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Fixed Income

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Fixed Income

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Module 1

Fixed-Income Instrument Features

Key Bond Features

- Issuer (Borrower):
  - Government sector: ***Sovereign (national) or Non-sovereign (local) governments, Supranational organizations, Quasi-government entities,***
  - Private sector: ***Corporate issuers, SPE***
- Maturity/Tenor: ***Money market securities, Capital market securities, Perpetual bonds***
- Principal/Par value/Face value
- Coupon rate and frequency: ***Fixed-coupon bond, Floating-rate notes, Zero-coupon bond (Pure discount bond)***
- Seniority: Senior debt, Junior debt
- Contingency provisions: embedded options

Source of Repayment

Types of bond	Source of repayment
Sovereign bonds	• ***Tax*** revenues • ***Print currency*** (in some cases)
Local or regional governments	• ***Taxing authority*** • Fees from infrastructure projects
Unsecured corporate bonds	• Operating cash flows of the firm (***sole*** source)
Secured corporate bonds	• Operating cash flows of the firm (***primary*** source) • a legal claim/lien/pledge on specific assets (a ***secondary*** source of debt repayment)
Asset-backed securities (ABS)	• The cash flows from a group of loans or receivables owned by SPE

Bond Covenants ★★ 判断属于哪一种

- **Affirmative Covenants:**
  - ***Require:*** the use of proceeds from the bond issue, the provision of timely financial reports, and permitting bondholders to redeem their bonds at a premium to par if the issuer is acquired
  - ***pari passu clause:*** ensures that a debt obligation is treated the same as the borrower's other debt obligations with similar seniority
  - ***cross-default clause:*** borrowers are considered in default if they default on another debt obligation.
- **Negative Covenants:**
  - ***restrict/limit/prohibit/not***
    - The ***limitations*** of liens and sale and leaseback, as well as merger and consolidation ***restrictions***
    - ***limitations*** on investments, the disposal of assets, or issuance of debt senior to existing obligations under what is known as a ***negative pledge clause***
  - 财务承诺: 持续性财务承诺、触发性财务承诺(***incurrence test***: ***restrict*** its ability to pay dividends to shareholders, repurchase shares, and / or take on additional debt unless tighter financial restrictions are met)

Module 2

Fixed-Income Cash Flows and Types

Cash Flow Structure ★★★ 概念、性质

Principal Repayment Structures		
Fixed-coupon bond/Bullet bond → ***Balloon payment***		
Amortizing Bonds	• Fully amortizing: reduces the bond's outstanding principal amount to zero by the maturity date • Partially amortizing → ***Balloon payment*** • The coupon payments of ***partially*** amortized bond are ***higher or equal***	
Sinking Funds	定义	• ***periodically retire a bond's principal outstanding*** • set aside funds over time in an escrow account to retire the bond early
	Advantage and disadvantage	Advantage: ***reduce credit risk*** Disadvantage: ***increase reinvestment risk***
Waterfall Structures	定义	determine the ***timing of cash flows*** to investor classes with ***different priority***
	现金流特点	• Interest or coupon payments are paid to all classes with no preference • The ***repayment of principal occurs sequentially***

Coupon Payment Structures		
Floating-rate notes (FRNs)	***FRN Coupon rate = Market reference rate + Credit spread*** • MRR resets periodically • Credit spread is ***constant***	
	应用	• Financial intermediaries prefer floating-rate loan assets • FRN are attractive to investors seeking to ***benefit from rising interest rates***.
	风险	• ***less interest rate risk,*** still ***have credit risk***
Step-up bonds	Coupon increases by specified margins at specified dates • ***protect investors against rising rates*** • provide an incentive for ***issuers*** to take advantage of a ***call provision***	
Credit-linked notes	***credit rating of the issuer falls (improves) → coupon rate will increase (decrease)***	
Payment-in-kind (PIK)	• ***pay interest*** in the form of ***an increase in the bond or loan principal outstanding*** • ***higher credit risk*** and ***interest rate*** to compensate investors	
Index-linked bonds	• ***Inflation linked bonds*** tied to a broad consumer price index • Capital-indexed bonds & Interest-indexed bonds • ***TIPS: Capital-indexed bond and Principal protected bond***	
Zero-coupon bonds(discount)	***separated (or stripped)*** from sovereign bullet bonds	
Deferred coupon bonds	pay no interest for the first few years and have a higher coupon paid later ***extreme*** form: ***zero-coupon bond***	

Fixed-Income Contingency Provisions ★★★ 概念、性质

分类	性质	
Callable bond	定义	*Issuer* has the *right* to redeem the bond before maturity date→ benefit to *issuer* *Investors: reinvestment risk* → *higher yield and sell at a lower price*
	基本性质	• YTM rises: like an option-free equivalent bond • YTM falls: option is exercised and the call price serves as a price cap
	Call schedule	Call protection period, Call period, Call price
	Make-whole call: issuer pays bondholder a high price based on the YTM of a sovereign bond	
Putable bond	定义	*Bondholder* has the *right* to sell the bond back to issuer → benefit to *bondholder*
	基本性质	• YTM rises: option is exercised and the put price serves as a price floor • YTM falls: like an option-free equivalent bond
Convertible bond	定义	*Bondholder* has the *right* to exchange the issuer's bond for its common shares
	Key terms	Conversion ratio = Convertible bond par value/Conversion price Conversion value = Conversion ratio × Current share price
	性质	• share price < conversion price→ a standard non-convertible bond • share price > conversion price→ track the conversion value
	Callable convertible bonds: includes a *call provision*	
Warrants: *not an embedded option* but rather an *"attached" option*		
Contingent convertible bonds ("CoCos"): *conversion is automatic*; *converted on the downside*; *offer a higher yield*		

Legal, Regulatory and Tax Considerations ★★★ 概念、性质

Bond Markets		
Domestic bonds: 发行市场=发行货币=发行公司 • Bonds issued by entities that are incorporated in that country		
Foreign bonds: 发行市场=发行货币≠发行公司 • Bonds sold in a country and denominated in that country's currency by an entity from another country		
Eurobonds	定义	发行市场≠发行货币 Bonds issued outside the jurisdiction of any single country
	特点	• They are usually ***unsecured*** bonds and can be denominated in any currency • ***registered bonds***
Global bonds: issued simultaneously in the Eurobond market and in at least one domestic bond market.		

Tax Considerations

- Capital gains recognized over a year may be taxed at a ***lower long-term capital gains tax rate***, capital gains recognized within a year may be taxed at a ***higher short-term capital gain tax rate***.
- ***OID (original issue discount tax provision):*** Pay tax on interest income each year & Do not pay capital gains tax at maturity
- ***No OID tax provision:*** Do not pay tax on interest income each year & Pay capital gains tax at maturity
- Investors in ***US Treasuries pay federal income tax on interest income*** but are ***exempt from state and local tax***, while ***municipal bonds*** are often ***exempt from federal income tax and from the income tax of the state***

Module 3

Fixed-Income Issuance and Trading

Fixed-Income Segments, Issuers and Investors

Three Dimensions 了解

By Issuer Type

- Government
- Corporate

By Credit Quality

- Investment grade
- Non-investment grade (high yield, speculative, or “junk”)

Time to Maturity

- Money market < 1year
- Capital market > 1 year

Fixed-Income Indexes 了解

- Fixed-income indexes have many ***more constituent securities*** than equity indexes.
- The finite maturity of bonds and the higher frequency of new issuance lead to far ***more changes in constituents (turnover)*** in fixed-income indexes.
- Bond index constituents are usually weighted by market value of debt outstanding and many broad bond indexes have ***high weights of government debt***.

Primary and Secondary Fixed-Income Markets

Primary bond markets ★★★ 特点对比

1. 两类发行人: ***Debut issuer/Repeat issuers***
2. 两种发行方式:
   - ***Public offering***
     - ***Underwritten*** bond offering: ***guarantee the sale***
     - ***Best-efforts*** offering: ***does not guarantee the sale*** and may serve only as a ***broker***
     - ***Shelf registration***: a range of future bond issuances used by frequent bond issuers
     - Public ***auction***: ***issuance of sovereign debt***
   - ***Private placement*** → ***selected investor***
3. Issuance Timeline: ***Secured bond issuance*** is a ***longer*** and more involved process than for unsecured investment-grade bonds.

Secondary bond markets

- Secondary fixed-income markets consist mostly of ***quote-driven*** or ***over the-counter markets.***
- ***Bid–offer spread*** is a key ***liquidity*** measure.
  - The most recently issued, or ***on-the-run***, ***developed market sovereign bonds*** are typically the ***most liquid***
  - Recently issued corporate bonds from frequent issuers of ***higher credit quality*** usually exhibit the ***greatest liquidity*** and ***tightest bid–offer spreads***
- ***Distressed debt*** (very close to or in bankruptcy) typically trades at a price well below par.

Module 4

Fixed-Income Markets for Corporate Issuers

Short-Term Funding Alternatives

External Loan Financing		
Uncommitted lines of credit (*least reliable*)	Advantages	• The company do not require to pay any compensation. • Bank ***maintains a long-term business relationship*** with the borrower.
	Disadvantages	• Uncommitted credit lines require ***minimal capital reserves.*** • Firms ***cannot*** rely on uncommitted lines ***as a primary source of funding***.
Committed lines of credit (*more reliable*)	• Committed lines require ***more bank capital.*** • Regular lines are ***unsecured*** and ***prepayable*** without penalty. These commitments face the ***risk of renewal*** at maturity • Regular lines usually ***involve upfront costs in the form of a commitment fee***.	
Revolving credit agreements (***most reliable***): multi-year credit commitments		
Secured loans: Companies that ***lack sufficient credit quality*** might arrange for secured loans.		
Factoring arrangement: The company shifts the credit-granting and collection process to the lender or factor.		

External, Security-Based Financing	
Commercial Paper	• ***Large, highly rated companies*** can issue ***short-term, unsecured*** notes known as CP. • CP can be used to fund working capital, seasonal demand for cash, or to provide bridge financing. • ***Rollover risk:*** an issuer is unable to issue new paper at maturity. • ***ECP*** transaction sizes are much ***smaller and less liquid*** than the USCP market.

Short-Term Funding Alternatives Available to Banks

1. Deposits

- Checking accounts (Demand deposits) → ***transactions purposes and no interest***
- Savings deposits → ***held for non-transactional purposes***
  - ***Non-negotiable CDs*** and ***Negotiable CDs***

2. Interbank Market

- ***Short-term*** borrowing and lending among financial institutions on a secured or ***unsecured*** basis
  - central bank funds market: ***central bank funds rate***
- ***Discount window lending*** is offered at a ***higher interest rate*** than the central bank funds rate.

3. Asset-Backed Commercial Paper

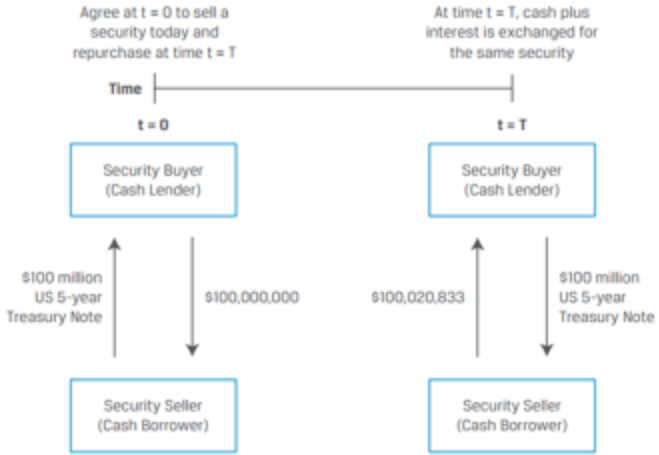
- a ***secured*** form of commercial paper issuance
- This financing ***is not recorded on the balance sheet*** of the issuer, which benefits both the bank and investors.

Repurchase Agreement

★★★ 结论、计算

1. 基础知识

- ***Borrower(seller)*** → financing & borrow cash; ***lender(buyer)*** → short sale & borrow security
- ***Repo periods:*** overnight ~any maturity longer ***(term repos)***
- ***Underlying securities:*** the most liquid bonds with the lowest credit risk, such as sovereign bonds
- ***reverse repurchase agreement or reverse repo***: the perspective of the security buyer



Repurchase Agreement

- ***Repo rates*** are ***lower*** when:
  - ***Money market interest rate*** is ***lower***.
  - The ***collateral risk*** is ***lower.***
  - Repo ***term*** is ***shorter.***
  - The ***demand*** for a specific security is ***higher***.
  - Collateral security is ***delivered*** to the lender.

- ***Repo margin***
  - Initial Margin = Security Price_0 / Purchase Price_0
  - Variation margin = (Initial margin × Purchase Price_t) − Security Price_t

Applications and Benefits	• Financial market participants
	  • Finance the ownership of a security
	  • Earn short-term income by lending funds on a secured basis
	  • Borrow a security in order to sell it short
	• Central banks are active participants: conduct monetary policy

Risks	• ***Default risk*** • ***Collateral risk***: little or no correlation between collateral the repo counterparty • ***Margining risk***: Proper and timely collateral valuation and transfer of variation margin to minimize collateral shortfalls in the event of liquidation following a default • ***Legal risk*** • ***Netting and settlement risk***
Bilateral &Triparty Repo	• ***Bilateral repos:*** repos executed directly ***between two parties*** • ***Triparty repo: third-party agent*** → cash, securities, collateral valuation, and management, as well as collateral custody.

Long-Term Corporate Debt

Similarities between IG and HY 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.
- More the risk-versus-return trade-off for issuers of lower credit quality.

Differences between IG and HY Issuance

Type	Bond Features	Analytical Approach
IG Bonds	• ***Bond-like*** cash flows • ***Lower YTM proportion*** due to credit spreads • ***Fewer*** issuer restrictions(***standardized***), relatively ***little monitoring from bondholders*** • Unlikely to default • Debt maturities: usually ***up to 30 years***	• Use ***financial ratios and credit ratings*** to determine if/when IG issuer's likelihood of default will change
HY Bonds	• ***Equity-like*** cash flows (i.e., uncertain cash flows) • ***Higher YTM proportion*** due to credit spreads • ***greater fluctuations in both issuer-specific credit spreads*** • Issuer restrictions and/or bonds secured by assets, ***less HY issuer flexibility and market availability*** • More likely to default • debt maturities: ***10 years or less***	• Consider likelihood of default and potential loss given default given covenants, restrictions and/or security

Module 5

Fixed-Income Markets for Government Issuers

Sovereign Debt

- Public sector financial accounting standards: ***cash***-based, excluding the depreciation or the accrual of unfunded liabilities, such as government pension obligations
- Under ***Ricardian equivalence***, a sovereign government should be ***indifferent*** between ***collecting taxes*** today or ***raising debt*** of any maturity. Ricardian equivalence suggests that governments should fund themselves with the ***shortest*** possible ***maturity*** to minimize borrowing costs.
  - Two assumptions:
    - Taxpayers are able to perfectly ***smooth consumption***.
    - Taxpayers form ***rational expectations***.
  - In practice, government should ***distribute debt across maturities*** and issue debt in regular, predictable intervals.

Sovereign Debt Issuance

Public auction

- ***Competitive bidder:*** If the price determined at auction is above the bid, a competitive bidder will not be offered & ***Non-competitive bidder:*** agrees to accept the price determined at auction and always receives securities.
- ***Single-price auction:*** all winning bidders pay the same price & ***Multiple-price auction***

Sovereign Debt Trading

- Sovereign debt is usually traded ***primarily on OTC markets***.
- ***On-the-run*** securities(the most recently issued, be used for benchmark yield analyses, more liquid) & ***Off-the-run*** securities
- A significant difference in trading between sovereign and corporate debt: investors' "***non-economic***" objectives.

Non-sovereign, Quasi Government, and Supranational Agency Debt

Government Agencies/Quasi-government entities	• fund the government-sponsored provision of specific public goods or services

Non-sovereign Government Bonds	• ***General obligation bonds (GO bonds)***
	  • are used to fund public goods and services
	  • are repaid with tax revenues from the provincial government
	• ***Revenue bonds***
	  • are issued for specific project financing
	  • are repaid with the project's revenue stream

Supranational Organizations	• Such as the World Bank, International Monetary Fund (IMF), and Asian Development Bank (ADB) • ***High credit quality*** and ***a strong ability*** to access capital markets across maturities

Module 6

Fixed-Income Bond Valuation: Prices and Yields

Bond Valuation

1. Valuation using single yield (YTM) 计算、概念、性质

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

Yield to Maturity (YTM) → assumptions:

- Investor holds the bond ***to maturity.***
- Issuer makes full coupon and principal payments on scheduled dates (***no issuer default***).
- The investor ***reinvests*** all coupon payments ***at the same YTM***.

2. Flat Price, Accrued Interest, and Full Price 定义、计算

定义	• ***Accrued Interest:*** the portion of the next coupon payment owed to the seller of a bond • ***Flat Price (Clean)*****: *quoted*** by bond dealers • ***Full Price*** = ***Flat Price + Accrued Interest***
计算	• Accrued Interest = (t/T)×PMT • Full price: 折现求和得到的价格 • Flat price = Full price - Accrued Interest

Relationships Between Price and Yield	Relationships Between Price and Time
coupon rate > market discount rate → premium coupon rate < market discount rate → discount	定量: 计算the value change attributable to the passage of time
Inverse relationship: market discount ↑→P↓ ***Convexity effect:*** 涨多跌少 ***Coupon effect:*** lower-coupon → greater percentage price change ***Maturity effect:*** longer-term → greater percentage price change	定性: ① At maturity date，price＝par ***②Discount：随着到期日临近，price上升*** ***③Premium：随着到期日临近，price下降***

3. Matrix Pricing 计算、结论

- Matrix pricing is used for ***not actively traded*** bond and ***not yet issued*** bond
  - These comparable bonds have ***similar times-to-maturity, coupon rates, and credit quality***.
- Matrix pricing also is used in underwriting new bonds to ***get an estimate of the required yield spread*** over the benchmark rate.

⬇

Linear interpolation

Module 7

Yield and Yield Spread Measures for Fixed-Rate Bonds

★★★

Periodicity and Annualized Yields

计算

$$\text{effective annual rate}=\left(1+\frac{YTM}{m}\right)^{m}-1 \qquad (1+\frac{APR_m}{m})^{m}=(1+\frac{APR_n}{n})^{n}$$

Semiannual bond basis yield (semiannual bond equivalent yield): ***periodicity of two***

Other Yield Measures and Conventions

Current yield:

$$\text{current yield}_t=\frac{\text{Annual coupon}_t}{\text{Bond price}_t}$$

计算

Simple yield = (coupon + the straight-line amortized share of G/L)/flat price

Street convention yield: does not account for weekends and bank holidays

True yield: accounts for weekends and bank holidays

性质

True yield ≤ Street convention yield

Government Equivalent Yield: restates a yield-to-maturity based on a 30/360 day count to one based on an actual/actual day count

YTC (yield-to-first-call, yield-to-second-call and so on), ***YTW*** 计算

Option-adjusted yield: Callable bond: option-adjusted yield<YTM; Putable bond: option-adjusted yield >YTM 性质

Yield Spread Measures for Fixed-Rate Bonds

Benchmark spread	• ***G-spread:*** the benchmark is ***government*** bond yield • ***I-spread:*** the benchmark is ***swap rate***
Z-spread	The spread that must be added to each rate on the ***benchmark spot curve***.
OAS	• ***Callable*** bond: ***OAS < ZS*** • ***Putable*** bond: ***OAS > ZS***

Module 8

Yield and Yield Spread Measures for Floating-Rate Instruments

★★★

Yield Measures for Floating-Rate Notes

Coupon rate = market reference rate ± ***quoted margin***
Discount rate = reference rate + ***required margin (or discount margin)***
1. 定性：
   - Priced at par (credit unchanged): required margin = quoted margin
   - Priced at discount (credit downgrade): required margin > quoted margin
   - Priced at premium (credit upgrade): required margin < quoted margin
2. 定量：已知price, 计算required margin; 已知required margin, 计算price

Yield Measures for Money Market Instruments 计算

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

Add-on rate: $PV = \frac{FV}{(1 + \frac{Days}{Year} \times AOR)} \Rightarrow AOR = \frac{Year}{Days} \times \frac{FV - PV}{PV}$

Bond equivalent yield for MMI:
365-day add-on rate basis

Module 9

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

Maturity Structure of Interest Rates

计算

Spot rates (Zero rates)	Spot rates are market discount rates on default-risk-free zero-coupon bonds $No\text{-}\ arbitrage\ prices = \frac{PMT}{(1+Z_1)^1} + \frac{PMT}{(1+Z_2)^2} + \cdots + \frac{PMT+FV}{(1+Z_N)^N}$
Par rates	***Par rates are derived from spot rates*** $100 = \frac{PMT}{(1+z_1)^1} + \frac{PMT}{(1+z_2)^2} + \cdots + \frac{PMT+100}{(1+z_N)^N}$
Forward Rates	***Implied*** forward rates or ***breakeven*** reinvestment rates $(1+Z_A)^A(1+IFR_{A,B-A})^{B-A} = (1+Z_B)^B$

Spot, Par and Forward Yield Curves

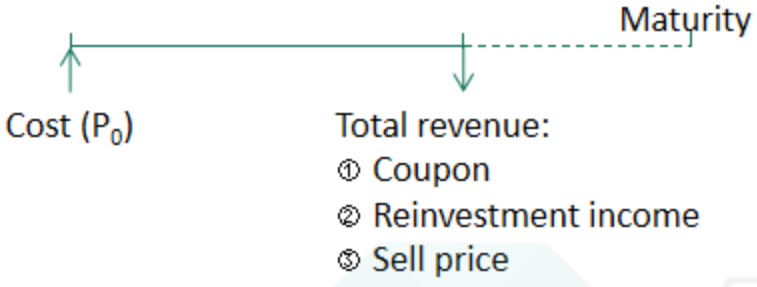
Spot Curve Shape	Par Curve	Forward Curve
Upward Sloping	Below spot curve	Above spot curve
Flat	Equal to spot curve	Equal to spot curve
Downward Sloping (Inverted)	Above spot curve	Below spot curve

Module 10

Interest Rate Risk and Return

Annualized holding period return

计算



Total return (horizon yield):

$$Annualized\ holding\ period\ return = \left(\frac{total\ return}{purchase\ price}\right)^{\frac{1}{T}} - 1$$

Capital gain or loss = *Sell price – Carrying value*

- Carrying value: the purchase price plus (minus) the amortized amount of the discount (premium)

Δy —影响→ Total return — **Reinvestment risk**; **Price risk**

Investment Horizon and Interest Rate Risk

结论

Price risk & Reinvestment risk相互抵消

- Short investment horizon: price risk > reinvestment risk
  Long investment horizon: price risk < reinvestment risk
- ***Duration gap = Macaulay duration – Investment horizon***
  - ***Positive gap*** exposes the investor to ***price risk*** from ***increasing*** interest rates.
  - ***Negative gap*** exposes the investor to ***reinvestment risk*** from ***falling*** interest rates.
  - A duration gap of approximately ***zero*** means it is nearly ***hedged against*** interest rate risk.

Module 11

Yield-Based Bond Duration Measures and Properties

Yield-based Bond Duration 结论、计算

计算	***Macaulay Duration:*** the ***weighted average of the time to receipt*** of the bond's cash flows $MacDur = \sum_{t=1}^{n}[t \times (PVCF_t / P_0)]$ ***Modified Duration:*** the ***slope or first derivative*** of the price of a bond with respect to its YTM $ModDur = \frac{MacDur}{1+r}$ ***Approximate Modified Duration:*** $Approximate\ Modified\ Duration \approx \frac{PV_- - PV_+}{2 \times \Delta Yield \times PV_0}$
	Money Duration/Dollar Duration = Annualized Modified Duration × Full price of bond ***Price value of a basis point (PVBP)*** = (PV_- - PV_+)/2
	• Zero-coupon bond: ***Macaulay duration of = t*** • Perpetual bond: ***Macaulay duration= (1+r)/r*** • Floating-Rate Notes: ***Macaulay duration= (T-t)/T***
Properties	• A ***lower-coupon bond has a higher duration.*** • A ***lower yield-to-maturity increases the duration.*** • ***Longer times-to-maturity*** typically correspond to ***higher duration.*** • For ***long-dated bonds*** trading at a ***discount*** to par, ***interest rate risk could be lower*** than that of a shorter-term bond. • As time passes, the Macaulay duration decreases smoothly but ***jumps upward by a small amount after the coupon is paid,*** which creates a ***"saw-tooth"*** pattern.

Module 12

Yield-Based Bond Convexity and Portfolio Properties

Yield-based Bond Convexity 结论、计算

计算	***Annualized Convexity***: (Time to receipt of CF) × (Time to receipt of CF + 1) × (Weight of CF) × (1 + Periodic YTM) (–Periods per year) ***Approximate annualized convexity***: $ApproxCon = \frac{PV_- + PV_+ - 2 \times PV_0}{(\Delta Yield)^2 \times PV_0}$ ***Money convexity*** = annConvexity*Pv^{full} ***Convexity adjustment***: $\frac{\Delta P}{P} = [-MD \times \Delta y] + \frac{1}{2} \times Conv \times (\Delta y)^2$ $\Delta PV^{Full} \approx (-MoneyDur \times \Delta Yield) + \frac{1}{2} \times MoneyCon \times (\Delta Yield)^2$
性质	• the ***second-order*** (non-linear) effect of yield changes on price • ***涨多跌少***

影响因素	• 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;***
	  • ***相同duration, 现金流越分散, convexity越大***

Portfolio Duration and Convexity

Portfolio Duration = $w_1D_1 + w_2D_2 + \ldots\ldots + w_nD_n$

Portfolio convexity = $w_1C_1 + w_2C_2 + \ldots\ldots + w_nC_n$

- Limitations: ***assumes a parallel shift in the yield curve***

Module 13

Curve-Based and Empirical Fixed-Income Risk Measures

★★★

Curve-based Bond Duration and Convexity

结论、计算

Yield-Based & Curve-Based		• ***Yield duration and convexity*** assume a bond's cash flows are certain. • Yield-based int rate risk measures are not appropriate for bonds with embedded options. • ***Curve duration and convexity*** are sensitivity of the bond's price to a change in a benchmark yield curve.
含权债券	Callable bond	• ***Effective duration*** is ***lower*** when interest rates are ***low***. • ***Effective convexity*** may be ***negative*** if ***yield is lower.***
	Putable bond	• ***Effective duration*** is ***lower*** when benchmark interest rates ***rise***. • The price-yield relationship will be ***more convex*** when ***yield increase***.
计算		$EffDur = \frac{PV_- - PV_+}{2 \times \Delta curve \times PV_0}$ $EffCon = \frac{PV_- + PV_+ - 2 \times PV_0}{(\Delta curve)^2 \times PV_0}$ $\%\Delta PV^{Full} \approx (-EffDur \times \Delta Curve) + \left[0.5 \times EffCon \times (\Delta Curve)^2\right]$
Key Rate Duration		• Non-parallel benchmark yield curve changes → ***shaping risk*** • The sum of weighted key rate durations are equal to the effective duration.

Analytical duration and Empirical duration

结论

- Analytical duration assumes that government bond yields and spreads are ***independent variables.***
- Empirical duration uses ***statistical methods and historical bond prices*** to derive the price–yield relationship, which is the best measure, especially under ***stressed*** market conditions. → ***empirical duration <analytical duration***

Module 14

Credit Risk

Credit risk构成

- ***Default risk (狭义Credit risk)***: fails to meet its promised interest and/or principal payment obligations
- ***Credit migration risk (downgrade risk):*** creditworthiness deteriorates

Cs of Credit Analysis

Five Bottom-Up Factors

- Capacity
- Capital
- Collateral
- Covenants
- Character

Three Top-Down Factors

- Conditions
- Country
- Currency

Measuring Credit Risk ★★

- ***EL = POD × LGD***
- ***LGD = EE × (1 – RR)***
- ***Expected Exposure*** (EE): bond face value plus accrued interest ***less the current market value of available collateral***.
- ***Credit Spread ≈ POD × LGD***

Credit Ratings ★★★

Investment grade (*Baa3/BBB-及以上*) & Non-Investment Grade (Junk)

Credit Rating Considerations

- 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.
- Some risks are difficult to capture in credit ratings.
- Ratings may involve miscalculations or ***unforeseen changes*** not fully captured in a rating agency's forward-looking analysis.

Yield Spread

Factors Impacting Yield Spreads

Macroeconomic Factors → *credit spread*

影响spread的因素

- Business/Credit cycle improve→*spread小*
- Funding stresses→ *credit spread大*
- General market demand and supply

HY bond ★★

- *HY bonds are more sensitive* to changing macroeconomic and credit conditions. under adverse market conditions, *"flight to quality"* → HY bond spreads widen

Reasons for investing in HY bonds

- *Portfolio diversification:* lower correlation with IG bonds
- *Capital appreciation:* Economic recovery, or improved issuer-specific →more sizeable positive impact
- *Equity-like return with lower volatility*

Market Factors →higher *liquidity spread: less* debt an issuer has outstanding and the *less frequently* its debt trades; *lower the credit quality* of an issuer; During times of *financial stress or crisis*

Issuer-Specific Factors: debt coverage and leverage

The Price Impact of Spread Changes ★★

Small spread changes: $\%\Delta PV^{Full} = -AnnModDur \times \Delta Spread$

Large spread changes: $\%\Delta PV^{Full} = -AnnModDur \times \Delta Spread + 0.5 \times AnnConvexity \times (\Delta spread)^2$

Module 15

Credit Analysis for Government Issuers

Sovereign Credit Analysis

Qualitative Factors

Government Institutions and Policy

Stable, Predictable Executive, Legislative and Judicial Institutions and Policies/ Willingness to Pay/Rule of Law

Fiscal Flexibility

Ability to Adjust Revenue and Expenditures/Fiscal Discipline/ Prudent Use of Debt

Monetary Effectiveness

Policy Credibility/Exchange Rate Regime/Financial System and Debt Market Development

Economic Flexibility

Economic Diversification/ Competitiveness/ Adaptability to Shocks

External Status

Global Currency Status/ Access to External Funding/ Geopolitical Risk

Quantitative Factors ★★

- ***Fiscal Strength***
  - Debt Burden(leverage): Debt to GDP, Debt to Revenue
  - Debt Affordability(debt coverage): Interest to GDP, Interest to Revenue
- ***Economic Growth and Stability***
  - Growth and Volatility: Average Real GDP Growth, Real GDP Growth Volatility
  - Size and Scale: GDP in PPP terms, Per Capita GDP
- ***External Stability***
  - Currency Reserves: FX Reserves to GDP, Reserve Ratio (= FX Reserves / External Debt)
  - External Debt: External Debt Burden (= LT External Debt / GDP), External Debt Due

Non-Sovereign Credit Risk

- Agencies: quasi-government entities: the ***same rating*** to these entities ***as the sovereign entity***.
- Government Sector Banks and Development Financing Institutions: created or supported by the sovereign government and enjoy a ***similar rating***
- Supranational Issuers: ***sovereign governments that join as members*** to pursue a common objective.
- Regional Government Issuers
  - ***GO bonds***: ***backed by the general revenues*** and ***supported by the taxing authority***
  - ***Revenue-backed bonds***: ***higher degree of risk*** than GO bonds because their cash flows are dependent upon a single source of revenue
    - ***Debt service coverage ratio:*** The ***higher the coverage ratio***, the ***stronger the creditworthiness***.

Module 16

Credit Analysis for Corporate Issuers

Assessing Corporate Creditworthiness

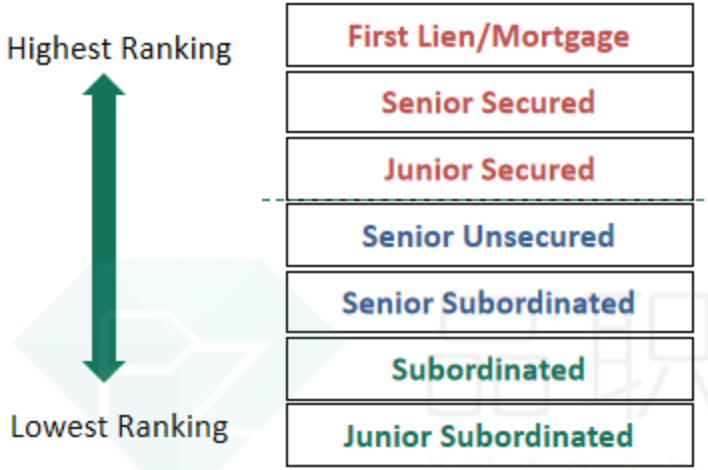
Qualitative Factors	Quantitative Factors
• Business Model • Industry and Competition • Business Risk • Corporate Governance	• Profitability • Leverage • Coverage • Liquidity

Financial Ratios in Corporate Credit Analysis ★★

Cash Flow Metrics	• ***Free cash flow (FCF)*** • ***Funds from operations (FFO): FFO = NI from continuing operations + dep. & amor. + deferred income taxes + other non-cash items*** • ***Retained cash flow (RCF): RCF=FFO-div***
Profitability Metrics	• ***EBIT margin*** = Operating Income/Revenue
Coverage Metrics	• ***EBIT to Interest Expense*** = Operating Income/Interest Expense
Leverage Metrics	• ***Debt to EBITDA***= Debt/EBITDA • ***RCF to Net Debt*** = Retained Cash Flow/(Debt – Cash and Marketable Securities)

Seniority Rankings, Recovery Rates, and Credit Ratings ★★★

Seniority Rankings



Priority of Claims: In the event of default, unsecured debtholders' claims rank below those of secured creditors.

Recovery Rates

- Recovery rates ***vary widely by industry*** and have high variability across companies within a given industry.
- Recovery rates also vary depending upon when they occur in the ***credit cycle***.
- ***Priority of claims is not always absolute.*** Creditors with lower seniority and even shareholders may receive consideration without more senior creditors being satisfied in full, since bankruptcy resolution takes time.

Issuer & Issue Rating

- Issuer rating usually applies to its ***senior unsecured debt***.
- ***Cross default provision***: default on one bond → trigger default on all outstanding debt
- ***Notching:*** the higher the senior unsecured rating, the smaller the notching adjustment
- ***Structural subordination: parent company's bonds are subordinated to those of the operating subsidiaries***

Module 17

Fixed-Income Securitization

Securitization Process

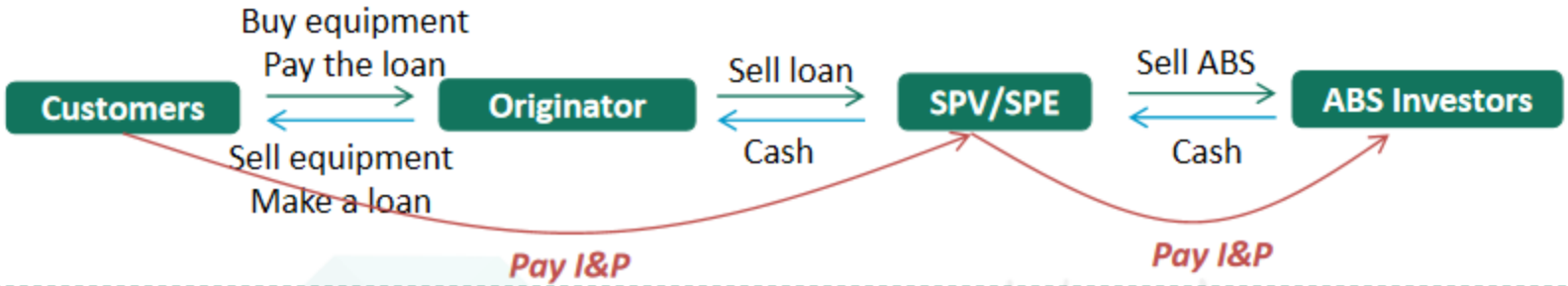
- The securitization process ***pools and transfers*** the ownership of cash flow generating assets(the ***securitized assets***), such as loans or receivables, from the original lender into a specially created legal entity.

The Benefits of Securitization ★★ 结论

- Benefits to ***Issuers***:
  - Banks can ***sell illiquid assets*** and ***operate more efficiently*** on a risk-adjusted basis.
  - Selling assets ***generates fee income***.
  - Securitization enables banks to ***expand lending origination*** beyond their balance sheets.
- Benefits to ***Investors***:
  - Securitization allows investors to ***tailor interest rate and credit risk exposures*** to suit their specific risk, return, and maturity needs.
  - Securitization allows investors to ***gain exposure to a wider range of imperfectly correlated assets*** to build more efficient and diversified portfolios.
- Benefits to ***Economies and Financial Markets***:
  - Securitization creates tradable securities with higher liquidity than the original underlying assets, it ***makes financial markets more efficient***.
  - Securitization ***improves overall liquidity*** in the financial system and ***reduces liquidity risk***.

The Securitization Process

结论



Three main parties

- ***Seller*** of the collateral ***(originator or depositor)***
- ***SPE*** (issuer or trust): ***legally independent and bankruptcy-remote entity***
- ***Servicer***: loan servicing

Two additional legal documents

- ***Purchase agreement***: outlines the representations and warranties
- ***Prospectus***: describes the structure of the securitization

The Role of the SPE

- Securitization can be a ***cheaper way to raise funds*** than a corporate bond issue because the ***SPE is not affected by the bankruptcy*** of the seller of the collateral. The ***SPE has full legal ownership*** of the securitized assets, which are de-recognized from the seller's balance sheet.
- Removing assets from the balance sheet into an SPE is an important ***decoupling of the credit risk*** of the entity needing funds from the SPE and the bond classes issued by it. The ***only credit risk*** is the risk that the ***borrowers*** whose loans are included in the SPE ***default*** on their loans.

Module 18

Asset-Backed Security Instrument and Market Features

Covered Bonds ★★★ 结论

Covered Bonds	

Features	Be issued by ***financial institutions*** as ***senior*** debt, Backed by a segregated pool of assets typically consisting of commercial or residential mortgages, or public sector assets, these assets ***remain on the issuer's balance sheet*** and ***are ringfenced into a separate cover pool***.
	• ***Dual recourse***
	  • the ringfenced loans in the cover pool that underlie the covered bond transaction
	  • the unencumbered assets of the issuing institution
	• ***One bond class***
	• ***Dynamic*** cover pool: issuer must replace any prepaid or non-performing assets

Two additional tools	• ***Overcollateralization***: collateral exceeds the face value of the issued bonds • ***Loan to value (LTV)*** on the mortgages must meet certain standards
Redemption regimes	• ***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. • ***Conditional pass-through covered bonds***: ***convert to pass-through securities*** after the original maturity date if all bond payments have not yet been made.

Covered Bonds: ***lower credit risks and lower yields*** than otherwise similar ABS

ABS Structures to Address Credit Risk ★★★

Credit Enhancement	
Internal credit enhancements	• ***Overcollateralization*** • ***Excess spread*** is the difference between the coupon on the underlying collateral and the coupon paid on the securities. • ***Subordination*** or ***credit tranching***: dictates ***the order of payments*** made to investors and ***the order in which losses are absorbed*** by the investors.
External credit enhancements	• ***financial guarantees*** by banks or insurance companies, ***letters of credit*** and ***cash collateral accounts***.

Credit Tranching

Waterfall structure:

- ***Subordination functions as credit protection for the more senior bond classes***.
- This waterfall structure ***redistributes the credit risk*** associated with the collateral.
- Each bond class created in a securitization is typically ***rated based on both the quality of the underlying collateral and the seniority of the class***.

Non-Mortgage Asset-backed Securities ★★ 结论

	Amortizing loans (eg: auto loans)	Non-amortizing loans (eg: credit card debt)
Descriptions	Involve periodic payments include both principal and interest; prepayments	***Do not involve scheduled principal repayments***
Characters	As loans mature, the number of loans and their total value shrinks.	During the ***lockout or revolving period***, the principal repaid is reinvested to acquire additional loans. This reinvestment during the lockout period replenishes the collateral pool.

Credit Card Receivable ABS

- ***Cash flow: Finance charges collected, Fees, Principal repayments***
- ***During the lockout period***: receive only payments from the ***finance charges and fees*** the lender collects
- ***After lockout periods***: ***principal repayments*** are used to pay off the outstanding principal on the ABS

Solar ABS

- ***Solar loans & Solar leases***
- Advantages:
  - removes receivables from originator's balance sheet
  - offer the opportunity to contribute to sustainability while generating attractive risk-adjusted yields.
  - Solar ABS have ***clear environmentally sustainable benefits***
  - Many solar ABS contain ***a pre-funding period***

Collateralized Debt Obligations (CDO) ★★

Structure of CDO Transaction

- The collateral pools ***are not static*** so there is a need for ***a collateral manager*** that ***buys and sells*** debt obligations for and from the CDO's collateral pool to ***generate sufficient cash flows*** to meet the obligations.
- The proceeds to pay the CDO bond classes can come from interest payments from collateral assets, maturing of collateral assets, and sale of collateral assets.
- The basic economics is to ensure that ***the return on the collateral pool is higher than the funding costs***.
- A CDO is a ***leveraged transaction***, where equity tranche holders use borrowed funds to generate a return above the funding cost.

Generic CLO Structure	
Capital Structure	• Investors in senior or mezzanine bond classes earn a potentially higher yield than comparable corporate bonds. • The ***residual tranche plays a key role*** in whether a CLO is viable or not.
CLO types	Cash Flow CLOs; Market Value CLOs; Synthetic CLOs
Features	• The collateral manager must ***continually meet various performance tests and collateral limits*** for the underlying collateral. • The collateral manager acts as an ***active bond portfolio manager.*** • The CLO lifecycle (warehouse period; ***ramp-up period***; reinvestment period; amortization period) • ***The collateral portfolio is not finalized until after the transaction closes***. • ***Recourse is typically limited*** to the collateral pool.

Module 19

Mortgage-Backed Security (MBS) Instrument and Market Features

Time Tranching ★★

Prepayment Risk	***Contraction risk*** occurs when ***interest rates decline***, ***actual prepayments*** for fixed-rate mortgages will be ***higher*** than forecasted because homeowners will refinance at lower interest rates. ***Extension risk*** occurs when ***interest rates increase***, ***actual prepayments*** will be ***lower*** than forecasted because homeowners will become less likely to refinance their mortgages.
Time tranching	An approach for ***reducing prepayment risk or extension risk*** among bond classes is to create bond classes that possess different expected maturities.

Mortgage Loans and their Characteristic Features

- **Foreclosure**: ***allow the lender to take possession of the property***
- Borrower's equity: down payment
- 衡量mortgage质量：★★
  - **Loan-to-value ratio**(LTV): The ***lower*** LTV, the ***less likely*** the borrower is to ***default.***
  - **Debt-to-income ratio** (DTI)**=Monthly Debt Payment/Monthly pre–tax gross income**
    - A ***low*** DTI suggests that the borrower could ***sustain additional debt***.
- Agency and Non-Agency RMBS
  - ***Conforming loans →Agency RMBS →prepayment risk***
  - ***Non-conforming loans →Non-Agency RMBS →credit risk***
- Prepayment option (early repayment option)
- ***Recourse loan*** (the lender ***has a claim*** against the borrower for the ***shortfall***) & Non-recourse loan ★★
  - Non-recourse loan: ***strategic default is more likely***

Residential Mortgage-Backed Securities (RMBS)

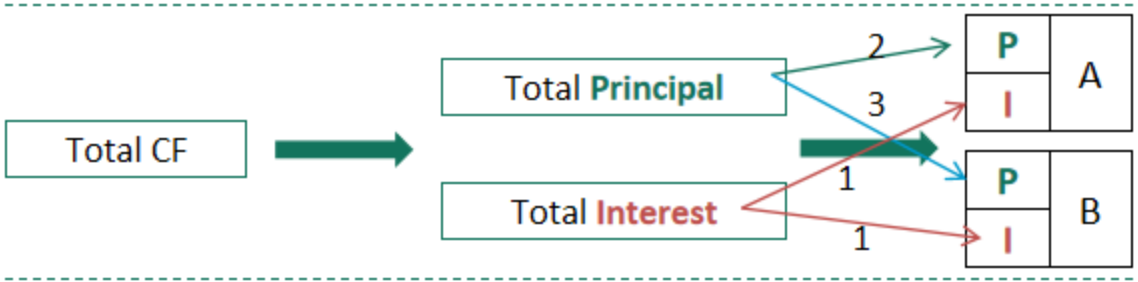
MPS

- ***Weighted average coupon (WAC)***
- ***Weighted average maturity(WAM)***
- ***Pass-through rate*** (net interest or net coupon): mortgage pass-through security's coupon rate
  - Pass-through rate is ***lower than the weighted average mortgage rate*** earned on the underlying pool of mortgages ***because of administrative charges***.

Collateralized Mortgage Obligations (CMOs) ★★★

- Collateralized mortgage obligations ***securitize mortgage pass-through securities*** or ***multiple pools of loans***.
- The tranching structure ***cannot eliminate*** prepayment risk, but it can ***redistribute*** the prepayment risk.
- The CMO tranche structures ***reduce the uncertainties of the size and timing of payments*** investors receive.
- The ***more senior*** a tranche is, the ***less exposure*** it has to extension risk and default risk.

Sequential Pay CMO ➡



Other CMO Structures

Z-tranches	• Z-tranches are ***the last tranche*** in a series of sequential or PAC and companion tranches. • A Z-tranche ***benefits the other tranches*** because it frees up cash flows that other tranches can distribute.
Residual tranches collect any remaining cash flow from the pool after all the obligations to the other tranches are met.	
PO&IO	• PO securities pay only the principal repayments from the pool. • With ***falling interest rates or when prepayments accelerate, the value of the PO will increase***.
	• IO securities pay their holders only the interest payments from the pool. • With ***increased prepayments, the cash flows paid to the IO investors decline***.
PAC & Support	• ***PAC tranches offer greater predictability and stability*** of the cash flows. • If the prepayment rate is within the specified range, ***all prepayment risk is absorbed by the support tranche***
Floating-Rate tranches	• interest rates are linked to an index or a market reference rate. • Floating-rate tranches can also be structured as inverse floaters

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

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

Commercial Mortgage-Backed Securities (CMBS) 结论

CMBS Structure	
Call Protection ★	*Loan-level call protection* • *Prepayment lockout*: prohibits any prepayments during a specified period • *Prepayment penalty points* • *Defeasance*: the borrower must purchase a portfolio of government securities
	Structural call protection: sequential-pay tranches
Balloon Maturity Provision	*Balloon payment* • *Balloon risk* is the risk that the borrower fails to make the balloon payment at maturity and is in default. Balloon risk is a type of *extension risk*.

CMBS Risks ★

- *Concentration risk*: A single default in a CMBS pool can have a significant impact on the CMBS investors.
- In commercial real estate lending, the key indicators of potential credit performance are the *loan-to-value ratio* (LTV) and the *debt service coverage ratio* (DSCR or DSC).
  - The *higher the DSC ratio*, the *more likely* it is that the borrower will be able to *meet debt-servicing requirements.*

计算 $DSC = \frac{Net\ Operating\ Income}{Debt\ Service}$

Debt service = interest payments+ principal repayments.
NOI = (rental income - cash operating expenses) - replacement reserve


Thank
You!