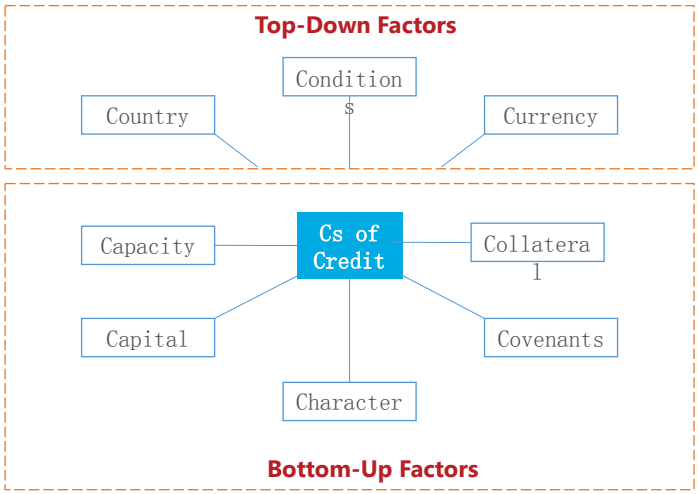
- **Credit risk:** expected economic **loss** under a potential borrower default over the life of the contract.
- **Default:** A borrower that fails to meet its promised interest and/or principal payment obligations under a bond or loan contract
- **Five of these criteria** are related to the specific **bottom-up** factors applicable to an individual borrower.
  - **Capacity** refers to the ability of the borrower to make its debt payments on time.
  - **Capital** addresses other company resources available that reduce reliance on debt.
  - **Collateral** refers to the quality and value of the assets supporting the issuer's indebtedness.
  - **Covenants** are the legal terms of debt agreements that an issuer must comply with.
  - **Character** refers to the quality of management and the willingness of repay indebtedness.

Sources of Credit Risk

- **The remaining three criteria** involve general **top-down** factors that apply to all borrowers to a greater or lesser extent.
  - **Conditions** refers to the **general economic, competitive, and business environment** faced by all borrowers that may affect their ability to service or refinance debt.
  - **Country** involves the **geopolitical environment** as well as the legal and political system faced by all issuers in a jurisdiction that may affect debt payment.
  - **Currency** affects issuers whose cash flows are affected by **exchange rate changes** or who borrow in a currency outside of their jurisdiction, such as **sovereign issuers with foreign currency debt**.

Sources of Credit Risk

- **The Cs of Credit Analysis**



Measure Credit Risk

- **Credit risk** is the risk of loss resulting form the borrower (issuer of debt) failing to make full and timely payments of interest and/or principal. It has two components.
  - **Default risk**, or **probability of default**, is the probability that a borrower defaults
  - **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 given default×(Expected Exposure-Collateral)**
  - Loss severity given default = 1 – Recovery rate
  - **Recovery rate** is the percentage of the principal amount recovered in the event of default.
- One way to interpret the **expected loss** on a fixed-income security for a given period is to compare it to the **compensation** an investor expects for taking on the **credit risk** of a borrower over that period, which is the **credit spread**.
  - Credit Spread ≈ POD × LGD, where LGD = EE × (1 – RR)

Example

Sources of Credit Risk

- A EUR500,000 loan has the following characteristics:
  - Probability of default 5%
  - Collateral EUR100,000
  - Recovery rate 90%
  - Expected exposure EUR400,000

- The expected loss for this loan in event of default is:

A. EUR1,500

B. EUR2,000.

C. EUR20,000.

Example

Sources of Credit Risk

- Correct Answer: A
  - We solve for expected loss (EL) as follows:
  - EL = POD × (EE – Collateral) × (1 – RR).
  - Since probability of default (POD) is 5%, expected exposure (EE) is EUR400,000, collateral is EUR100,000, and the recovery rate (RR) is 90%:
  - EL = EUR1,500 = 0.05 × (400,000 – 100,000) × (1 – 0.9).

Example

Sources of Credit Risk

- A bond investor analyzing Broadvue Corporation's unsecured debt estimates a POD of 2% and an LGD of 80%. Using this information to approximate the annual credit spread and observing an actual credit spread of 200 bps per year, which of the following statements is correct?

  A. An investor would be fairly compensated for assuming Broadvue's credit risk.

  B. An investor would be less than fairly compensated for assuming Broadvue's credit risk.

  C. An investor would be more than fairly compensated for assuming Broadvue's credit risk.

- Correct Answer: C
  - Since POD × LGD = 1.60% and the credit spread is 2.00%, Credit Spread > POD × LGD and the investor would expect to be more than fairly compensated for assuming Broadvue's credit risk.

Summary

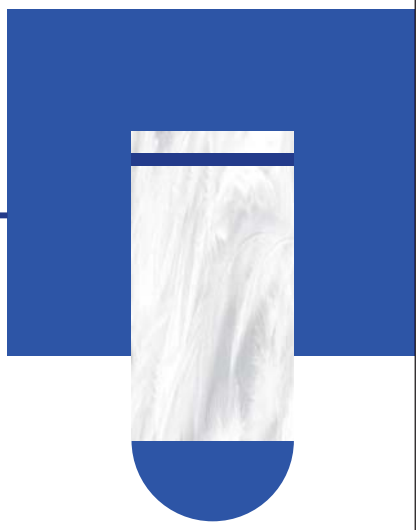
Credit Risk

Sources of Credit Risk

The Cs of Credit Analysis, Credit risk

Credit Rating Agencies and Credit Ratings

- Credit ratings
- Credit Rating Agencies



Credit Rating Agencies and Credit Ratings

- **Credit ratings**
  - **The three major credit rating agencies:**
    - ✓ Moody's Investors Service ("Moody's")
    - ✓ Standard & Poor's ("S&P")
    - ✓ Fitch Ratings ("Fitch")
  - **Credit migration (or downgrade) risk**: this is the risk that a bond issuer's **creditworthiness deteriorates**, or **migrates to a lower rating**, 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.

Credit Rating Agencies and Credit Ratings

- **Credit ratings**

Moody's	S&P	Fitch	Summary Definition
Investment Grade—High Credit-Worthiness			
Aaa	AAA	AAA	High-Quality Grade
Aa1 Aa2 Aa3	AA+ AA AA-	AA+ AA AA-	
A1 A2 A3	A+ A A-	A+ A A-	Upper-Medium Grade
Baa1 Baa2 Baa3	BBB+ BBB BBB-	BBB+ BBB BBB-	Low-medium Grade

Credit Rating Agencies and Credit Ratings

- **Credit ratings**

Moody's	S&P	Fitch	Summary Definition
Non-Investment Grade"Junk"or "High Yield"			
Ba1	BB+	BB+	Low Grade or Speculative Grade
Ba2	BB	BB	
Ba3	BB-	BB-	
B1	B+	B+	
B2	B	B	
B3	B-	B-	

Credit Rating Agencies and Credit Ratings

- **Credit ratings**

Moody's	S&P	Fitch	Summary Definition
Non-Investment Grade"Junk"or "High Yield"			
Caa1	CCC+	CCC+	Low Grade or Speculative Grade
Caa2	CCC	CCC	
Caa3	CCC-	CCC-	
Ca	CC	CC	
C	C	C	
C	D	D	Default

Credit Rating Agencies and Credit Ratings

- **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.

Credit Rating Agencies and Credit Ratings

- **Credit Rating Considerations: Solo reliance on crediting rating has several pitfalls**
  - **Credit ratings tend to be sticky and lag market pricing of credit risk.**
    - ✓ Bond prices and credit spreads often move faster than rating agencies change their ratings (or ratings outlook) in response to changes in perceived creditworthiness.
    - ✓ **Credit rating outlooks** tend to be more closely aligned with market condition.
  - **Some risks are difficult to capture in credit ratings.**
    - ✓ Rating agencies may view complex risks very differently, resulting in **split ratings** between the agencies.
  - **Ratings may involve miscalculations or unforeseen changes not fully captured in a rating agency's forward-looking analysis.**
    - ✓ Credit rating agency analyses failed to anticipate the sharp decline in housing prices that led to the default of highly rated subprime mortgage bonds during the Global Financial Crisis of 2008–2009.

Example

Sources of Credit Risk

- Which of the following choices properly ranks ratings from the three major credit rating agencies from the lowest to highest credit risk?

  A. B1, Ba2, Baa3

  B. BBB+, Ba3, B–

  C. Baa1, BB, Baa3

- Correct Answer: B

Summary

Credit Risk

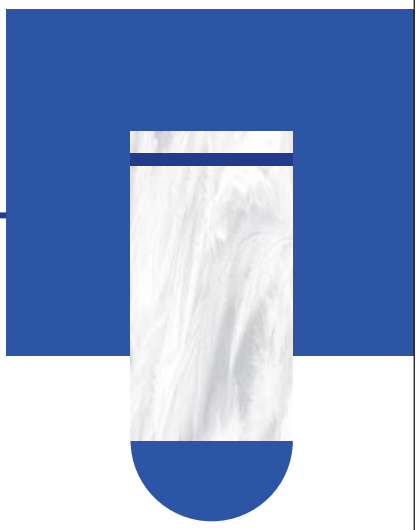
Credit Rating Agencies and Credit Ratings

Credit ratings

Credit Rating Agencies

Factors Impacting Yield Spreads

- Credit Rating Considerations
- The Price Impact of Spread Changes



Factors Impacting Yield Spreads

- **Credit spread risk**
  - **Credit spread risk** is the risk of greater expected loss due to changes in credit conditions as a result of macroeconomic, market, and/or issuer-related factors.
  - **1. Macroeconomic Factors**
    - ✓ As the **business cycle improves**, credit spreads **narrow** and investors are willing to assume more credit risk. A deteriorating credit cycle will cause credit spreads to widen.
    - ✓ Reasons for investing in HY bonds include the following:
      - Portfolio diversification
      - Capital appreciation
        - Economic recovery, or improved issuer-specific performance, often has a **more sizeable positive impact** on **HY** than IG bond prices.
      - Equity-like return with lower volatility

Factors Impacting Yield Spreads

- **Credit spread risk**
  - **2. Market Factors**
    - ✓ **Market liquidity risk**: refers to the transaction costs associated with selling a bond. 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.
      - Liquidity spread: use bid/offer price
  - **3. Issuer-Specific Factors: financial performance**
    - ✓ **Debt coverage** refers to the sufficiency of a borrower's resources or cash flows to make necessary interest and principal payments.
    - ✓ **Leverage** measures a borrower's relative reliance on debt versus other sources of financing.

Factors Impacting Yield Spreads

- **The Price Impact of Spread Changes:**
  - **Spread risk**: the effect on prices and returns from changes in spreads.
  - The price impact can be approximated (a **small**, instantaneous change in yield spread):
    - ✓ $\%\Delta PV^{Full} = -AnnModDur \times \Delta Spread$
  - The price impact can be approximated (**larger** spread changes)
    - ✓ $\%\Delta PV^{Full} = -(AnnModDur \times \Delta Spread) + \frac{1}{2}AnnConvexity \times (\Delta Spread)^2$

Factors Impacting Yield Spreads

- **The Price Impact of Spread Changes:**
  - **Reported convexity:** For option-free bonds, convexity should be scaled so it has the **same order** of magnitude as **duration** squared and the spread change is expressed as a decimal.
  - For example, if a bond has duration of 5.0 and reported convexity of 0.235, then first re-scale convexity to 23.5, and then apply the formula. For a 1% increase in spread, the result would be
    - ✓ $\%\Delta PV_{Full} = (-5.0 \times 0.01) + \frac{1}{2} \times 23.5 \times (0.01)^2 = -0.048825$ or -4.8825%.

Example

Factors Impacting Yield Spreads

- A bond investor observes a bid/offer quote for a 5-year French government zero-coupon bond of 93.75/93.775. The bond's liquidity spread is closest to:
  - A. 0.25 bps.
  - B. 0.05 bps.
  - C. 0.54 bps.

- Correct Answer: C
  - We first calculate the respective bid and offer yields as follows:
  - Offer yield: $93.775 = \frac{100}{(1+r)^5}$, $r_{offer} = 1.2937\%$
  - Bid yield: $93.75 = \frac{100}{(1+r)^5}$, $r_{bid} = 1.2991\%$
  - The liquidity spread of 0.54 bps (0.0054%) is equal to the difference in the bid yield and the offer yield (= 1.2991% − 1.2937%).

Example

Factors Impacting Yield Spreads

- **Decomposition of a Romanian Eurobond Yield**
  - In 2019, the Government of Romania issued a 4.625% 30-year bond, with a spread of 411.4 bps over the 1.25% Federal Republic of 30-year Germany bond. The initial yield spread indicated the combined credit and liquidity risk of the bond.
  - Two years later, the bond was traded at 122.75/125.25 (bid/offer). This meant that a buyer would have to pay the offer price of 125.25 for the bond and a seller would receive the bid price of 122.75. Bond mid-market price = (122.75 + 125.25)/2 = 124.00.
  - With 28 years remaining to maturity, the Romanian bond yield based on its mid-market price is equivalent to 3.2988%:

$$124 = \sum_{n=1}^{28} \frac{4.625}{(1+r)^n} + \frac{100}{(1+r)^{28}}$$

Example

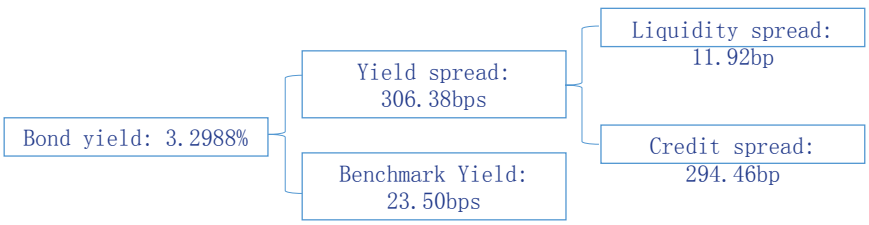
Factors Impacting Yield Spreads

- **Decomposition of a Romanian Eurobond Yield**
  - Assume we observe a Federal Republic of Germany benchmark bund yield of 0.2350% on the same day. The current spread of the Romania bond may be shown as:
    - ✓ = 3.2988% − 0.2350%
    - ✓ = 3.0638% or 306.38 bps.
  - To further break down this spread, we can compute the liquidity spread using the bid/offer prices.
  - At the offer price, the yield is equivalent to 3.2396%:
    - ✓ $125.25 = \sum_{n=1}^{28} \frac{4.625}{(1+r)^n} + \frac{100}{(1+r)^{28}}$
  - At the bid price, the yield is equivalent to 3.3588%:
    - ✓ $122.75 = \sum_{n=1}^{28} \frac{4.625}{(1+r)^n} + \frac{100}{(1+r)^{28}}$
  - Therefore: Liquidity spread = 3.3588% − 3.2396% = 0.1192% or 11.92 bps. Credit spread = 306.38 bps − 11.92 bps = 294.46 bps.

Example

Factors Impacting Yield Spreads

- **Decomposition of a Romanian Eurobond Yield**
  - These "building blocks" of the Romania bond yield are summarized below:



Summary

Credit Risk

Factors Impacting Yield Spreads

Credit Rating Considerations

The Price Impact of Spread Changes

Summary

Module: Credit Risk

Sources of Credit Risk

Credit Rating Agencies and Credit Ratings

Factors Impacting Yield Spreads

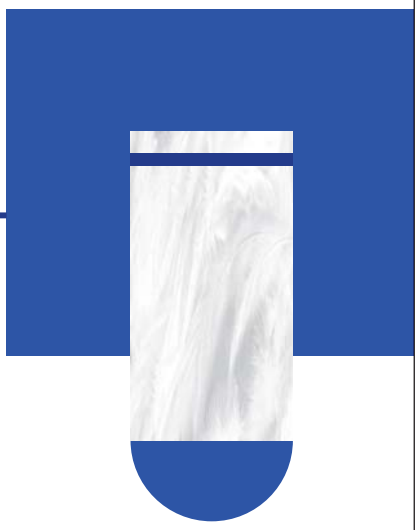
Module

Credit Analysis for Government Issuers

1. Sovereign Credit Analysis
2. Non-Sovereign Credit Risk

Sovereign Credit Analysis

- Qualitative Factors
- Quantitative Factors



Sovereign Credit Analysis

- **Major difference between sovereign issuers and corporate issuers**
  - Use of proceeds
  - Source of repayment (Operating cash flow vs. Tax revenue and other income such as tariff)
- **Analysis of a sovereign issuers**
  - While sovereign bonds in the most **advanced** economies are often considered **default risk-free,** those issued by **emerging and frontier market governments** involve **greater default risk**.
  - Combination of **qualitative** and **quantitative** factors is used to analyze a sovereign issuer's ability and willingness to pay.

Sovereign Credit Analysis

- **Qualitative Factors:**
  - **1. Government Institutions & Policy**
    - ✓ 1) This factor addresses the role of sovereign government institutions and policies in **improving political and economic stability. (ability to pay)**
    - ✓ 2) In addition to a sovereign government's ability to pay, we must also consider its **willingness to pay.**
      - Willingness is important because **principle of sovereign immunity**
        - It is difficult for investors to force a sovereign government to declare bankruptcy or liquidate its assets to settle debt claims as would be the case for a corporate issuer.

Sovereign Credit Analysis

- **Qualitative Factors:**
  - **2. Fiscal Flexibility**
    - ✓ Sovereign governments are also evaluated on how well they establish and maintain **fiscal discipline** over time and under different economic conditions, such as reduce deficit.
  - **3. Monetary Effectiveness**
    - ✓ **Central bank independence** from the public Treasury **reduces the likelihood** that a sovereign government will **monetize their domestic debt**, driving domestic inflation higher and reducing the external value of the domestic currency.
      - Simply print money to purchase gov debt.
  - **4. Economic Flexibility**
    - ✓ available to tax and service debt is usually the primary source of debt repayment.
    - ✓ Key factors important in gauging creditworthiness include not only the size of an economy and level of per capital income, but also the degree of **economic diversification** and **economic growth potential**.

Sovereign Credit Analysis

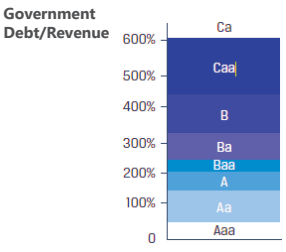
- **Qualitative Factors:**
  - **5. External Status**
    - ✓ External status or governance refers to how a sovereign government's international trade, international capital flow, and foreign exchange policies influence its ability to support and service outstanding debt.
      - Monetary policy credibility and the exchange rate regime have a significant effect on international capital flows.
    - ✓ A key distinction for the creditworthiness of a sovereign government is whether its domestic currency is considered to be a **reserve currency**
      - That is fully convertible and frequently held by foreign central banks and other investors as a portion of their foreign exchange reserves.
      - minimizes the likelihood of sovereign default and increases a government's ability to sustain budget deficits and a higher level of debt.

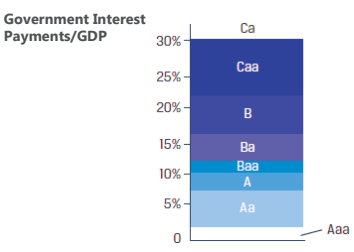
Sovereign Credit Analysis

- **Quantitative Factors:**
  - **1. Fiscal Strength**
    - ✓ **Debt burden:** both its current and expected future debt burden
      - **higher** debt burden ratio is associated with **lower** credit quality
    - ✓ Debt affordability
      - Debt coverage, with a **higher** ratio also a sign of **lower** credit quality

Fiscal Strength

Debt Burden	Debt Affordability
Debt to GDP: General Government Debt / GDP	***Interest to GDP:*** Government Interest Payments / GDP
Debt to Revenue: *General Government Debt / Revenue*	***Interest to Revenue:*** Government Interest Payments / Revenue





Sovereign Credit Analysis

- **Quantitative Factors:**
  - **2. Economic Growth and Stability**
    - ✓ The **economy's size** as measured by **GDP** as well as its **per capita income** are important factors in gauging a country's economic prospects.
    - ✓ **Economic growth** levels as well as their **variability** also important.

Economic Growth and Stability

Growth and Volatility	Size and Scale
Average Real GDP Growth: $\frac{\text{Real GDP}_t - \text{Real GDP}_{t-1}}{\text{Real GDP}_{t-1}}$	**Size of Economy:** GDP in PPP terms
Real GDP Growth Volatility: Standard Deviation (Real GDP)	**Per Capita GDP**: $\frac{\text{GDP}}{\text{Population}}$

Sovereign Credit Analysis

- **Quantitative Factors:**
  - **3. External Stability**
    - ✓ focus on the relative size of external debt as compared to available sources of repayment.
      - Country with **reserve currency** exhibit **greater** external stability.
      - For **non-reserve currency ,** key factor is its **external liquidity and solvency.** That is, the short- and long-term ability to generate **sufficient, stable, diversified foreign currency cash inflows** is important.

External Stability

Currency Reserves	External Debt
FX Reserves to GDP: $\frac{\text{FX Reserves}}{\text{GDP}}$	***External Debt Burden:*** $\frac{\text{LT External Debt}}{\text{GDP}}$
Reserve Ratio: $\frac{\textit{FX Reserves}}{\textit{External Debt}}$	***External Debt Due:*** $\frac{\text{External Debt Due in 12m}}{\text{GDP}}$

Example

Factors Impacting Yield Spreads

- Which of the following is a key ratio to measure the fiscal strength of a sovereign government?
  - A. FX reserves to GDP
  - B. Government interest payments to GDP
  - C. GDP to population

- Correct Answer: B
  - Measuring a sovereign issuer's relative fiscal strength depends upon both its current debt burden as well as the relative reliance on debt versus other financial resources. Debt burden measures provide an indication of a government's solvency, one of which is the level of government interest payments as a percentage of GDP.

Summary

Credit Analysis for Government Issuers

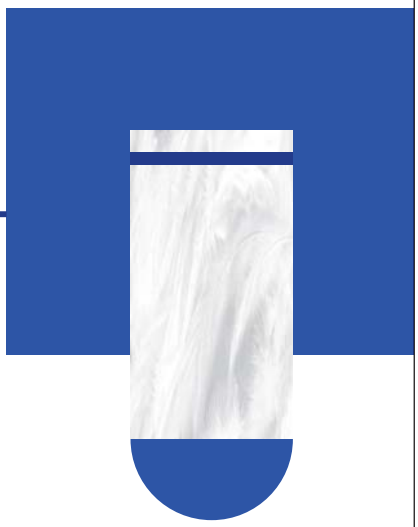
Sovereign Credit Analysis

Qualitative Factors

Quantitative Factors

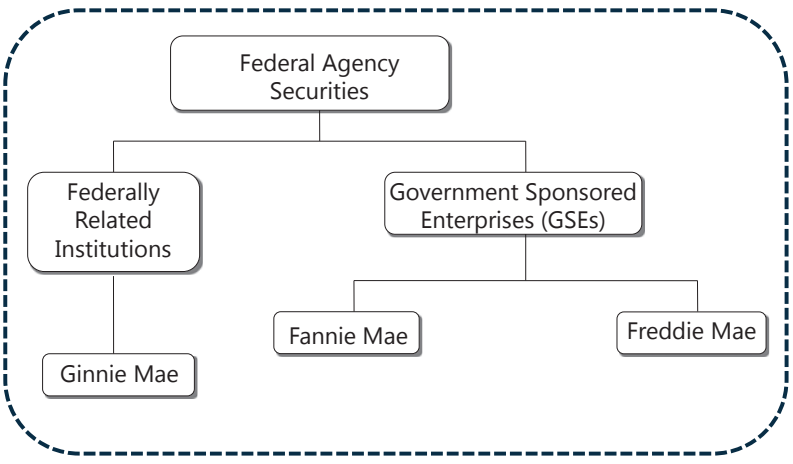
Non-Sovereign Credit Risk

- Types of Non-Sovereign Government Debt



Non-Sovereign Credit Risk

- **1. Agencies:** issued by entities created by national government and may be explicitly or implicitly backed by government.



Non-Sovereign Credit Risk

- **2. Government Sector Banks and Development Financing Institutions**
  - Sovereign governments often sponsor the establishment of specialized financial intermediaries to operate in a specific market or to promote specific sovereign political, economic, social, or other growth and policy objectives.
  - Similar to agencies, these institutions are usually created or supported by the sovereign government and enjoy a similar rating.

Non-Sovereign Credit Risk

- **3. Supranational Issuers**
  - issued by supranational agencies (multilateral agencies) that operate across national.
  - High credit quality and can be very liquid, especially large issues of well-known entities.
  - E.g. World bank, the IMF, the Asian Development Bank.

Non-Sovereign Credit Risk

- **4. Regional Government Issuers**
  - These include provincial, state, and local governments, referred to as municipal bonds in the US and most often as local authority bonds elsewhere.
  - 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.
      - Debt service coverage ratio (DSCR): a measure of revenue available to cover principal and interest payments. Higher, safer.

Summary

Credit Analysis for Government Issuers

Non-Sovereign Credit Risk

Non-Sovereign Government Debt

Summary

Module: Credit Analysis for Government Issuers

Sovereign Credit Analysis

Non-Sovereign Credit Risk

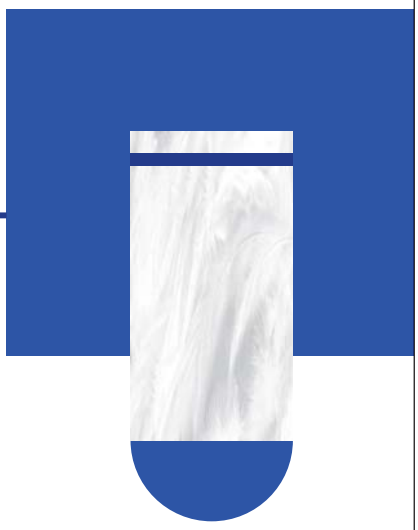
Module

Credit Analysis for Corporate Issuers

1. Corporate Credit Analysis
2. Seniority Rankings, Recovery Rates, and Credit Ratings

Corporate Credit Analysis

- Qualitative and quantitative factors
- Financial ratios used in credit analysis

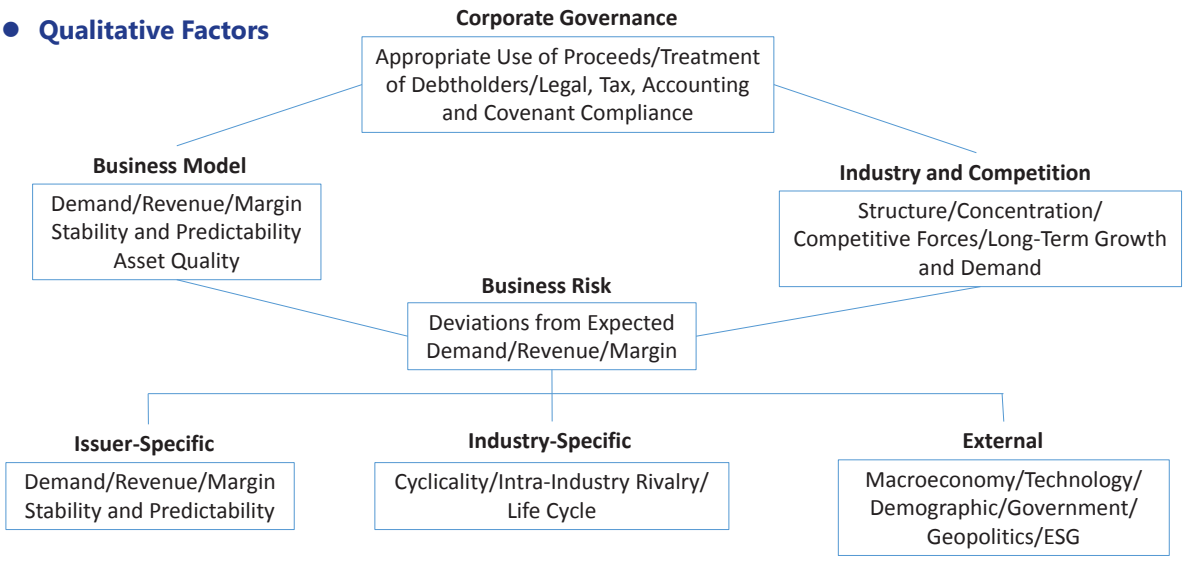


Corporate Credit Analysis

- **Assess corporate issuers**
  - A company's creditworthiness depends primarily on its ability to **generate profits and cash flow sufficient** to meet interest and principal payments.
  - Analysts rely on both **qualitative** and **quantitative** factors to evaluate both the likelihood of corporate default as well as an investor's loss in the event of a default.

Corporate Credit Analysis

- **Qualitative Factors**

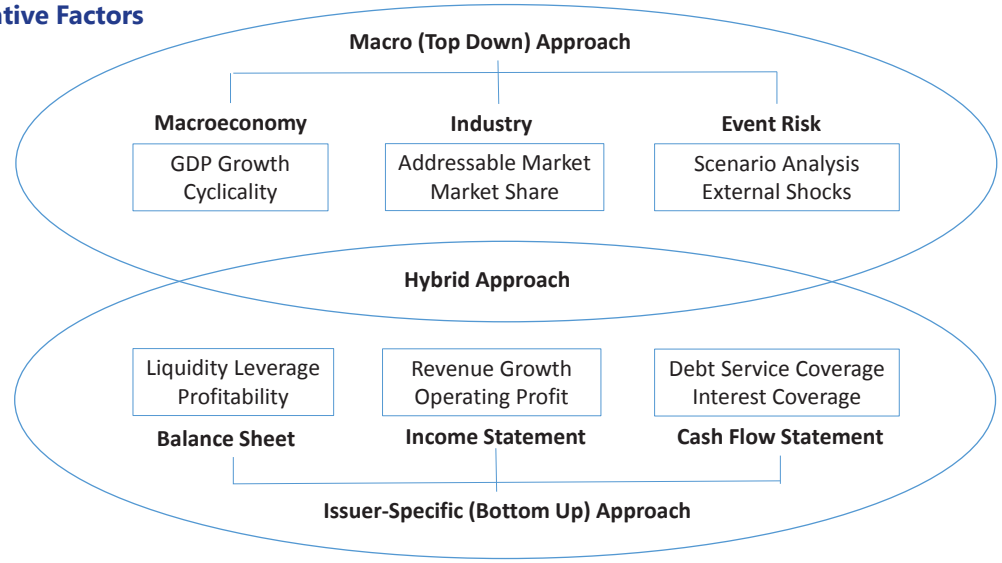


Corporate Credit Analysis

- **Corporate Governance**
  - Management's past track record in the treatment of bondholders is an important consideration. For example, if management pursued business or financial strategies that resulted in major credit rating downgrades—such as an overleveraged debt-financed acquisition, a large debt-financed special dividend to shareholders, or a major debt-financed stock buyback program—credit analysts should look closely at the borrower's character.
  - Credit analysts should also evaluate accounting policies. Aggressive accounting policies mask the performance and the risk of the underlying business and are potential warning flags to the true character of the business and its leaders. Examples may include the use of significant off-balance-sheet financing, the preference for capitalizing versus immediately expensing items, and early and premature revenue recognition. Perhaps the **most important red flag** is **changing auditors or CFOs frequently.** These potential warning flags, as well as any evidence of fraud or malfeasance, may signal other behaviors or actions that may adversely impact an issuer's creditworthiness.

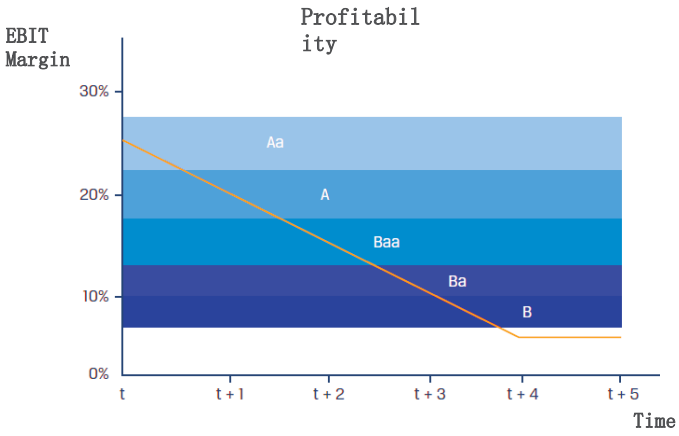
Corporate Credit Analysis

- **Quantitative Factors**



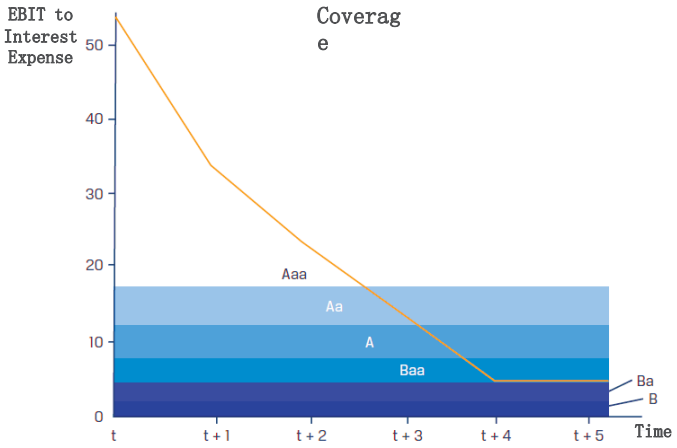
Corporate Credit Analysis

- **Financial ratios used in credit analysis**
  - **1. Profitability:** strong and stable earnings are important in generating the cash flows that are a primary source of debt repayment. Typically focus on operating profits and recurring revenues as opposed to non-recurring or one-time gains. Such as **EBIT margin.**



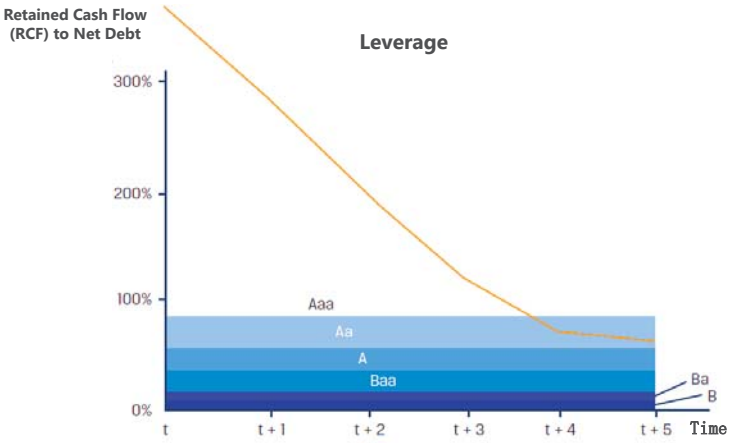
Corporate Credit Analysis

- **Financial ratios used in credit analysis**
  - **2. Coverage:** comparing periodic income to debt service. Greater coverage means that debt investors benefit from higher income or cash flows from which fixed debt obligations can be paid. Such as **EBIT to Interest Expense, EBITDA to Interest Expense.**



Corporate Credit Analysis

- **Financial ratios used in credit analysis**
  - **3. Leverage,** such as **Debt to EBITDA or Debt to Capital, FCF to debt,** lower leverage, higher credit quality.
  - **4. Liquidity:** often consider availability of short-term resources to pay interest or principal and committed line of bank credit.



Example

Corporate Credit Analysis

- All else being equal, a borrower will have higher capacity to repay its debt in an industry where the:
  - A. barriers to entry are higher.
  - B. threat of substitutes is higher.
  - C. bargaining power of buyers is higher.

- Correct Answer: A
  - An industry with higher barriers to entry tend to have lower threat of new entrants and lower competition. All else being equal, a borrower in such an industry has higher capacity to support its debt.

Example

Corporate Credit Analysis

- Companies X, Y, and Z belong to the same industry with the following financial ratios:

	Company X	Company Y	Company Z
EBITDA margin	15%	18%	18%
Free cash flow (FCF) after dividends/ debt	10%	10%	8%
Debt/EBITDA	1.5	1.5	1.8
Debt/capital	35%	35%	38%
EBITDA/interest	5.6	6.2	6.2

- Based on the following financial ratios only, which company has the lowest credit risk?

A. Company X

B. Company Y

C. Company Z

Example

Corporate Credit Analysis

- Correct Answer: B
  - Compared to Company X, Company Y has similar leverage metrics but better profitability and coverage. Compared to Company Z, Company Y has similar profitability and coverage but better leverage ratios. Also, when viewing all the metrics, Company Y has either the same value or better than the other two companies. Therefore, Company Y has the lowest credit risk among the three companies.

Summary

Credit Analysis for Corporate Issuers

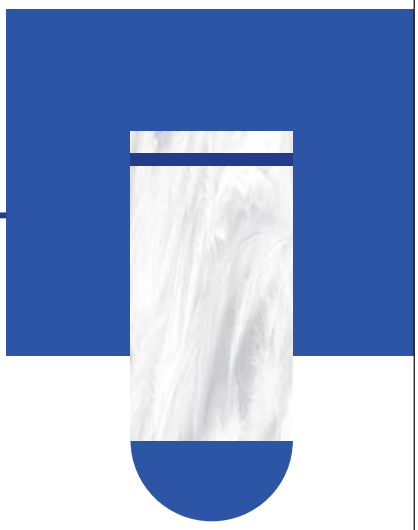
Corporate Credit Analysis

Qualitative and quantitative factors

Financial ratios used in credit analysis

Seniority Rankings, Recovery Rates, and Credit Ratings

- Seniority rankings
- Recovery Rates
- Issuer and Issue Ratings

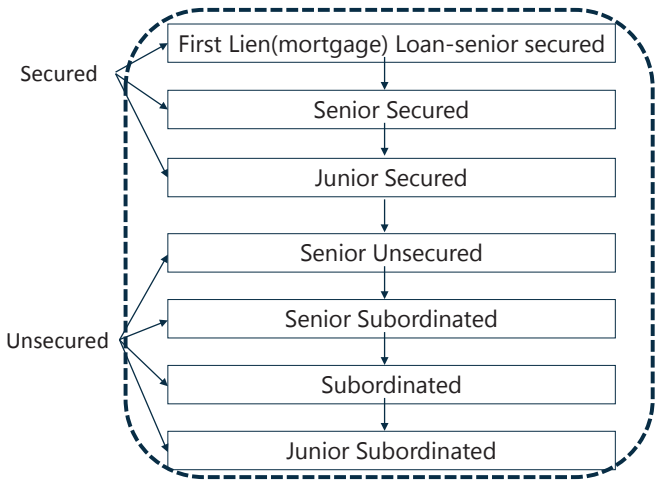


Seniority Rankings, Recovery Rates, and Credit Ratings

- **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 Rankings, Recovery Rates, and Credit Ratings

- **Seniority Ranking**



Seniority Rankings, Recovery Rates, and Credit Ratings

- **Priority of claims:** in the event of default, unsecured debtholders claim rank below (i.e., get paid after) those of secured creditors.
  - **Secured debt**: the debtholder has a direct claim 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.
    - ✓ If the value of the pledged property is less than the amount of the claim, then the difference becomes a senior unsecured claim.
  - **Unsecured debt** is often referred to as debentures. Unsecured bondholders have only a general claim on an issuer's assets and cash flow.
    - ✓ **Senior unsecured debt is the most common type of corporate bond**.

Seniority Rankings, Recovery Rates, and Credit Ratings

- **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.

Seniority Rankings, Recovery Rates, and Credit Ratings

- **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.

Seniority Rankings, Recovery Rates, and Credit Ratings

- **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.

Seniority Rankings, Recovery Rates, and Credit Ratings

- **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.

Example
Seniority Rankings, Recovery Rates, and Credit Ratings

- A company faces impairment on its net current assets (other than cash) of USD90. Identify the potential recovery of the company's debt according to the priority of claims in an event of default:

Assets	USD	Liabilities & Equity	USD
Cash	40	Secured bank loans (secured by cash collateral)	30
Net Current Assets (other than Cash)	100	Unsecured bonds	90
Net Fixed Assets	60	Subordinated bonds	10
		Common shares	40
		Retained earnings	30
Total Assets	200	Total Liabilities & Equity	200

A. Shareholders and subordinated debtholders receive zero recovery, while unsecured bondholders receive partial recovery.

B. Unsecured debtholders receive zero recovery as the impairment equals the amount of unsecured debt outstanding.

C. Subordinated and unsecured bondholders both face partial recovery, as the impairment is greater than the sum of these bonds outstanding.

Example
Seniority Rankings, Recovery Rates, and Credit Ratings

- Correct Answer: A
  - The seniority ranking of the capital structure is as follows:
  - Secured bank loans > Unsecured bonds > Subordinated bonds > Equity
  - The USD90 impairment will initially be absorbed by the company's most junior claim, equity (including common shares and retained earnings), with a total equity value of USD70 (40 + 30 = 70).
  - The remaining USD20 (USD90 – USD70) impairment balance will be borne by the next junior claim, subordinated bonds. As subordinated bonds total just USD10, they have zero recovery.
  - The remaining USD10 impairment is allocated to the unsecured bonds. The USD10 impairment reduces the recovery to USD80 (USD90 – USD10). The USD30 bank loans secured by cash collateral are unaffected, as the cash collateral value of USD40 fully covers this loan.

Example
Corporate Credit Analysis

- Two senior unsecured bonds of the same issuer of different maturities have the same:
  A. issue credit rating only.
  B. issuer credit rating only.
  C. issuer and issue credit rating.

- Correct Answer: C
  - An issuer rating usually applies to its senior unsecured debt and is meant to address an obligor's overall creditworthiness. All senior unsecured bonds are treated as one class and rank pari passu irrespective of maturity. Therefore, both the issuer and the issue credit ratings are the same.

Summary

Credit Analysis for Corporate Issuers

Seniority Rankings, Recovery Rates, and Credit Ratings

seniority rankings

recovery Rates

issuer and Issue Ratings

Summary

Module: Credit Analysis for Corporate Issuers

Corporate Credit Analysis

Seniority Rankings, Recovery Rates, and Credit Ratings

Module

Fixed-Income Securitization

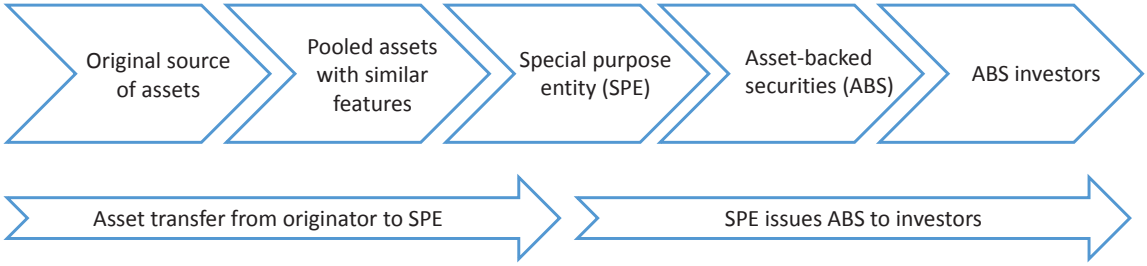
1. The Benefits of Securitization
2. The Securitization Process

The Benefits of Securitization

- Benefits to Issuers, Investor and Economies and Financial Markets

The Benefits of Securitization

- **Securitization**



The Benefits of Securitization

- **Benefits to Issuers**
  - Selling illiquid assets and operate more efficiently, then improving their profitability;
  - Earning loan origination fees;
  - Reducing capital requirements for loans that are sold to investors;
  - Enable bank to expand lending origination beyond their balance sheets.
- **Benefits to Investors**
  - Allowing investors to tailor interest rate and credit risk exposures to suit their specific risk, return, and maturity needs.
  - Increasing exposure to the risk–return characteristics of a wider range of underlying assets, easier to make asset liability match.

The Benefits of Securitization

- **Benefits to Economies and Financial Markets**
  - Create tradable security with higher liquidity, improving overall liquidity in the financial system and reduces liquidity risk;
  - Providing an alternative means of funding business operations beyond traditional financing tools, such as bonds, preferred equity, and common equity; reducing their funding costs by pooling securitizable assets (often receivables and loans), which increases their return on capital versus borrowing though traditional financing methods;
  - Facilitating the process of selling their products by extending credit to their customers, usually through their financing subsidiary, capturing the benefits of a cheaper source of funding without reducing the company's overall credit quality.

Summary

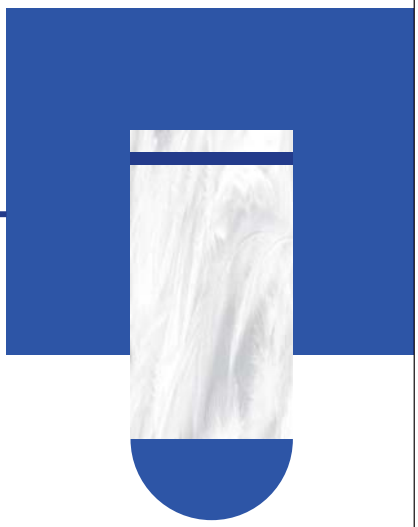
Fixed-Income Securitization

The Benefits of Securitization

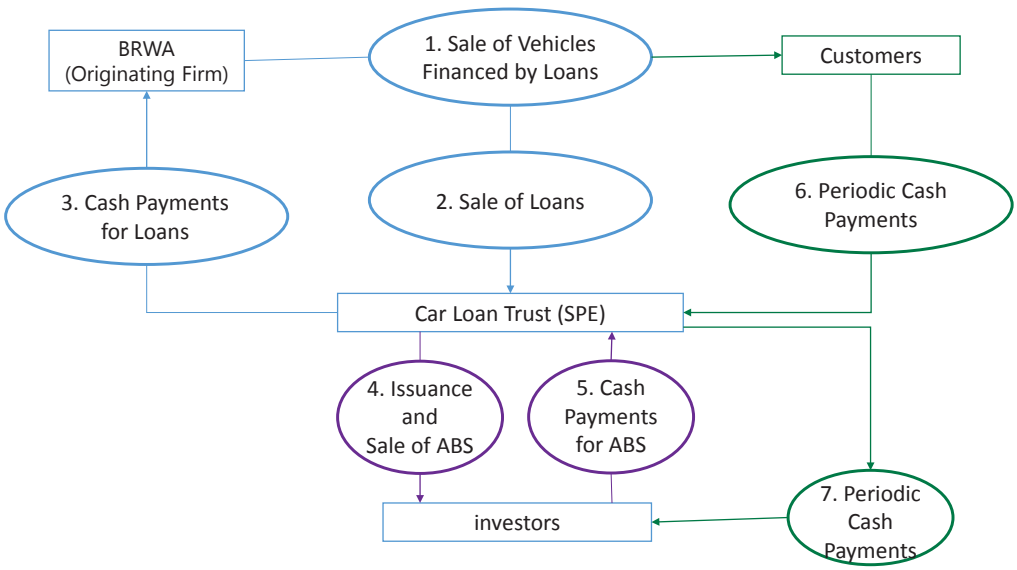
Benefits to Issuers, Investor and Economies and Financial Markets

The Securitization Process

- Securitization Process
- Parties to a Securitization



The Securitization Process



The Securitization Process

- **Parties to a Securitization**
  - **Three main parties**:
    - ✓ The seller of the collateral (originator or depositor, e.g. Bank)
      - Purchase agreement
      - Prospectus: structure of the securitization, priority and amount of payment, credit enhancement
    - ✓ The SPE (issuer)
    - ✓ The servicer of the loans
  - **Other parties**:
    - ✓ Independent accountants, lawyers/attorneys: Prepare Legal documents
    - ✓ Trustee or trustee agent: safeguard the assets after placed in the trust, hold funds due to the bondholders until they are paid, provides periodic information to the bondholders.
    - ✓ Underwriters, Rating agencies: perform same function as they do in a standard corporate bond offering
    - ✓ Guarantors: guarantees part of the obligations issued by the SPV.

The Securitization Process

- **Benefits of SPE in securitization: sell the loan to SPE instead of using it as collateral**
  - Protect investors from the seller's bankruptcy
    - ✓ SPE is a **bankruptcy-remote** vehicle.
      - Assets belong to the SPE, not to the entity that sold the assets to the SPE in exchange for funds
    - ✓ The **only credit risk** that the investors face is the risk that the borrowers default on their loans.
      - Thus, lower cost compared with corporate bond when issued by same collateral.

Example

The Securitization Process

- Questions 1 to 4 are based on the following example:
- Ahbaling Industries (Ahbaling), a manufacturer of industrial machine tools based in Johor, Malaysia, has SGD500 million of corporate bonds outstanding. These bonds have a credit rating below investment grade. Ahbaling has SGD400 million of receivables on its balance sheet that it would like to securitize. Ahbaling's finance subsidiary sells the receivables to Ahbaling Trust, an SPE. Ahbaling Trust then issues ABS, backed by the pool of receivables, with the following structure:

Bond Class	Par Value (SGD millions)
A (senior)	280
B (subordinated)	60
C (subordinated)	60
Total	400

Example

The Securitization Process

- 1. Identify the correct order for the following steps related to securitizing receivables of Ahbaling Industries:

	A. Investors buy securities based on their preferred level of risk and return.
	B. Ahbaling pools SGD400 million in receivables.
	C. Ahbaling sells machine tools on credit.
	D. ABS are issued.
	E. Segregated receivables are sold to Ahbaling Trust.

- Correct Answer:

Step 1	C. Ahbaling sells machine tools on credit.
Step 2	B. Ahbaling pools SGD400 million in receivables.
Step 3	E. Segregated receivables are sold to Ahbaling Trust.
Step 4	D. ABS are issued.
Step 5	A. Investors buy securities with their preferred level of risk and return.

Example

The Securitization Process

- 2. If Ahbaling Industries issues SGD400 million in corporate bonds one year from now:
  - A. the new bonds will be senior to the ABS.
  - B. the ABS will be senior to the new bonds.
  - C. seniority will not apply between the new bonds and the ABS.

- Correct Answer: C
  - Since the new bonds are issued by Ahbaling Industries and the ABS are issued by Ahbaling Trust, two distinct entities, seniority will not apply.

Example

The Securitization Process

- 3. Investors considering the purchase of the ABS bonds will rely most on:
  - A. the financial health of Ahbaling Trust.
  - B. the financial health of Ahbaling Industries.
  - C. the default risk associated with collecting payments from Ahbaling customers.

- Correct Answer: C
  - As long as Ahbaling's customers make the interest payments and/or principal repayments on their loans, Ahbaling Trust will be able to make cash payments to the ABS investors. The legal implication of setting up Ahbaling Trust is that investors contemplating the purchase of any ABS backed by the cash flows from the pool of Ahbaling receivables will evaluate the default risk associated with collecting the payments from the machine tool customers. The credit quality and default risk of Ahbaling Industries are no longer directly relevant.

Example

The Securitization Process

- 4. Identify the most important reason why the ABS issued by Ahbaling Trust offers a lower interest rate than the existing Ahbaling Industries corporate bonds outstanding.
  - A. Ahbaling Industries' existing bonds are rated below investment grade.
  - B. Ahbaling Trust would not be affected if Ahbaling Industries files for bankruptcy.
  - C. The ABS issued by Ahbaling Trust are secured by collateral, the receivables purchased from Ahbaling Industries.

- Correct Answer: C
  - A secured bond is secured by collateral and is considered less risky than an unsecured bond without collateral backing, and accordingly, has a lower credit spread than an unsecured bond.

Summary

Fixed-Income Securitization

The Securitization Process

Securitization Process

Parties to a Securitization

Summary

Module: Fixed-Income Securitization

The Benefits of Securitization

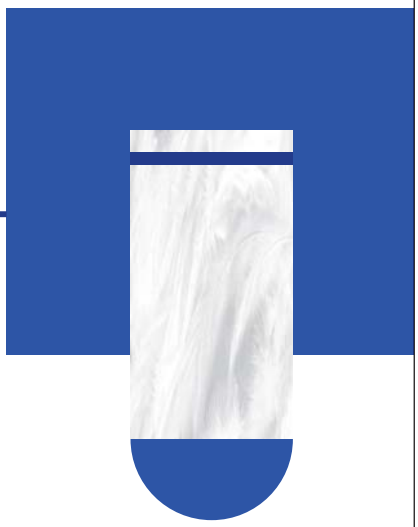
The Securitization Process

Module

Asset-Backed Security (ABS) Instrument and Market Features

1. Covered Bonds
2. ABS Structures to Address Credit Risk
3. Non-Mortgage Asset-Backed Securities
4. Collateralized Debt Obligations

Covered Bonds



- Covered bonds

Covered Bonds

- **Covered bonds** are senior debt obligations issued by a financial institution and backed by a segregated pool of assets that typically consist of commercial or residential mortgages or public sector assets.

Covered Bond Issuer (Bank)	
Assets	**Liabilities**
Cash Loans Other assets	Deposits Debt Equity

Bank ringfences certain eligible loans to create the Cover Pool

Covered bonds

Cover Pool — **Covered bond investors**

Interest and principal repayments

Asset monitor

Reviews the Cover Pool

1. Claim on the Cover Pool
2. Recourse to the unencumbered assets of the issuer

Covered Bonds

- **Covered bonds**
  - Covered bonds are similar to ABS but offer bondholders **dual recourse**—that is, to both the **issuing financial institution and the underlying asset pool**.
  - In the case of ABS, the financial institution that originates loans transfers securitized assets to a bankruptcy-remote special legal entity, but the pool of underlying assets in a covered bond **remains on the financial institution's balance sheet.** Covered bondholder retain a top-priority claim.
- **Asset pool of covered bonds**
  - Covered bonds usually **consist of one bond class** per cover pool, i.e. no tranching.
  - **Dynamic nature:** The assets in the pool are monitored by a third party for performance and adherence to underwriting standards. Moreover, the covered bond issuer must replace any prepaid or non-performing assets (i.e., assets that do not generate the promised cash flows) to ensure sufficient cash flows until the maturity of the covered bond.

Covered Bonds

- **Additional tools to mitigate risk of investors**
  - Overcollateralized.
  - Loan to value (LTV) on the mortgages included in the transactions must meet certain standards to be eligible for inclusion in the pool. If a mortgage fails to meet the LTV criteria, it is replaced with another mortgage that meets the criteria.
    - ✓ For example: LTV cut-off: 80%
- **Redemption regimes** exist to align the covered bond's cash flows as closely as possible with the original maturity schedule in the event of default of a covered bond's financial sponsor.
  - **Hard-bullet covered bonds**: if payments do not occur according to the original schedule, a **bond default is triggered** and bond payments are accelerated.
  - **Soft-bullet covered bonds** **delay the bond default** and payment acceleration of bond cash flows until a new final maturity date, which is usually up to a year after the original maturity date.

Covered Bonds

- **Advantages**
  - Dual recourse nature (ringfenced loans and unencumbered asset of issuing financial institution) ;
  - Strict eligibility criteria;
  - Dynamic cover pool;
  - Redemption regimes in the event of sponsor default.
- As a result, covered bonds usually carry **lower credit risks** and **offer lower yields** than otherwise **similar ABS.**

Example

Covered Bonds

- Which of the following statements about covered bonds is correct?
  - A. Covered bonds have a single recourse nature.
  - B. Covered bonds have lower credit risk and offer lower yields than otherwise similar ABS.
  - C. Covered bonds are removed from the issuer's balance sheet and are ringfenced into a separate cover pool.

- Correct Answer: B
  - Covered bonds have remained a relatively stable and reliable source of funding over time because of their dual recourse nature, strict eligibility criteria, dynamic cover pool, and redemption regimes in the event of sponsor default. As a result, covered bonds usually carry lower credit risks and offer lower yields than otherwise similar ABS.

Summary

Asset-Backed Security (ABS) Instrument and Market Features

Covered Bonds

Covered bonds

ABS Structures to Address Credit Risk

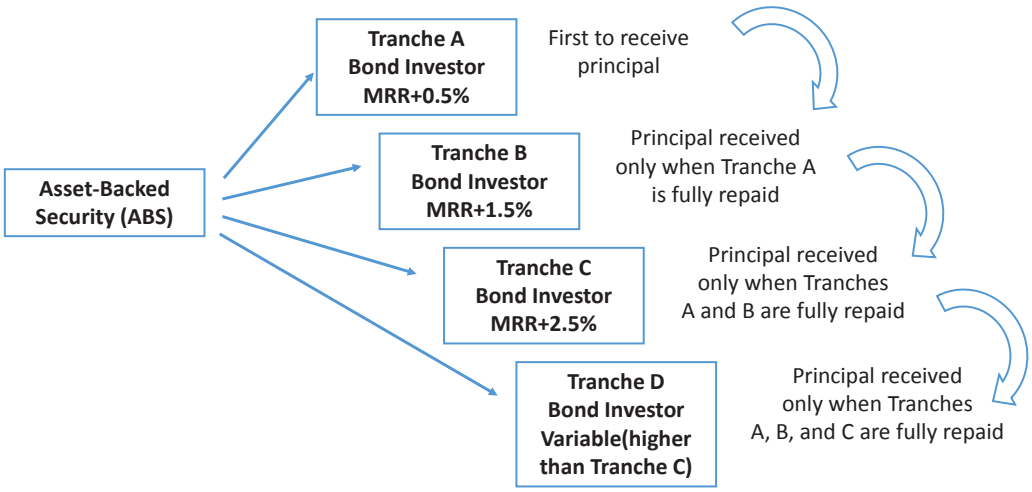
- Credit Enhancement
- Credit Tranching

ABS Structures to Address Credit Risk

- **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;
    - ✓ **Reserve accounts** or **reserve funds:** provide credit support by paying for possible future losses.
      - **Cash reserve fund:** deposit of cash that can be used to absorb losses.
      - **Excess spread:** difference between the coupon on the underlying collateral and the coupon paid on the securities.
    - ✓ **Subordination/credit tranching:** Creating more than one bond class or tranche and ordering the claim priorities for ownership or interest in an asset between the senior/subordinated(junior) tranches. In the event of default, the proceeds from liquidating assets will first be used to repay the most senior creditors.

ABS Structures to Address Credit Risk

- **Credit tranching**:



ABS Structures to Address Credit Risk

- **Credit tranching**: Different tranches have different risk exposures.
  - Subordination functions as **credit protection for the more senior bond classes**; that is, **losses are realized by the subordinated bond classes** before any losses are realized by the senior bond classes.
  - This type of protection is also commonly referred to as a **"waterfall" structure** because of the cascading flow of payments between bond classes in the event of default. This waterfall structure **redistributes the credit risk** associated with the collateral.
    - ✓ So, some senior tranches may have a **better credit rating** than the issue company.
  - The creation of a set of bond classes **allows investors to choose the level of risk that they prefer to bear and receive a return accordingly.**

ABS Structures to Address Credit Risk

- **Credit enhancement (cont.)**
  - **External credit enhancement:**
    - ✓ **Surety bond:** issued by insurance companies and are a promise to make up any shortfall in the cash available to service the debt.
    - ✓ **Bank guarantee**: similar to surety bond, the major difference is that it issued by a bank.
    - ✓ **Letter of credit:** a promise to lend money to the issuing entity if it does not have enough cash to make the promised payments on the covered debt.

ABS Structures to Address Credit Risk

- **Limitation of External credit enhancement:**
  - While external credit enhancements increase the credit quality of debt issues and decrease the yields, deterioration of credit quality of the guarantor will also reduce the credit quality of the covered issue.
  - Surety bonds, bank guarantees, and letters of credit expose the investor to **third-party (or counterparty) risk**, 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.

ABS Structures to Address Credit Risk

Example: Which tranche first absorb if any loss occurs

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

- Solution: Tranche B is first to absorb any losses.

Example

ABS Structures to Address Credit Risk

- For Questions 1 and 2, please refer to the additional information below regarding the ABS issued by Ahbaling Trust.

Bond Class	Par Value (SGD millions)	Interest Rate	When Principal Is Repaid If No Prepayments in the Pool	Credit Enhancement Features
A (senior)	280	MRR + 1.0%	One year, per ABS terms	Subordination of the Class B and the Class C Notes
B (subordinated)	60	MRR + 2.0%	Two years, per ABS terms	Subordination of the Class C Notes
C (subordinated)	60	MRR + 4.0%	Three years, per ABS terms	None
Total	400			

Example

ABS Structures to Address Credit Risk

- 1. Calculate the value for each of the three bond classes if SGD140 million of the securitized receivables backing the ABS default.
- Correct Answer:

Bond Class	Initial Value (SGD millions)	After Default (SGD millions)
A (senior)	280	260
B (subordinated)	60	0
C (subordinated)	60	0

  - The rules for the distribution of losses are as follows. All losses on the collateral are absorbed by Bond Class C before any losses are realized by Bond Class B and then Bond Class A. Consequently, if the losses on the collateral are SGD140 million, then the entire SGD60 million par value of Bond Class C is lost, as is the entire SGD60 million par value of Bond Class B. Bond Class A loses SGD20 million of its original SGD280 million par value.

Example

ABS Structures to Address Credit Risk

- 2. Identify the new maturity dates for the three bond classes if economic conditions worsen, driving up interest rates in year three.
- Correct Answer:

Bond Class	When Principal Is Repaid If No Prepayments in the ABS Pool	When Principal Is Repaid If Interest Rates Increase, Causing Some Borrowers to Slow Their Payments
A (senior)	One year, per ABS terms	One year, per ABS terms
B (subordinated)	Two years, per ABS terms	Two years, per ABS terms
C (subordinated)	Three years, per ABS terms	Potentially more than three years

Summary

Asset-Backed Security (ABS) Instrument and Market Features

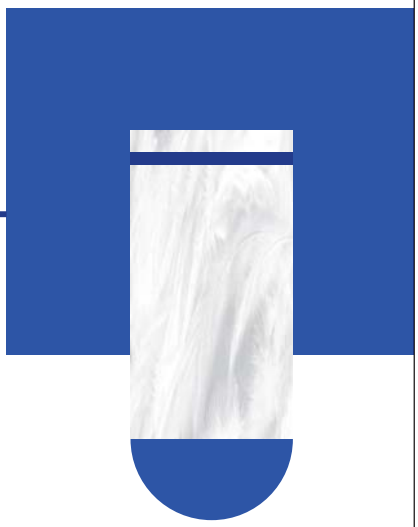
ABS Structures to Address Credit Risk

Credit Enhancement

Credit Tranching

Non-Mortgage Asset-Backed Securities

- Credit Card Receivable ABS
- Solar ABS

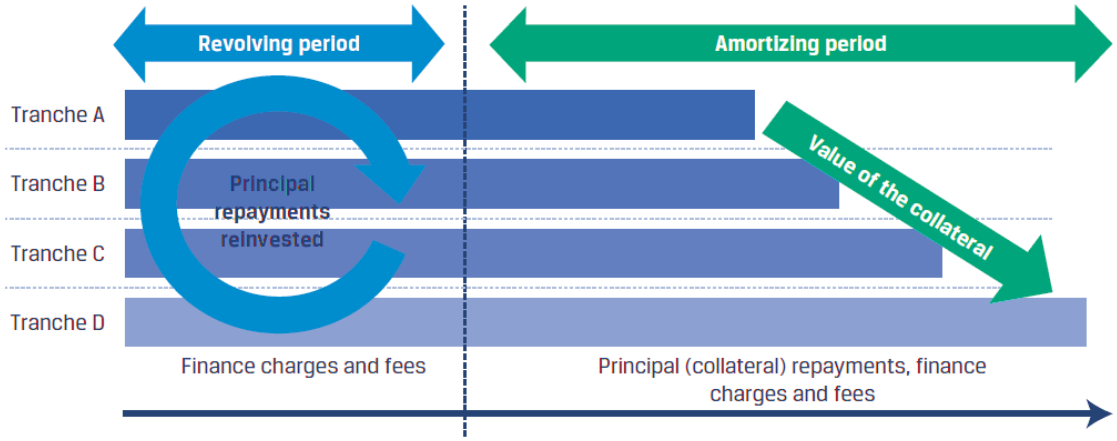


Non-Mortgage Asset-backed Securities

- **1. Credit Card Receivable ABS:** credit card receivables are used as collateral for the issuance
  - **Underlying asset pool**
    - ✓ **Non-amortizing loans,** do not involve scheduled principal repayment. But in non-amortizing collateral pool, it would happen after lockout period.
    - ✓ **Lockout periods (revolving period):** cash flow paid out based on finance charges and fees.
      - **After lockout periods:** principal no longer reinvested in acquiring new loans but paid to investors.
  - For a pool of credit receivables, the cash flows consist of
    - ✓ **Finance charges:** periodic interest charged on the unpaid balance after the grace period.
    - ✓ **Fees:** include late payment fees and any annual membership fees.
      - ABS generate **additional fee income from interest gap**.
    - ✓ **Principal repayments**
      - "Early amortization" or "rapid amortization" provisions require early principal amortization if specific events occurs, such as significantly defaults; which **decrease** the cost of default risk from credit card debt.

Non-Mortgage Asset-backed Securities

- **Example: Cash Flows from a Credit Card ABS**



Non-Mortgage Asset-backed Securities

- **2. Solar ABS**
  - Many specialty finance companies have begun to offer specialized home improvement financing options: solar loans or solar leases.
    - ✓ **Solar loans** allow consumers to borrow the cost of purchasing and the system from an installer.
    - ✓ **Solar leases** involve renting the solar equipment directly from a solar company.
  - Institutional investors have become interested in purchasing solar ABS as these structures offer the opportunity to contribute to sustainability while generating attractive risk-adjusted yields.
    - ✓ Sustainability: since the energy payment always exists

Non-Mortgage Asset-backed Securities

- **2. Solar ABS**
  - An additional feature is that the proceeds are directed to **financing green or environmentally friendly projects**.
    - ✓ Because solar loans facilitate environmentally sustainable benefits through the installation of a renewable and efficient energy source, they may qualify as **green bonds**. For institutional investors looking for **environmental, social, and governance (ESG)** or climate finance investment alternatives, solar ABS can offer an attractive investment alternative.

Non-Mortgage Asset-backed Securities

- **2. Solar ABS**
  - Usually, solar loan borrowers are prime borrowers that own their homes and have good payment records.
    - ✓ The loans can be **further collateralized** by a lien pledged on the **installed systems, on the property itself**, or **both**.
      - When the solar energy system loans are structured as **residential home improvement loans**, the solar ABS effectively securitizes **a subordinated (junior) mortgage on the property**.
      - Combine **multiple** liens to **lower** default risk.
  - Many solar ABS contain a **pre-funding period**, which allows the trust to **acquire** during a certain period of time after the close of the transaction **additional qualifying transactions** that meet certain eligibility criteria.
    - ✓ investor benefit due to diversification benefits from a broader pool.

Example

Non-Mortgage Asset-backed Securities

- Which of the following statements about credit card securitization is correct?

  A. Additional fee income is generated for the issuer.

  B. The credit card receivables are kept on the issuer's balance sheet.

  C. The cost of default risk from credit card debt to the issuer increases.

- Correct Answer: A
  - Credit card securitization generates additional fee income for the issuer. B is incorrect because the credit card receivables are removed from the issuer's balance sheet, which provides both capital efficiency and reduces the cost of funding. C is incorrect because the cost of default risk from credit card debt is reduced.

Summary

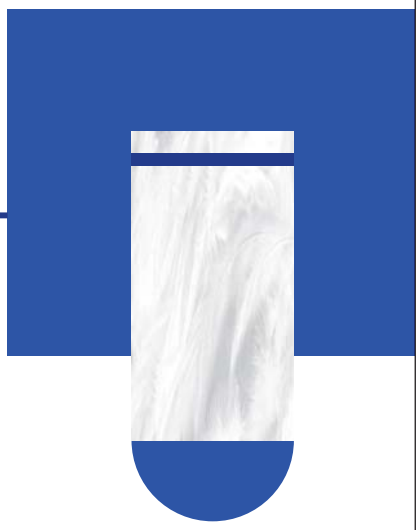
Asset-Backed Security (ABS) Instrument and Market Features

Non-Mortgage Asset-Backed Securities

Credit Card Receivable ABS, Solar ABS

Collateralized Debt Obligations

- Collateralized debt obligations



Collateralized Debt Obligations

- **Collateralized debt obligation (CDO)**
  - 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 Obligations

- **Overview of CDO with other securitized products**
  - A typical feature of CLO is that the collateral portfolio is **not finalized until after** the transaction closes. While the collateral manager **acquires most of the loans** before the transaction closes, there is a **subsequent ramp-up period** when additional assets are added to the collateral pool. After this period, the manager may **replace loans** in the portfolio as long as the new asset meets the portfolio selection criteria.

Collateralized Debt Obligations

	Covered Bonds	CDO	MBS	Non-Mortgage ABS
Collateral	Commercial or residential mortgages	Leveraged bank loans (CLOs)	Commercial and residential mortgage loans	Credit card receivables and Solar lease/loans
Impact on Issuer Balance Sheet	Collateral remains on the balance sheet and ringfenced into a separate cover pool	Collateral removed from balance sheet		
Number of Bond Classes	One bond class with its associated default exposure in its cover pool	Typically several		
Collateral Pool	Unstable with ongoing collateral management	Unstable with ongoing collateral management	Stable	Unstable with ongoing collateral management; a pre-funding period is used by solar ABS post-transaction
Recourse	Dual recourse nature: **first** on the ringfenced loans in the cover pool and **second** on the unencumbered assets of the issuing institution	Single recourse nature		

Collateralized Debt Obligations

- **CDO Structure**
  - In a CDO, the collateral pool are not static. 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

- **Generic CLO Structure**
  - These tranches include **senior, mezzanine, and subordinated/junior/equity** tranches.
    - ✓ Investors in senior or mezzanine bond classes earn a potentially **higher yield** than comparable corporate bonds offer.
    - ✓ Investors in **equity tranches** take on equity-like risks with the potential to earn returns comparable to equities.
      - The **residual/equity tranche plays a key role in whether a CLO is viable or not**; the CLO structure has to offer competitive returns for this tranche.

Collateralized Debt Obligations

- **Generic CLO Structure**
  - Asset pool quality ongoing monitoring
    - ✓ The collateral manager must continually meet various performance tests and collateral limits for the underlying collateral. If the manager **fails pre-specified tests**, a provision is triggered that **requires the payoff of the principal to the senior bond class until the tests are met**.
      - One such test is an **overcollateralization test**, which helps to keep the principal value of the pool exceed the principal value of issued notes. If the principal value **declines below** the overcollateralization test **trigger value**, cash will be diverted away from **equity and junior** CLO debt tranches toward **senior debt tranche** investors.
    - ✓ This process effectively **deleverages** the CLO because the cheapest funding source for the CLO, the senior bond class, is reduced.

Summary

Asset-Backed Security (ABS) Instrument and Market Features

Collateralized Debt Obligations

Collateralized debt obligations

Summary

Module: Asset-Backed Security (ABS) Instrument and Market Features

Covered Bonds, ABS Structures to Address Credit Risk

Non-Mortgage Asset-Backed Securities, Collateralized Debt Obligations

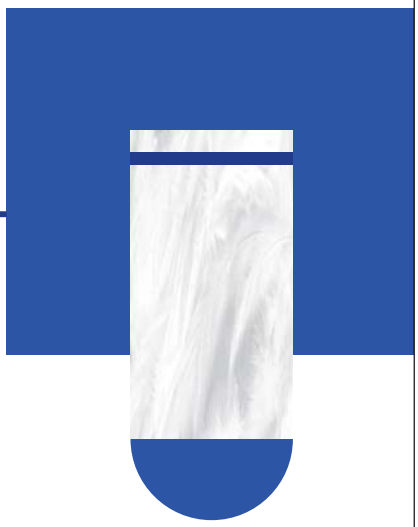
Module

Mortgage-Backed Security (MBS) Instrument and Market Features

1. Mortgage Loans
2. Residential Mortgage-Backed Securities (RMBS)
3. Commercial Mortgage-Backed Securities (CMBS)

Mortgage Loans

- Residential mortgage loans



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.

Mortgage Loans

- **Loan-to-value ratio(LTV): the ratio of the amount of the mortgage to the property's purchase price.**
  - The higher the LTV, the lower the borrower's equity, vice versa.
  - Lower LTV, more equity the borrower has
    - ✓ the less likely the borrower is to default
    - ✓ More protection the lender has for recovering the amount loaned if the borrower does default and the lender repossesses and sells the property
- **Debt-to-income ratio (DTI):**
  - **DTI = monthly debt payments / monthly pre-tax gross income.**
  - To measure an individual's ability to manage monthly payments and repay debts.
    - ✓ A high DTI ratio signals that the borrower may carry too much debt for the amount of income earned each month.
    - ✓ A low DTI shows a balance between income and debt and suggests that the borrower could sustain additional debt.

Mortgage Loans

- **Mortgage-backed securities (MBS):** are bonds created from the securitization of mortgages.
  - **Residential mortgage-backed securities (RMBS)**: The bonds created from the securitization of mortgages backed by residential properties.
    - ✓ **Agency RMBS**:
      - Guaranteed by a federal agency: These RMBS carry the full faith and credit of the government, essentially a guarantee with respect to timely payment of interest and repayment of principal.
      - Guaranteed by government-sponsored enterprises (GSEs): RMBS issued by GSEs do not carry the full faith and credit of the government, but rather the GSEs' guarantee of the timely payment of interest and principal for the securities. The GSE's charge a fee for this guarantee.
    - ✓ **Non-Agency RMBS**: Issued by private entities and thus not guaranteed by a federal agency or a GSE.
      - These private pass-throughs or private label MBS gained credit enhancement through pool insurance, letters of credit, guarantees, or subordination.

Mortgage Loans

- **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.
- **Foreclosure:** allows the lender to take possession of the mortgaged property and then sell it in order to recover funds toward satisfying the debt obligation
  - **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**.

Mortgage Loans

- **Strategic default:** the borrower has an incentive to default and allow the lender to foreclose on the property if the **property value declines below the loan amount** owed by the borrower, even if resources are available to continue to make mortgage payments
  - A strategic default is **less likely in a recourse provision** because the lender can seek restitution from the borrower's other assets and/or income in an attempt to recover the shortfall.

Example

Mortgage Loans

- A real estate investor has obtained a recourse mortgage loan on a shopping center from a bank. The loan has an outstanding balance of USD7,000,000, while the property is valued at only USD5,000,000. In the event of a default on the loan, the bank has a claim on:

  A. the property.

  B. the borrower's personal assets.

  C. both the property and the borrower's personal assets.

- Correct Answer: C
  - In a recourse loan, the lender has a claim against the borrower for the shortfall (deficiency) between the amount of the outstanding mortgage balance and the proceeds received from the sale of the property.

Summary

Mortgage-Backed Security (MBS) Instrument and Market Features

Mortgage Loans

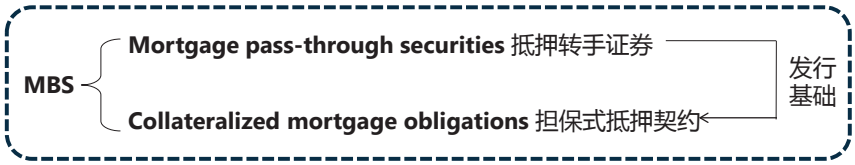
Residential mortgage loans

Residential Mortgage-Backed Securities (RMBS)

- Mortgage Pass-Through Securities
- Collateralized mortgage obligations

Residential Mortgage-Backed Securities

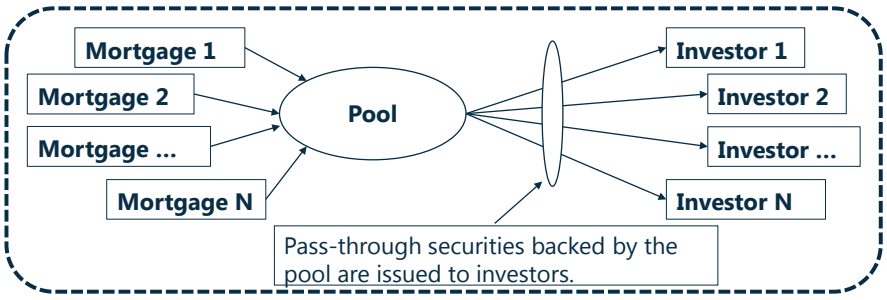
- **Mortgage-Backed Securities**



- **Mortgage pass-through 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 (CMO) :** created from mortgage pass-through certificates and referred as derivative mortgage-backed securities.

Residential Mortgage-Backed Securities

- **Mortgage pass-through security:** a security created when one or more holders of mortgages form a pool of mortgages and sell shares or participation certificates in the pool.



- **Pass-through rate: mortgage pass-through security's coupon rate**
  - Pass-through rate(net interest or net coupon)=mortgage rate on the underlying pool of mortgages −Servicing and other 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.
- **Average life** is the weighted average time until both scheduled principal payments and expected prepayments are received.

Residential Mortgage-Backed Securities

- **Example– WAM and WAC**

Mortgage	Interest rate	Beginning Balance (BB)	Current Balance (CB)	Original Term (months)	Number of Months to Maturity (MM)
A	2.50%	EUR300,000	EUR238,000	240	180
B	3.30%	EUR420,000	EUR380,000	600	480
C	2.80%	EUR100,000	EUR87,000	288	240
D	4.00%	EUR280,000	EUR132,000	360	120
E	3.70%	EUR350,000	EUR312,000	384	312
		EUR1,450,000	EUR1,149,000		

$$\text{WAC} = 2.5\%\left(\frac{238,000}{1,149,000}\right) + 3.3\%\left(\frac{380,000}{1,149,000}\right) + 2.8\%\left(\frac{87,000}{1,149,000}\right) + 4\%\left(\frac{132,000}{1,149,000}\right) + 3.7\%\left(\frac{312,000}{1,149,000}\right) = 3.29\%$$

$$\text{WAM} = 180\left(\frac{238,000}{1,149,000}\right) + 480\left(\frac{380,000}{1,149,000}\right) + 240\left(\frac{87,000}{1,149,000}\right) + 120\left(\frac{132,000}{1,149,000}\right) + 312\left(\frac{312,000}{1,149,000}\right) = 313 \text{ months}$$

Time Tranching

- **Prepayment:** Any payment toward the repayment of principal that is in excess of the scheduled principal repayment.
- **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.
  - **Time tranching:** Bond classes that posses different expected maturities.
    - ✓ The structure of a securitization that allow the redistribution of prepayment risk among bond classes.

Time Tranching

- **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.
    - ✓ **Adverse consequence:** reinvestment risk, and reduced the potential price appreciation for the bond.
  - **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.
    - ✓ **Adverse consequence:** higher interest rate reduce the value of CF investor received. And Extension risk stretch out the payments the investor receive.

Residential Mortgage-Backed Securities

- **Creating Collateralized Mortgage Obligations (CMO)**
  - **CMOs** are securities issued against mortgage pass-through securities (MPS) 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 pass-through securities' cash flows **does not eliminate** contraction and extension risk.

Residential Mortgage-Backed Securities

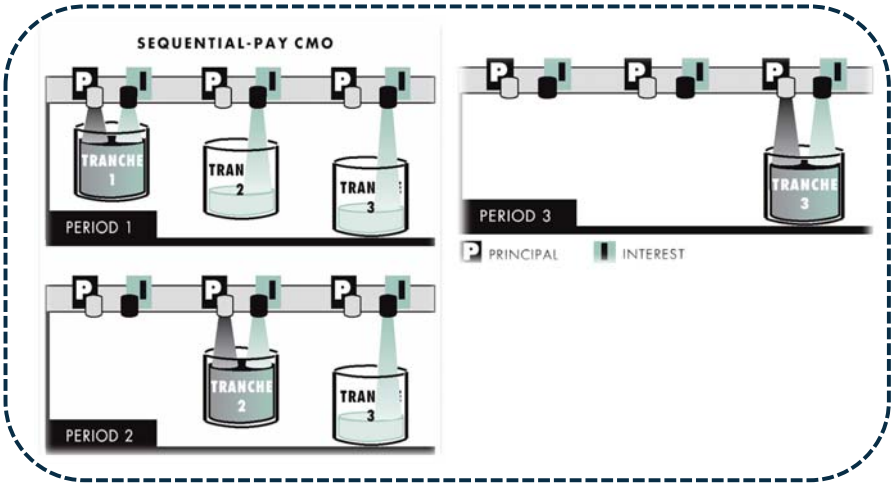
- **Different types of CMOs**
  - **1. Sequential Pay tranches**
    - ✓ Each class of bonds is retired sequentially in sequential pay **CMO.**

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

    - ✓ 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.

Residential Mortgage-Backed Securities

- **Different types of CMOs**
  - **1. Sequential Pay tranches**



Residential Mortgage-Backed Securities

- **2. Planned amortization class (PAC) CMO**
  - ✓ Have greater predictability of the cash flows for PAC tranches because a principal repayment schedule 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.

Summary

Mortgage-Backed Security (MBS) Instrument and Market Features

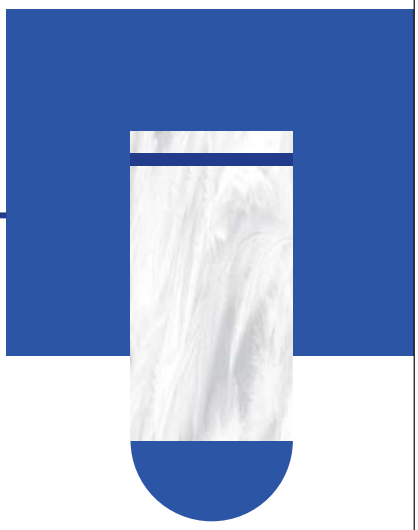
Residential Mortgage-Backed Securities (RMBS)

Mortgage Pass-Through Securities

Collateralized mortgage obligations

Commercial Mortgage-Backed Securities (CMBS)

- Commercial Mortgage-backed Securities



Commercial Mortgage-backed Securities

- **CMBS (Commercial mortgage-backed securities)** backed on commercial mortgages, 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).
  - CMBS can consists of few commercial mortgages, whereas RMBS usually consists of thousands of mortgages.
- **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.
- Analysis of CMBS securities **focuses on the property and not the borrower.**
  - Debt-to-service coverage (DSC) ratio= $\frac{\text{net operating income}}{\text{debt service}}$
  - Loan-to-value ratio = $\frac{\text{loan amount}}{\text{property value}}$

Commercial Mortgage-backed Securities

- **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**.
    - ✓ The call protection comes either at the **structure level** or at the **loan level**.
      - In fact, it is this protection that results in CMBS trading in the market more like corporate bonds than like RMBS.

Commercial Mortgage-backed Securities

- **Call protection at the structure level**
  - **Structural call protection** is achieved through **sequential-pay tranches** in the CMBS: A lower-rated tranche cannot be paid down until the higher-rated tranche is completely retired. Principal losses are always borne by the junior tranches first.

Commercial Mortgage-backed Securities

- **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.

Commercial Mortgage-backed Securities

- **Basic CMBS Structure - Balloon Maturity Provision**
  - Many commercial loans backing CMBS are balloon loans that require substantial principal payment at maturity of the loan through **a large "balloon" payment.**
  - 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 is called **balloon risk**.
    - ✓ Balloon risk is a type of extension risk.
  - Lender may modify the original loan terms and charge a higher interest rate, called "default interest rate" during the **workout period**.

Summary

Mortgage-Backed Security (MBS) Instrument and Market Features

Commercial Mortgage-Backed Securities (CMBS)

Commercial Mortgage-backed Securities

Summary

Module: Mortgage-Backed Security (MBS) Instrument and Market Features

Time Tranching, Mortgage Loans, Residential Mortgage-Backed Securities (RMBS)

Commercial Mortgage-Backed Securities (CMBS)

问题反馈

- 如果您认为金程**课程讲义/题库/视频**或其他资料中**存在错误，欢迎您告诉我们，**所有提交的内容我们会在最快时间内核查并给与答复。
- **如何告诉我们？**
  - 将您发现的问题通过扫描右侧二维码告知我们，具体的内容包含:
    - ✓ 您的姓名或网校账号
    - ✓ 所在班级
    - ✓ 问题所在科目(若未知科目，请提供章节、知识点和页码）
    - ✓ 您对问题的详细描述和您的见解
- **非常感谢您对金程教育的支持，您的每一次反馈都是我们成长的动力。**

求知无坦途。

There is no royal road to learning.