CFA 一级知识框架图
Fixed Income

专业来自101%的投入！

Framework

Study Session 16 Fixed Income: Basic Concepts

R50 Fixed-Income Securities: Defining Elements

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Fixed - Income Securities: Defining Elements

Basic features of a fixed-income security			
Five elements	Issuer		
	Maturity / Tenor		
	Par value		
	Coupon rate & frequency		
	Payment currency	Dual currency bond	
		Currency option bond	
Bond market	Global bond	National	Domestic bond
			Foreign bond
		Eurobond	

Bond indenture

Issuer	Bonds	Source of repayment
	Sovereign bond	Tax, print money
	Non-sovereign bond	Tax, revenue of project
	Corporate bond	Operation
	Securitization (SPV)	Cash flow of underlying assets
	Supranational organizations	Repayment of previous loans、 Paid-in capital from its members
Collateral	Bonds	Collateral
	Collateral trust bond	Financial assets
	Equipment trust certificates	Equipment or physical assets
	MBS	Mortgage loans
	Covered bond	"covered pool"
Purpose: reduce credit risk		

Credit enhancements	Internal ★	Overcollateralization
		Tranches (senior / subordinated)
		Excess spread-reserve fund: ➤ Cash reserve ➤ Excess spread
	External	Surety bond
		Bank guarantee
		Letter of credit
		Cash collateral account (CCA)
Covenants ★	Affirmative: require	
	Negative: limit / prohibit / not	

Legal and regulatory considerations	
Tax	OID (original issue discount tax provision)

Classified by cash flow structures ★ ★		
Principal repayment structures	Plain vanilla bond /Bullet bond	No amortization
	Amortizing loan	➤ Fully amortizing ➤ Partially amortizing
	Sinking fund provision	Advantage: decrease credit risk Disadvantage: increase reinvestment risk
Coupon payment structures	Floating rate security	➤ Coupon rate = reference rate+quoted margin ➤ Coupon reset date ➤ Cap & floor ➤ Variable-rate notes & inverse floater
	Step-up coupon bond	
	Deferred coupon bond: zero coupon bond	

Classified by cash flow structures ★ ★			
Coupon payment structures	Credit-linked coupon bond		
	Pay-in-kind bond (PIK)		
	Index-linked bond	Equity-linked note (ELN)	
		Inflation-linked bond	Indexed-annuity bond
			Indexed zero-coupon bond
			Interest-indexed bond
			Capital-indexed bond
		Principal protected bond	

Bonds with contingency provisions

Embedded option	Callable bond	- r↓, issuer 赎回，benefit to issuer ★ - American style/European style/Bermuda style $V_{callable} = V_{non-callable}$ - call option value	
	Putable bond	- r↑, bondholder 卖回，benefit to bondholder ★ $V_{putable} = V_{non-putable}$ + put option value	
	Convertible bond	Conversion price	$P_{conversion} = P_{par\ value}/CR$
		Conversion ratio	$= par\ value\ /\ conversion\ price$
		Conversion value	$= market\ price\ of\ stock \times conversion\ ratio$
		- At parity: conversion value = convertible bond's price - Above parity: conversion value > convertible bond's price - Below parity: conversion value < convertible bond's price	
	CoCos (contingent convertible bonds)	不是赋予发行人或者投资者的权利；是合约里规定的特定事件发生时，债券自动转成股票，银行多发行此类债券。	
Attached option	Warrants		

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Fixed - Income markets: Issuance, Trading, Funding

Classifications of global fixed-income markets	
Government and government-related sector ★	Sovereign governments: 一般无信用风险，发行量最大
	Non-sovereign (local) governments: high credit quality
	Quasi-government entities: agency bond
	Supranational organizations: IMF, world bank
Corporate sector	Financial company: 发行量大
	Non-financial company
Securitization	

Primary and secondary market for bonds		
Primary markets	Public offering ★	➢ Underwritten offering: 包销 ● Grey market: 试发行市场，特殊 ➢ Best efforts: 代销 ➢ Auction ➢ Shelf registration: 注册一次连续发行
	Private placement	
Secondary markets	Exchange market: 场内交易市场	
	OTC (over-the-counter): 场外交易市场，最大的债券市场	
	Electric trading network	
发行参考利率: Libor		

Source of funding for government & government-related sector	
Sovereign bonds	Sovereign governments: 一般无信用风险，发行量最大

Non-sovereign government bonds	➢ High credit quality, but lower than sovereign bonds
	➢ Municipal bond
	    ● GO (general obligation)/Tax-backed debts
	    ● Revenue bonds

Agency/quasi-government bonds	➢ Issued by entities created by national government and may be explicitly or implicitly backed by government
	    ● Federally related institutions
	    ● Government sponsored enterprises (GSEs)

Supranational bonds	High credit quality, very liquid

Source of funding for Corporate sector	
Bank debts	
Commercial papers ★	U.S commercial paper V.S. Euro commercial paper
Corporate bonds	
MTNs ★	
Short-term source of funding for banks	
Customer deposits	
Negotiable CDs	
Central bank funds market: central bank funds rate	
Interbank funds	
Source of funding for banks and other market participants	
Repurchase agreement ★★	1. Repo rate（计算、影响因素） 2. Repo margin（计算、影响因素） 3. Reverse repo agreement

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Introduction to Fixed-Income Valuation ★★

Bond price ★ ★	
Bond valuation	$$P = \sum_{i=1}^{n} \frac{C_n}{(1+r)^n} + \frac{Par}{(1+r)^n}$$
YTM	$$No-arbitrage\ price = \frac{CPN_1}{\left(1+\frac{YTM}{2}\right)} + \frac{CPN_2}{\left(1+\frac{YTM}{2}\right)^2} + \cdots + \frac{CPN_{2n}+Par}{\left(1+\frac{YTM}{2}\right)^{2n}}$$
Valuation with spot rates	$$No-arbitrage\ price = \frac{CPN_1}{(1+S_1)} + \frac{CPN_2}{(1+S_2)^2} + \cdots + \frac{CPN_n+Par}{(1+S_n)^n}$$

Time value of money	
Relationships between price and time	➢ At maturity date, price=par ➢ Discount: 随着到期日临近， price上升 ➢ Premium: 随着到期日临近，price下降
	计算 the value change attributable to the passage of time

Quoted price and price paid	
Flat price, accrued interest, full price ★★	➢ Full price=Clean price + Accrued interest (掌握定义、计算) ➢ Full price: 折现求和得到的价格 ➢ Quoted price=Clean price
Matrix pricing	➢ 适用于交易不活跃的债券 ➢ 已知identical treasury bond, 通过求spread得到 ➢ Yield of identical treasury bond不知道，直接求解

Yield measures for fixed-rate notes	
Current yield, YTM, YT-Call, YT-Put, YT-Worst	
Effective yield	$= (1 + YTM/m)^m - 1$
APR $_m$	$(1 + APR_m/m)^m = (1 + APR_n/n)^n$
Street convention yield & True yield（不用计算）	
Option-adjusted yield (OAS) ★	➢ Callable bond: option-adjusted yield < YTM ➢ Putable bond: option-adjusted yield > YTM
Yield measures for floating-rate notes	
Coupon rate = reference rate + quoted margin	
Discount rate = reference rate + required margin (discount margin) ★	

Yield measures for money market instruments ★	
Discount yield (U.S. Treasury bills)	$$PV = FV \times \left(1 - \frac{\text{Days}}{\text{Years}} \times DR\right)$$
Add-on yield （Libor, bank CD rates）	$$PV = FV / \left(1 + \frac{\text{Days}}{\text{Years}} \times AOR\right)$$
	Bond equivalent yield for money market security

Maturity structure of interest rates	
Spot curve	➢ Spot rate: 零息债券的折现率=零息债券的YTM ➢ Spot rate & Forward rate（计算）
Yield curve for coupon (YTM) 不需要计算，了解概念	
Par curve: par rate 不需要计算，了解概念	
Forward rates ★	$$(1+S_T)^T = (1+S_1)(1+1y1y)\ldots(1+(T-1)y1y)$$ $$Bond\ value = \frac{CF_1}{(1+S_1)} + \frac{CF_2}{(1+S_1)(1+1y1y)} + \ldots$$ $$+ \frac{CF_n}{(1+S_1)(1+1y1y)\ldots(1+(T-1)y1y)}$$

Yield spread	
Spread	=risk premium=taxation + liquidity + credit risk
Benchmark spread	G-spread: benchmark is government bond yield
	Interpolated spread (I-spread): benchmark is swap rate
Z-spread	Calculate a constant yield spread over a government spot curve
OAS	➢ Callable bond: ZS > OAS ➢ Putable bond: ZS < OAS

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Introduction to Asset-Backed Securities ★

Securitization	
Parties	The seller of the collateral (originator or depositor, e.g. bank)
	The SPV (issuer or trust)
	The servicer (if different from the seller)

Residential mortgage loans ★	
条款	➢ Loan-to-value ratio (LTV) ➢ Term of a mortgage: the number years to maturity ➢ Interest rate: mortgage rate/contract rate ➢ Amortization: fully amortization & partially amortization ➢ Prepayment option & prepayment penalty mortgages ➢ Foreclosure: recourse loan & non-recourse loan
分类	Conforming loans
	Non-conforming loans

ABS				
Mortgage asset-backed securities	RMBS	Agency RMBS	MPS	
			CMO ★	Sequential-pay CMO
				CMO: PAC & Support tranches
				Other CMO
		Non-agency RMBS: Credit enhancement		
	CMBS: call protection			
Non-mortgage asset-backed securities	Auto loan ABS			
	Credit card receivable ABS ★		Non-amortizing loans	
			Lockout periods	

Prepayment risk

- Contraction risk & extension risk
- Weighted average life: prepay 导致WAL不一定

PSA/CPR/SMM（计算）★★	$SMM = 1 - (1 - CPR)^{1/12}$
	$SMM = \dfrac{\text{Prepayment for month}}{\left(\begin{array}{c}\text{Beginning mortgage balance for month} \\ -\text{scheduled principal repayment for month}\end{array}\right)}$

CMBS			
性质 ★	Non-recourse loan		
	Debt to service coverage 计算		
	Loan to value ratio 计算		
Call protection	Loan level	Prepayment lockout	
		Defeasance	
		Prepayment penalty points	
		Yield maintenance charges (make-whole charge)	
	CMBS-level: tranches		
Balloon maturity provision → balloon risk (extension risk) 概念			

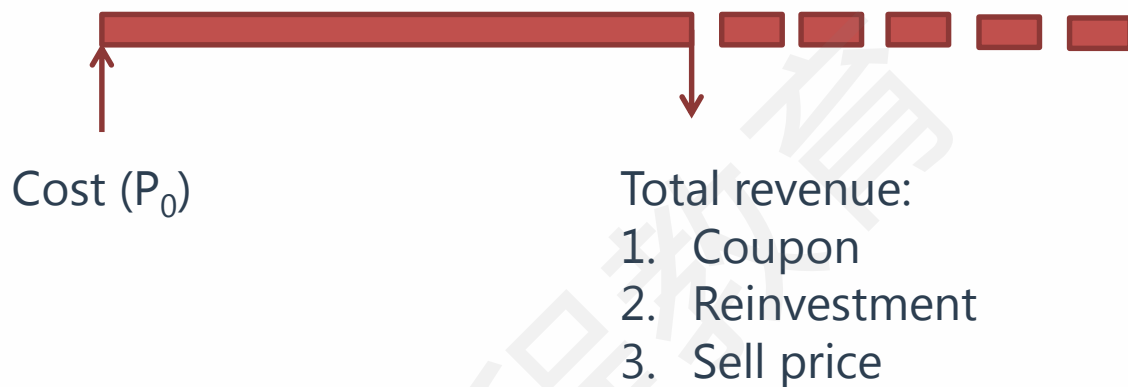| CDO ★	
Senior tranches	Highest credit ratings
Mezzanine tranche	Credit ratings between senior and subordinate bond classes
Subordinate/residual or equity tranche	Receive the residual cash flow

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Understanding Fixed-Income Risk and Return★★

Sources of return ★

Cost (P_0)

Total revenue:
1. Coupon
2. Reinvestment
3. Sell price

> t=0时刻求成本，cost=P_0

> 持有到期或交割日求total revenue

> 复利求realized return，$P_0(1+r)^t$=TR, 反求r

Interest rate risk
➤ Price risk (Y上升→P下降) ➤ Reinvestment risk: Y上升 → RI上升 ➤ Duration & Convexity

Duration ★★	
Different types of duration	➤ 计算: • Mac duration, Effective duration, Approximation duration • Money duration, PVBP • Portfolio duration= $w_1D_1 + w_2D_2 + ...+w_nD_n$ ➤ Three duration interpretations
Effects of bond characteristics on duration	➤ Maturity effect-正相关 ➤ Coupon effect-负相关 ➤ Interest rate-负相关

Convexity ★★

- 计算: Effective convexity, Approximation convexity
- 性质: 涨多跌少
- $\frac{\Delta P}{P} = [-MD \times (\Delta y)] + \left[\frac{1}{2} \times conv \times (\Delta y)^2\right]$
- Callable bond: negative convexity
- Putable bond: more convexity

Term structure of yield volatility

The relationship between maturity and yield volatility.

ΔP caused by	➢ The impact per basis-point change in the yield-to-maturity;
	➢ The number of basis points in the yield-to-maturity change.

Duration gap ★	
Duration gap = Macaulay duration – Investment horizon	
Positive gap	➢ market price risk > reinvestment risk ➢ suffer market price risk from increasing interest rates
Negative gap	➢ market price risk < reinvestment risk ➢ suffer reinvestment risk from decreasing interest rate

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Fundamentals of Credit Analysis

Credit risk
Default risk (Probability of default）
Loss severity = 1- recovery rate →Seniority ranking
Credit-related risk
Spread risk
Credit migration risk/downgrade risk
Market liquidity risk

Seniority rankings
First lien or first mortgage > Senior secured >Junior secured>Senior unsecured>Senior subordinated>Subordinated>Junior subordinated

Credit ratings	
Investment grade & speculative grade	
Issue & issuer rating	Cross-default provision
	Notching: different ratings to bonds of the same issuer
	Structural subordination: 母公司债券评级＜子公司
Risks in relying on agency rating 考法: 评级缺点（4条）	

Credit analysis: corporate debt securities

Four Cs ★	Character		
	Capacity	Industry analysis	考法:
		Company fundamental analysis	➢ 判断是哪一C？ ➢ 给出一公司情况，判断rating高低
		Ratio analysis	
	Collateral	公司资产的质量	
	Covenants（同R50）		

Yield and spread	
影响Spread的因素 ★	Credit cycle
	Economic conditions: 经济好, spread小
	Financial market performance
	Broker-dealer capital
	General market demand and supply

Specific credit consideration of different bonds		
High yield bond	Covenant analysis	
Sovereign bond	Ability and willing to pay	
Non-sovereign government bond	GO bond	Operating budget
	Revenue bond	Project analysis