

Fixed-Income securities

1. 基础概念 Basic features

1. Issuer/Borrower

1. Supranational organizations, such as world bank and IMF
2. Sovereign(national) governments, such as China and Japan
3. Non-sovereign(local) governments, such as city of Edmonton
4. Quasi-government entities, such as agencies that are owned by government
5. Companies

2. Maturity date

1. Money market 小于一年
2. Capital market securities 大于一年
3. Perpetual bond 永续债

3. Par value/Face value/Maturity value 面值

4. Coupon 票息、付款频率

5. Currency denomination 货币

1. Dual-currency bonds
2. Currency option bonds

2. Structures of CF

1. Principal repayment

1. Bullet bond
2. Amortizing bond
 1. Fully amortized bond
 2. Partially amortized bond
 1. Balloon payment 未计入摊销的本金
3. Sinking fund provision(偿债基金条款)
 1. Advantage: Less credit risk
 2. Disadvantage: More reinvestment risk

2. Coupon payment

1. Fixed-rate coupon bonds (plain vanilla bond/conventional bond)
 1. Zero-coupon(pure discount) bond: do not pay coupon
 2. Step-up coupon bonds(梯升债券)
 3. Deferred coupon bonds/split coupon bonds(递延债券)
 4. Payment-in-kind(PIK) coupon bonds(实物支付债券)
 5. Floating-rate notes(FRN)
 1. Coupon rate = reference rate + quoted margin(spread)
 1. Reference rate resets **periodically**, quoted margin is usually constant.
 1. Libor rate(Benchmark)
 2. Coupon payment are in arrears: based on previous period's reference rate.
 3. 按每季度付款
 4. 有一个Floor和Gap
 5. Inverse or reverse FRN(inverse floater)
 1. Coupon rate = -reference rate + quoted margin 投资者赌利率下跌, 若利率下跌对投资者有好处
6. Index-linked bonds(指数挂钩债券)
 1. Inflation-linked bonds 通货膨胀指数
 2. Tips
 1. 本金保护 (change with inflation)
 2. Coupon rate does not change
 3. Coupon will change(because principal change)
7. Credit-linked coupon bonds(信用挂钩债券)
 1. Coupon changes when the bond's credit rating changes

2. 评级下跌, rate上升

3. Contingency provision (或有条款)

1. Embedded option

1. Callable bonds (可赎回债券)

1. 对发行人有利, 要求更高的yield,更低的价格, 面临更高的再投资风险

2. Puttable bonds (可回售债券)

1. 对投资者有利, 要求更低的yield,支付更高的价格

3. Convertible bonds(可转债)

1. 投资人要求更低的yield, 支付更高的价格

2. 对投资者有利

3. Convertible bonds = straight bond + call option on equity

3. Bond Indenture(契约)/Trust deed

1. 概念: The legal contract that describes the form of bond,the obligations of issuer,and the rights of bondholders.

1. Legal identity of the bond issuer and its legal form(法律形式)

1. Corporate legal entity

2. SPE/SPV/SPC

2. Source of repayment proceeds

1. Supranational bond 超国家债券

1. repayment of previous loans,paid-in capital from its members

2. Sovereign bonds 主权债券

1. Tax revenues print money

3. Non-sovereign government debt 非政府主权债券

1. General taxing authority,cash flow of the project funded,special taxes or fees

4. Securitized bonds 证券化债券

1. Cash flow from underlying financial assets

5. Corporate bonds 公司债券

1. Cash flow from its operations

3. Assets or collateral backing

1. Assets backing

1. Secured bonds 担保债券: backed by assets or financial guarantees pledged to ensure debt repayment in case of default.

2. Unsecured bonds 无担保债券: have no collateral, bondholders have only a general claim on the issuer's asset and cash flows.

3. **Debentures** 信用债券: can be secured or unsecured.

2. Types of collateral backing bonds:

1. Collateral trust bonds: 股票、债券、金融资产

2. Equipment trust certificates: 设备、物理资产

3. Mortgage-backed securities(MBS): 一般的房贷

4. Credit enhancements 信用增长

1. Internal credit enhancement 靠自己

1. Subordination: waterfall structure,tranches

2. Overcollateralization: 超额抵押

3. Reserve accounts/funds 储蓄账户

2. External credit enhancement 赵大哥

1. Surety bond 履约保证 reimburse investors for any losses incurred if the issuer defaults, by an insurance company.

2. Bank guarantee

3. Letter of credit

4. Cash collateral account

5. Covenants 条款

1. Negative covenants 否定条款: prohibitions on borrower(can not)

1. Restrictions on asset sales 限制资产销售

2. Negative pledge of collateral 抵押品的负抵押

3. Restrictions on additional borrowings 限制额外的借款
2. Affirmative covenants 正面条款: promised by borrower(should do)
 1. Maintain financial ratios
 2. Timely payment of principal and interest
4. Legal, Regulation and Tax
 1. National bond market
 1. Domestic bonds 国内债券 (发行人=发行地=发行币)
 2. Foreign bonds 外国债券 (发行人≠发行地=发行币)
 2. Eurobond market
 1. 发行地≠发行货币
 3. Global bond markets
 1. National bond markets
 2. Eurobond market
 4. Bearer bonds 不记名债券 (Eurobonds 欧洲债券)
 5. Registered bonds 记名债券
 6. Interest
 7. Capital gain or loss
 1. 在某些国家, 长期利得税< 短期利得税
 2. 和taxable income不一样

Fixed-Income Markets: Issuance, Trading and Funding

1. Market classification
 1. Classification by type of issuer
 1. Gov or gov-related sector
 2. Corporate sector
 3. Structured finance sector
 2. Classification by credit quality
 1. Investment grade bond 投资级
 2. Non-investment grade bond 非投资级
 3. Classification by maturity
 1. Money market security 一年到期或少于一年
 2. Capital market security 大于一年
 4. Classification by type of coupon
 1. Fixed-rate bonds
 2. Floating-rate bonds
2. Issuance and Trading
 1. Primary bond market
 1. Public offering
 1. Underwritten offering 包销
 1. Syndicated offering 联合发行
 2. Best efforts offering 代销
 3. Auction 拍卖
 4. Shelf registration(上架注册)
 2. Private placement 私下募集
 2. Secondary bond market
 1. Organized exchange
 2. OTC markets (Dealers will post bid and ask price)
3. Funding
 1. Government-related bonds 政府相关债券
 1. Sovereign bonds
 1. T-Bills 短期

- 2. T-Notes 中期
- 3. T-Bonds 长期
- 2. Non-sovereign bonds 非主权政府债券（州、省）
- 3. Quasi-government bonds/agency bonds（准政府债券）
- 4. Supranational bonds 超国家债券
- 2. Corporate debts 公司债券
 - 1. Bank loans
 - 1. Bilateral loan 双边带宽
 - 2. Syndicated loan 银团贷款
 - 2. Commercial paper 短期票据
 - 3. Corporate notes and bonds 公司票据和债券
 - 1. Medium-term note(MTN)
- 3. Short-term funding to banks 向银行提供短期资金
 - 1. **Retail deposits 零售存款**
 - 1. Demand deposits/Checking accounts 活期存款/支票账户
 - 2. Saving accounts 储蓄账户
 - 3. Money market account 货币市场账户
 - 2. **Short-term wholesale funds 短期批发基金**
 - 1. Central bank funds
 - 2. Interbank funds
 - 3. Large-denomination negotiable certificates of deposit 大面额流通存单
- 4. Structured financial instruments 结构性金融工具
 - 1. Basic features of structured financial instruments
 - 2. **Categories of structured financial instruments**
 - 1. Assets-backed securities(ABS) 资产支持债券
 - 2. Collateralized debt obligations(CDOs) 抵押债务凭证
 - 3. Capital protected instrument 保本工具
 - 1. Guarantee certificate 担保证书
 - 4. Yield enhancement instruments
 - 1. A credit-linked note(CLN)
 - 5. Participation instruments
 - 1. Floating-rate bond is an example which allow investor to participant in movement of interest rate.
 - 2. 不保证本金；
 - 6. Leveraged instruments 杠杆性工具
 - 1. Inverse floater coupon rate = $C - (R * L)$
 - 1. C: Maximum coupon rate
 - 2. R: The reference rate
 - 3. L: leverage
 - 1. $L > 1$: leveraged inverse floater
 - 2. $0 < L < 1$: deleveraged inverse floater
- 5. Repurchase agreements 回购协议
 - 1. Repurchase agreement(Repo)
 - 2. A repo can be viewed as a **collateralized loan**.
 - 3. Repo rate
 - 4. Repo margin/haricut
 - 5. Reverse repurchase agreement/Reverse repo 逆回购

Fixed-Income Valuation(重点)

- 1. Pricing bond with a single discount rate
 - 1. **Market discount rate** 用于计算PV

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

2. Yield-to-maturity(YTM) 到期收益率

1. 关键假设:

1. 持有到期
2. The issuer makes full and timely coupon and principal payments
3. The investor is able to reinvest coupon payment at YTM.

▪ The Internal rate of return on the cash flow

▪ If the market price of bond is known, the valuation equation can be used to calculate its YTM.

$$P = \sum_{t=1}^n \frac{PMT_t}{(1+YTM)^t} + \frac{F}{(1+YTM)^n}$$

2. Constant-yield price trajectory 恒定收益率轨迹

3. Yield to call

1. Yield to first call
2. Yield to second call
3. Yield to worst: the lowest to sequence of yields-to-call and the yield-to-maturity.

4. Matrix pricing 相对估值法

1. Comparable bonds
2. Benchmark rate
3. The spread

5. Yield measures for floating-rate bonds

1. Coupon rate = reference rate +/- quoted margin
2. Quoted margin
3. Required margin

2. Pricing bonds with spot rates

1. Pricing bonds with spot rates 匹配不同的折现率

2. Forward rate

1. 定义: the interest rate on a bond or money market instrument traded in a forward market.
2. "2y5y" means 'the two year into five-year rate' The first number(2) refers to **when to start the forward contract** and the second number(5) refers to the tenor.

3. Implied forward rates

$$(1 + S_3)^3 = (1 + S_2)^2(1 + 2Y1Y)$$

3. Pricing bonds with forward rates

$$P = \frac{PMT}{0y1y} + \frac{PMT}{0y1y * 1y1y} + \frac{PMT}{0y1y * 1y1y * 2y1y}$$

4. Maturity structure of interest rates 利率的期限结构

1. Yield curve

1. 收益率曲线描绘了相同信用和不同期限的债券的利率。
2. 收益率曲线的三种关键类型包括正常、倒置和平坦。向上倾斜（也称为正常收益率曲线）是指长期债券的收益率高于短期债券。
3. 正常曲线指向经济扩张，向下倾斜（倒置）曲线指向经济衰退。

2. Spot curve: A sequence of YTM's on zero-coupon bonds.

3. Par curve: a sequence of YTM's such that each bond is priced at par value, and is obtained from a spot curve.

4. Forward curve: a series of forward rates, each having a specific initiation date.

5. Conventions in FI Market

1. Price quotation and calculation

1. Full/Dirty price = Flat/Clean price + Accrued interest(AI)

$$FullPrice = \left[\frac{PMT}{(1+r)^1} + \frac{PMT}{(1+r)^2} + \dots + \frac{PMT + F}{(1+r)^n} \right] * (1+r)^{\frac{t}{T}}$$

3.

$$AI = \frac{t}{T} * PMT$$

2. Annual yields for varying compounding periods in the year

1.

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

3. Consideration of weekends and holidays

1. Street convention yield (忽略节假日)
2. True yield (按照实际的日期)

1. True yield \geq Street convention yield

4. Amortization of discount or premium

1. **Current yield:** the sum of the coupon payments received over the year divided by the flat price.
2. **Simplified yield:** the sum of annual coupon payment plus straight-line amortization of discount or premium, divided by the flat price.

5. Money market instruments 货币市场工具

1. Discount rates 折扣率

1.

$$DR = \frac{Year}{Days} * \frac{FV - PV}{FV}$$

2. Add-on rates 附加费率

1.

$$AOR = \frac{Year}{Days} * \frac{FV - PV}{PV}$$

6. Yield Spread

1. Yield spread over benchmark
2. G-Spread: yield spread over an actual or interpolated **government bond**.
3. I-Spread: yield spread of a specific bond over the **standard swap rate in that currency of the same tenor**.
4. Zero volatility spread (Z-spread, static spread): **a constant yield spread over a government spot curve**.

1.

$$PV = \frac{PMT}{(1 + z_1 + Z)} + \frac{PMT}{(1 + z_2 + Z)^2} + \dots + \frac{PMT + FV}{(1 + z_N + Z)^N}$$

5. Option-adjusted spread (OAS):

1. OAS = Z-spread - Option value(%)

ABS

1. ABS

1. Securitized asset: assets used to create ABS, including mortgage loans, automobile loans, and receivables.

2. MBS

1. Mortgage-backed security (MBS): securities backed by high-quality real estate mortgages.

3. Securitization 证券化

1. SPV buys the assets and issues ABS, and is a bankruptcy-remote vehicle.
2. SPV plays a pivotal role in the securitization process in terms of protecting the rights of creditors investing ABS.
3. SPV is called special purpose entity (SPE), or special purpose company.

4. Benefits of securitization

1. Lower funding cost of borrowers while enhance the risk-adjusted return of investors
2. Allow investors to achieve better legal claims on the underlying.
3. Allow investors to access asset classes matching their risk, return, and maturity profiles that are otherwise not directly available (trading).
4. Increase the liquidity of financial asset.

5. MBS (Mortgage-backed securities) 抵押贷款支持证券

1. Mortgage loan

1. Foreclosure: 丧失抵押品赎回权
2. Loan-to-value ratio(LTV): ratio of the amount of the mortgage to the property's value
 1. 越小越好
 2. $LTV = \text{loan} / \text{Value}$
3. Prepayment
 1. Prepayment option
 2. Prepayment penalty 提前还款罚金
 3. Prepayment risk 提前还款风险
4. 追索权
 1. Recourse loan 追索权贷款
 2. Non-recourse loan 无追索权贷款
2. Residential mortgage-backed securities(RMBS) 住宅抵押担保证券
 1. 是否被 **guaranteed by a federal agency**
 1. Agency RMBS: guaranteed by a federal agency
 1. 贷款质量
 1. Conforming mortgage
 2. Non-conforming mortgage
 2. Mortgage pass-through security(MPS,抵押转手债券)
 1. 所有产品是通知的, 收益和风险相同, 不分层;
 2. Weighted average coupon rate(WAC): weighting the mortgage rate of each mortgage loan in the pool.
 3. Pass-through rate(net interest, net coupon): the coupon rate that investors receive.
 1. $WAC - \text{service fee} = \text{pass-through rate}$
 4. Weighted average maturity(WAM): weighting the remaining number of months to maturity for each mortgage loan in the pool.
 3. Measurement of prepayment rate
 1. Single monthly mortality(SMM) rate: a monthly measure of prepayment rate.
 1.
$$SMM = \frac{\text{Prepayment for month}}{\text{Beginning mortgage balance for month}} - \text{Scheduled principal repayment for month}$$
 2. Conditional prepayment rate(CPR): 从年初开始大概有6%的概率可能会被提前还款
 3. PSA prepayment benchmark
 4. Weighted average life
 1. The convention-based average time to receipt of all principal repayments(scheduled principal repayments and projected prepayments)
 5. Prepayment risk
 1. 30年loan PSA 预计28年还清
 2. 26年还清 Contraction risk(紧缩性风险)
 3. 29年还清 Extension risk (延长性风险)
 4. 32年还清 default (违约)
 6. Structuring
 1. Time tranching 对提前还款风险在做风险
 2. Credit tranching 对信用风险敞口做再次分配
 3. "Structuring" can not **eliminate(消除)** risk but **redistribute (重新分配)** risk.
 7. Collateralized mortgage obligations(CMO,担保抵押质押债券)
 1. 定义:
 1. Securities that redistribute the cash flow of mortgage-related products to various tranches.
 2. Backed by mortgage pass-through security(MPS).
 2. Collateralized mortgage obligations
 1. Sequential-pay tranches
 2. Planned amortization class(PAC) tranches
 3. Support tranches/companion tranches
 4. Floating-rate tranches

2. Non-agency RMBS: issued by private entities and are not guaranteed by a federal agency or a GS.
 1. Internal credit enhancements
 2. External Credit enhancements
3. Commercial mortgage-backed securities(CMBS) 商业抵押贷款支持证券
 1. 定义: Are backed by a pool of commercial mortgage loan on income producing property.
 2. 性质:
 1. non-recourse loans 无追索权 and the lender will face credit risk.
 2. Measures of credit quality
 1. Loan-to-value
 2. Debt service coverage(DSC) ratio = NI/Debt service 越大越好
 3. CMBS investors have to considerable call protection (like corporate bond)
 4. CMBS investors may face "balloon risk"
6. Non-mortgage ABS
 1. 车贷: are backed by auto loan and lease receivables.
 2. 信用卡应收贷款
 3. Collateralized debt obligation(CDO,担保债务凭证):
 1. 需要一个collateral manager to buy and sell debt obligations for and from the CDO portfolio of assets to generate sufficient cash flows.
 2. Structure of a CDO includes senior,mezzanine,and subordinated/equity bond classes.

Understanding FI Risk and Return

1. Source of return
 1. Promised **coupon** and **principal payments**
 2. **Reinvestment of coupon payments**
 3. ****Capital gain or loss ****on the sale of bond prior to maturity.
2. Interest rate risk on fixed-rate bond investment
 1. 利率影响票息在投资和bond market price
 2. market price matters more 如果投资者有一个短期的投资期间
 3. coupon reinvestment risk matters more when the investor has a long-term investment horizon.

3. Duration

有两种类型的债券久期: 收益率久期和曲线久期。收益率久期定义为债券价格对其到期收益率的敏感性。另一方面, 曲线久期被定义为债券价格对基准收益率曲线(如政府收益率曲线、即期曲线或远期曲线)的敏感性。然而, 政府面值曲线是最常用的。收益率久期统计数据是麦考利久期、修正久期、美元久期和基点价格值(PVBP)。

1. Yield duration 收益率久期
 1. 定义: **Sensitivity of bond price** to the bond's own YTM.
2. Macaulay duration 麦考利久期
 1. 麦考利久期是投资者通过息票和本金偿还收回投资于债券的资金所花费的时间。它试图衡量投资者从债券的总现金流中收回债券价格所需的年数。
 2. MacDur is measured in terms of time periods.

$$3. \quad MacDur = \frac{\sum_{t=1}^n t * PVCF_t}{\sum PVCF_t}$$

4. 对于永续债券: $MacDur = (1+r)/r$
5. 对于零息债券, $MacDur = \text{maturity}$, 只有一笔现金流就是他的期限。

3. Modified duration

1. Modified duration: requires a simple adjustment to Macaulay duration.

$$2. \quad ModDur = \frac{MacDur}{1 + r}$$

3. **r: yield per period**

$$4. \quad \% \Delta Price \approx -ModDur * \Delta Yield$$

4. Approximate modified duration

1. 近似修正久期: an alternative approach to calculate modified duration.

$$2. \quad ApproxModDur = \frac{P_- - P_+}{2 * (\Delta Yield) * P_0}$$

$$5. ApproxMacDur = ApproxModDur * (1+r)$$

6. Money duration

1. 定义: a measure of the price change in units of currency given a change in its YTM.

$$2. \quad MoneyDur = ModDur * Price(full)$$

3. **MoneyDur per 100 units of par value = Moddur * Price(Full) of bond per 100 of par value.**

7. Price value of a basis point(PVBP)

1. 定义: the money change in full price of a bond when its YTM changes by one basis point(0.01%).

$$2. \quad PVBP = \frac{P_- - P_+}{2}$$

2. Curve duration

1. 定义: **Sensitivity of bond price to a benchmark yield curve.**

2. Effective duration 有效久期

$$3. \quad EffDur = \frac{P_- - P_+}{2 * (\% \Delta Curve) * P_0}$$

4. 用途:

1. Measures interest rate risk in terms of a **parallel shif** in the benchamrk yield curve($\Delta Curve$).

2. Used for bonds **with embedded option due to uncertain future cash flow and absence of well-defined IRR(YTM).**

3. Key rate duration/partial duration 关键久期、部分久期 (Sensitivity to yield at specific maturity) --非平移

4. Properties of bond duration 债券的期限特性

1. Longer time-to-maturity usually leads to higher duration.

2. Higher coupon rate leads to lower duration.

3. Higher yield-to-maturity leads to lower duration.

4. Embedded call option

1. r下降, 导致更低的久期

5. Embedded put option

1. r升高, 导致更低的久期

5. Bond portfolio duration(two methods)

1. method1: the weighted average of time to receipt of the aggregate cash flow.

2. method2: the weighted average of the individual bond durations

$$1. \quad Portfolioduration = w_1 D_1 + w_2 D_2 + \dots + w_n D_n$$

2. Limitations: implicitly **assume a parallel shif** in the yield curve.

4. Convexity

1. 久期是价格相对于利率的敏感度, 凸度是久期相对于利率的敏感度。

2. The "second-order" effect of the price-yield curve.

$$3. \quad \% \Delta Price^{Full} \approx (-ModDur * \Delta Yield) + [\frac{1}{2} * Con * (\Delta Yield)^2]$$

$$4. \quad ApproxCon = \frac{P_- + P_+ - 2P_0}{(\Delta Yield)^2 * P_0}$$

5. Money convexity 美元凸度

$$1. \quad MoneyCon = Convexity * Price^{Full}$$

6. Effective convexity 有效凸度

1. 定义: Is a curve convexity statistic that measures the second-order effect of a change in a benchmark yield curve.

$$2. \quad EffCon = \frac{P_- + P_+ - 2P_0}{P_0 * (\Delta Curve)^2}$$

3. **Callable bonds** often have **negative convexity**, especially when interest rates are **low**.

4. **Putable bonds** often have higher **positive convexity**, especially when interest rates are **high**.

7. Benefits of greater convexity

1. The more convex bond outperforms the less convex bond 涨多跌少

8. Properties of bond convexity

1. The factors that leads to greater convexity are the same as for duration.

1. Longer time-to-maturity
2. Lower coupon rate
3. Lower yield-to-maturity

2. For bonds with same duration, 现金流越分散, 凸度越大。

9. Interest rate risk

1. Term structure of yield volatility(波动利率的期限结构)

1. The bond price changes are products of two factors

$$1. \quad \% \Delta Price \approx -ModDur * \Delta Yield$$

2. Shorter-term bond may have more price volatility than a long-term bond because of higher yield volatility.

2. The investment horizon for which coupon reinvestment risk and market price risk offset each other.

3. Duration gap

1. $DG = MacDur - Investment\ horizon$

1. $DG < 0$, reinvestment dominates market price risk.
2. $DG > 0$, market price risk dominates reinvestment risk.

10. Credit and liquidity spread 信用流动性利差

Fundamentals of Credit Analysis

1. Credit risk and credit rating

1. Default risk/default probability
2. Loss severity/Loss given default
3. Expected Loss = Default probability * Loss severity
4. Recovery rate
 1. Loss severity(损失严重程度) = 1 - Recovery rate

2. Credit-related risk

1. Spread risk
 1. Credit migration risk 信用迁移风险/downgrade risk 降级风险
 2. Market liquidity risk
2. Seniority ranking 资历排名
3. Notching 评级微调

3. Risks in relying on agency ratings

1. credit ratings can be very dynamic
2. not infallible(不靠谱)
3. lag market pricing
4. 特殊的事件风险

4. Credit analysis

1. 4C
 1. Capacity 能力

- 2. Collateral 抵押物
 - 3. Covenants 条款
 - 4. Character 质量分析
- 2. Yield spread
 - 1. $\text{Yield spread} = \text{Credit spread} + \text{liquidity premium}$
 - 3. Special consideration in credit analysis
 - 4. High yield debt
 - 5. Sovereign debt
 - 6. Municipal debt 市政债务